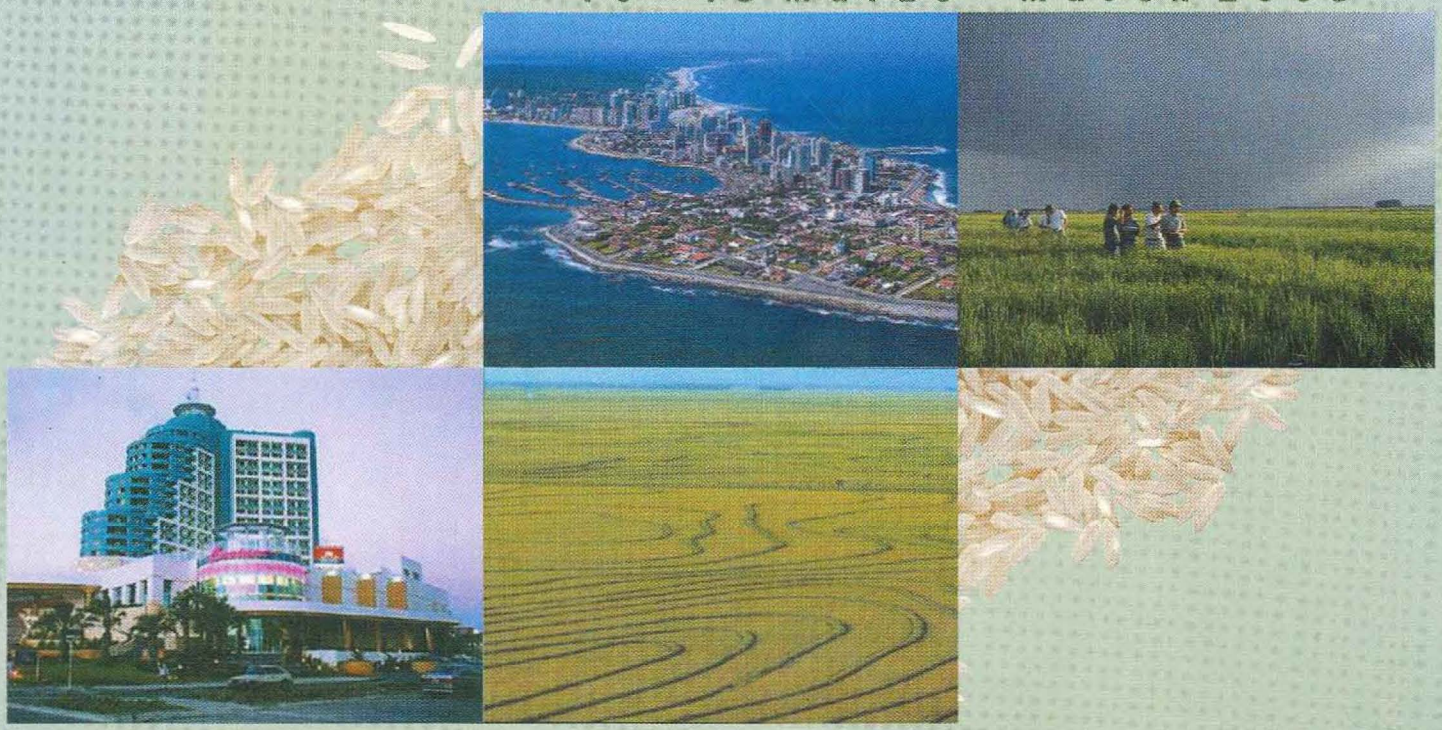
3ra. Conferencia Internacional de Arroz de Clima Templado

3rd International Temperate Rice Conference

10 - 13 Marzo - March 2003



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RESUMENES *ABSTRACTS*

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National Agricultural Research Institute - Uruguay

Asociación Cultivadores de Arroz - Uruguay
Rice Growers Association - Uruguay

Gremial de Molinos Arroceros - Uruguay
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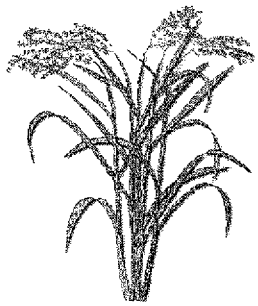

3ra. Conferencia Internacional de Arroz de Clima Templado
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Hotel Conrad Resort & Casino, Punta del Este - Uruguay

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National Agricultural Research Institute - Uruguay
Instituto Nacional de Investigación Agropecuaria (INIA) - Uruguay

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MESSAGE FROM THE PRESIDENT OF THE ORGANIZING COMMITTEE

Dear Colleagues and Friends:

Welcome to Uruguay and to the 3rd International Temperate Rice Conference. It is an honor for our Country and for our rice sector to host this important meeting.

The organizing Institutions did their best to ensure that these four days of activities meet you expectations. We worked very hard for it.

Our goal is that everyone brings home something new to improve production and development. In these days of world anxiety, this Conference joins us to share knowledge that may help to improve people's food supply, to increase jobs, to make sustainable use of our natural resources, and to minimize the environmental impact of rice production. All these goals are efforts for peace.

We wish a fruitful week for all participants and that you would enjoy our natural beauties and Uruguayan hospitality.

Gonzalo Zorrilla de San Martín

MENSAJE DEL PRESIDENTE DEL COMITÉ ORGANIZADOR

Estimados Colegas y Amigos:

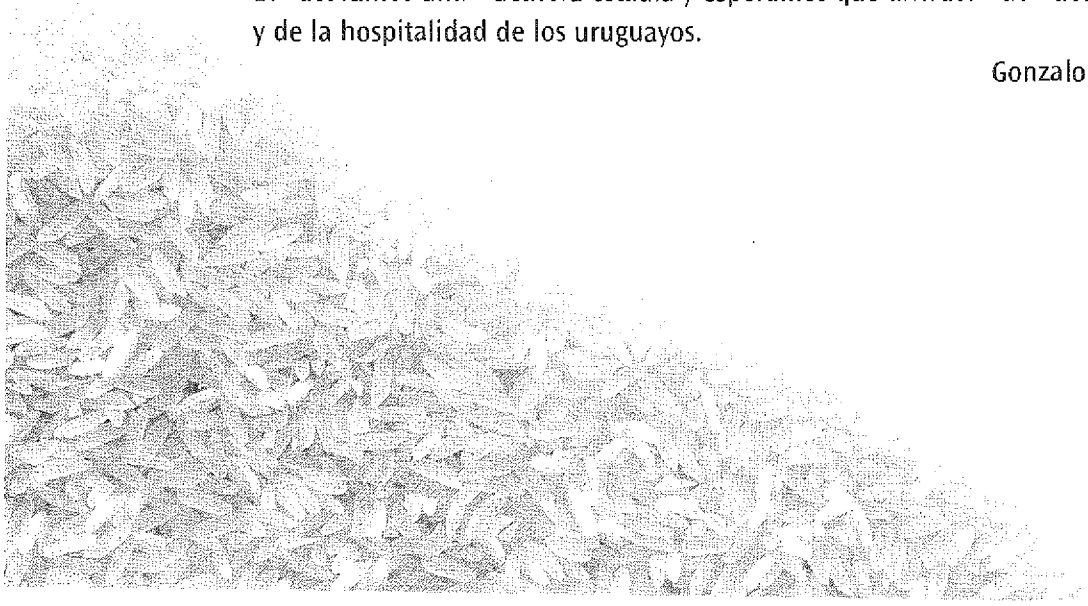
Bienvenidos a Uruguay y a la 3ra. Conferencia Internacional de Arroz de Clima Templado. Es un honor para nuestro país y para nuestro sector arrocero, ser la sede de este importante evento.

Las Instituciones organizadoras han puesto todo su empeño en que estos cuatro días de trabajo tengan el valor que cada uno de Uds. espera. Hemos trabajado duro para que ello sea así.

Aspiramos a que todos se lleven algo nuevo para su país o región y que ello sirva para apoyar la producción y el desarrollo. En estos tiempos de inquietud mundial, esta Conferencia nos reúne para intercambiar conocimientos que ayudarán a mejorar la alimentación de la gente, el trabajo, el cuidado de los recursos naturales y el ambiente en nuestros sistemas de producción arroceros. Todos estos objetivos son, sin duda, aportes para la paz.

Les deseamos una fructífera estadía y esperamos que disfruten de nuestras bellezas naturales y de la hospitalidad de los uruguayos.

Gonzalo Zorrilla de San Martín



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Confalonieri, R.; Mariani, L.; Bochi, S.; University of Milan; **Italia**; Wednesday 12; Miércoles 12; 14:20; PUNTA 1; Pág: **56**

087 *RICE VARIETIES RESPONSE TO PLANTING DATE IN CORRIENTES*
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Marin, A. R.; Kraemer, A. F.; INTA; **Argentina**; Tuesday 11; Martes 11; 13:30; PUNTA 1; Pág: **58**

128 *PREDICTING NITROGEN MINERALIZATION OF RICE SOILS WITH NIR*
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131 *IMPROVEMENT OF BINASHAIL RICE LODGING CONTROL THROUGH EFFICIENT FERTILIZER MANAGEMENT*
Islam, M. Z.; Hossain, M. B.; INSTITUTE OF NUCLEAR AGRICULTURE, MYMENSINGH, BANGLADESH; **Bangladesh**; Tuesday 11; Martes 11; 16:40; PUNTA 1; Pág: **60**

177 *TECHNOLOGY FOR RICE CROP SEEDING WITH MINIMUM OR NO-TILLAGE FOR EASTERN URUGUAY*
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Méndez, R.; Deambrosi, E.; Blanco, P.; Saldain, N.; Perez De Vida, F.; Gaggero, M.; INIA - Treinta y Tres; **Uruguay**; Tuesday 11; Martes 11; 17:40; PUNTA 1; Pág: **64**

197 *RICE IN RUSSIA: HISTORY AND PERSPECTIVE.*
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005 *RICE STRAW PRESENCE AND CHEMICAL FALLOW PERIOD LENGHT EFFECT ON TWO RICE CULTIVARS IMPLANTATION AND INITIAL GROWTH, SOWN WITH NO TILLAGE.*
EFECTO DE LA PRESENCIA DE RASTROJO DE ARROZ Y EL LARGO DEL PERÍODO DE BARBECHO QUÍMICO, SOBRE LA IMPLANTACIÓN Y CRECIMIENTO INICIAL DE DOS VARIEDADES DE ARROZ SEMBRADAS SIN LABOREO
Ernest, O.; Larralde, S.; Nolla, F.; Fernández, G.; Facultad de Agronomía; **Uruguay**; Pág: **49**

012 *EFFECT OF DURATION OF DECOMPOSITION AND OF MOISTURE AND BIOTIC CONDITIONS DURING DECOMPOSITION OF RICE STRAW ON ESTABLISHMENT AND GROWTH OF RICE UNDER NO TILLAGE SEEDING*
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024 *RICE UNDER SHALLOW IRRIGATION*
RIEGO DE ARROZ SIN INUNDACION
Arguissain, G. G.; Durand, A.; Boffeli, A.; Schlegel, C.; Iconicoff, D.; Occhi, M.; EEA INTA Concepción del Uruguay; **Argentina**; Pág: **51**

031 *COMPETITION INTRA-SPECIFIEC IN PLANTS OF RICE (ORIZA SATIVA L.), IN FUNCTION OF THE QUALITY OF THE SEEDS.*
COMPETIÇÃO INTRA-ESPECIFICA EM PLANTAS DE ARROZ (*Oriza sativa L.*), EM FUNÇÃO DA QUALIDADE DAS SEMENTES.
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034 *GRAIN YIELD OF SPRINKLER IRRIGATED RICE, MAIZE AND SORGHUM CULTIVATED IN DIFFERENT SOWING TIMES*
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056 *PREDICTING NITROGEN STATUS OF SOILS OF PUNJAB USING DIFFERENT NITROGEN AVAILABILITY INDICES FOR RICE*
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062 *NITRIFICATION AND UREASE INHIBITORS IN WATER SEEDED RICE IN ITALY*
Romani, M.; ENTE NAZIONALE RISI - CENTRO RICERCHE SUL RISO; **Italia**; Pág: **54**

077 *PLANT P CONTENTS AT PANICLE INITIATION STAGE IN RICE AS FUNCTION OF SOIL P AVAILABILITY*
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083 *A SIMULATION MODEL AND AN AGRO-ECOLOGICAL INDICATOR TO ASSESS RICE YIELD LOSSES*
Confalonieri, R.; Mariani, L.; Bochi, S.; University of Milan; **Italia**; Pág: **57**

086 *EFFECTS OF NO-TILLAGE SYSTEM ON PLANOSOIL FERTILITY AND IRRIGATED RICE PRODUCTION*
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Gomes, A. Da S.; De Ferreira, L. H.; Sousa, R. O.; Pauletto, E. A.; Gomes, D. N.; Embrapa Clima Temperado; **Brasil**; Pág: **57**

WD - WEEDS

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163 *DISTRIBUTION OF THE ECHINOCHLOA ECOTYPES RESISTANT TO HERBICIDE QUINCLORAC AT RIO GRANDE DO SUL STATE.*
DISTRIBUIÇÃO DE CAPIM-ARROZ RESISTENTE AO QUINCLORAC NO RIO GRANDE DO SUL
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006 *MONITORING WEED RESISTANCE TO HERBICIDES IN PADDY RICE IN SANTA CATARINA, SOUTHERN BRAZIL*
Noldin, J. A.; Eberhardt, D. S; Rampelotti, F. T.; EPAGRI; **Brasil**; Pág: **67**

043 *ECHINOCHLOA CLASSIFICATION BY MOLECULAR MARKERS*
Mantegazza, R.; Università degli Studi di Milano, Biology Department, Ente Nazionale Risi-Centro Ricerche sul Riso, Castello D'Agogna (PV); **Italia**; Pág: **67**

057 *MORPHOLOGICAL TRAITS RELATED TO ECHINOCHLOA spp. INFESTING ITALIAN RICE FIELDS*
Tabacchi, M.; Ferrero, A.; Ente Nazionale Risi - Centro Ricerche sul Riso; **Italia**; Pág: **68**

064 *WEED CONTROL IN RICE WITH METAM-SODIO*
Sparacino, A. C.; Ferro, R.; Riva, N.; Ditto, D.; Croce, G.; Tano, F.; Universita' degli Studi di Milano - Facolta' di Agraria; **Italia**; Pág: **68**

065 *IDENTIFICATION AND CHARACTERIZATION OF SOMATIC RED RICE (ORYZA SATIVA VAR. SYLVATICA) CHROMOSOMES USING COMPUTERIZED CHROMOSOMAL (C.H.I.A.-XL) IMAGING*
Sparacino, A. C.; Halfer, C.; Ditto, D.; Tano, F.; Universita' degli Studi di Milano - Facolta' di Agraria; **Italia**; Pág: **68**

066 *CONTROL OF BLACKBERRY ON RICE CHANNEL BANKS*
Sparacino, A. C.; Ferro, R.; Riva, N.; Destefani, G. P.; Tano, F.; Universita' degli Studi di Milano - Facolta' di Agraria; **Italia**; Pág: **69**

153 *RED RICE SEEDS VIABILITY IN SOIL*
VIABILIDADE DE SEMENTES DE ARROZ-VERMELHO NO SOLO
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158 *TRATEGIES TO REDUCE SOIL STOCK OF RED-RICE*
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164 *DETERMINATION OF A LABORATORY METODOLOGY TO IDENTIFY ECHINOCHLOA SEEDS RESISTANT TO QUINCLORAC*
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169 *ECHINOCLHOA SP CONTROL WITH HERBICIDE TANK MIXES UNDER TWO TIMES OF FLOODING.*
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Deambrosi, E.; Saldain, N.; INIA - Treinta y Tres; **Uruguay**; Pág: **72**

182 *INIA TACUARÍ (Oryza sativa L.) SUSCEPTIBILITY TO MALEIC HYDRAZIDE AND GLYPHOSATE APPLIED OVER-THE-TOP AT GRAIN FILLING STAGE ON RICE YIELD AND GRAIN MILLING QUALITY*
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Saldain, N. E.; Deambrosi, E.; INIA - Treinta y Tres; **Uruguay**; Pág: **72**

183 *SEED VIABILITY SUPPRESSION OF RED RICE (Oryza sp.) BY MALEIC HYDRAZIDE AND GLYPHOSATE APPLIED OVER-THE-TOP*
SUPRESIÓN DE LA SEMILLAZÓN DEL ARROZ ROJO (*Oryza sp.*) POR LA APLICACIÓN DE HIDRACIDA MALEICA Y GLIFOSATO
Saldain, N. E.; Deambrosi, E.; INIA - Treinta y Tres; **Uruguay**; Pág: **73**

184 *RED RICE CONTROL (Oryza sp.) UNDER WATER- AND DRY-SEEDED RICE (Oryza oryza L.) CULTURE USING MOLINATE*
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Saldain, N. E.; Deambrosi, E.; INIA - Treinta y Tres; **Uruguay**; Pág: **73**

DI - DISEASES

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074 *WHITE TIP DISEASE IN ITALIAN RICE*
Giudici, M. L.; Callegarin, A. M.; Villa, B.; Tamborini, L.; Ente Nazionale Risi; **Italia**; Wednesday 12; Miércoles 12; 18:30; PUNTA 2; Pág: **75**

129 *RELATIONSHIP BETWEEN VIRULENCE AND LINEAGE CHARACTERIZATION OF Pyricularia grisea IN THE STATE OF RIO GRANDE DO SUL, BRAZIL.*
Maciel, J. L. N.; Moraes, M. G.; IRGA - INSTITUTO RIO-GRANDENSE DO ARROZ; **Brasil**; Wednesday 12; Miércoles 12; 17:10; PUNTA 2; Pág: **76**

166 *REPORT OF BACTERIA AND OTHER PATHOGENS IN THE CULTURE OF RICE IN URUGUAY. PART I: BACTERIA*
RELEVAMIENTO DE BACTERIAS Y OTROS PATOGENOS EN EL CULTIVO DE ARROZ EN URUGUAY. PARTE I: BACTERIAS
Verdier, E.; Díaz, L.; Fernández, J.; Fischer, G.; M.G.A.P., D.S.S.A.A.; **Uruguay**; Wednesday 12; Miércoles 12; 17:30; PUNTA 2; Pág: **77**

167 *RICE CROP SURVEY OF BACTERIA AND OTHER PHYTOPATOGENS IN URUGUAY. PART II: FUNGI.*
RELEVAMIENTO DE BACTERIAS Y OTROS PATOGENOS EN EL CULTIVO DE ARROZ EN URUGUAY. PARTE II: HONGOS.
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193 *STUDIES OF SCLEROTIUM ORYZAE AND RHIZOCTONIA ORYZAE SATIVAE POPULATIONS IN THE SOIL, AND ITS RELATIONSHIP WITH THE RICE STEM DISEASES, IN URUGUAY*
ESTUDIOS DE LAS POBLACIONES DE *SCLEROTIUM ORYZAE* Y *RHIZOCTONIA ORYZAE SATIVAE* EN EL SUELO Y SU RELACIÓN CON LAS ENFERMEDADES DEL TALLO DEL ARROZ EN URUGUAY
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019 *STUDY ON THE PRIMARY INOCULUM OF MAGNAPORTHE GRISEA IN THE FIRST PLANTING FIELD OF RICE*
Bueno, C. R. N. C.; Gutierrez, S. A.; Urashima, A. S.; Facultad de Ciencias Agrarias; **Argentina**; Pág: **75**

047 *WHITE TIP SYMPTOMS IN ITALIAN RICE VARIETIES*
Giudici, M. L.; Villa, B.; Ente Nazionale Risi - Centro Ricerche sul Riso, Castello d'Agogna; **Italia**; Pág: **75**

049 *POTENTIAL CHEMICAL AND BIOLOGICAL AGENTS FOR THE CONTROL OF AGGREGATE SHEATH SPOT AND SHEATH SPOT OF RICE IN SOUTH EASTERN AUSTRALIA.*
Lanoiselet, V. L.; Cother, E.; Ash, G.; Harper, J.; School of Agriculture PO Box 588; **Australia**; Pág: **75**

088 *RICE DISEASES IN THE REPUBLIC OF MACEDONIA*
Mitrev, S.; Spasov, D.; Koleva-Gudeva, L.; INSTITUTE OF SOUTHERN CROPS; **Macedonia**; Pág: **76**

089 *OUTBREAK OF RICE GRAIN DISCOLORATION IN ITALY*
Cortesi, P.; Giudici, M. L.; Pizzatti, C.; Bermano, A.; Pedrali, D.; Villa, B.; Istituto di Patologia Vegetale Università degli Studi di Milano, Milano; **Italia**; Pág: **76**

095 *MONITORING FUNGI ON RICE SEED OF SEVERAL ITALIAN VARIATIES*
Lorenzi, E.; Rodolfi, M.; Brandolini, M. A.; Rodino, D.; Picco, A. M.; Biloni, M.; SA.PI.SE. Soc. Coop.; **Italia**; Pág: **76**

154 *FUNGI ASSOCIATED TO IRRIGATED RICE SEEDS CROP IN RIO GRANDE DO SUL*
FUNGOS ASSOCIADOS A SEMENTES DE ARROZ IRRIGADO NO RIO GRANDE DO SUL
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168 *REPORT OF BACTERIA AND OTHERS PATHOGENS IN THE CULTURE OF RICE IN URUGUAY. PART III: NEMATODOS.*
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Fernández, J.; Díaz, L.; Fischer, G.; Verdier, E.; M.G.A.P., D.S.S.A.A.; **Uruguay**; Pág: **78**

191 *MOLECULAR STRATEGIES FOR CHARACTERIZATION OF FUNGAL ISOLATES FROM URUGUAYAN RICE FIELDS*
Capdevielle, F.; Federici, M. T.; Solares, E.; Branda, A.; Avila, S.; INIA; **Uruguay**; Pág: **79**

192 *STEM ROT AND AGGREGATE SHEATH SPOT EVOLUTION IN RICE AND DEGREE OF SEVERITY PREDICTION, THROUGH EARLY SYMPTOM DETECTION IN THREE CULTIVARS*
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Avila, M. S.; Blanco, P. H.; Casales, L. A.; INIA; **Uruguay**; Pág: **79**

VI - VERTEBRATES AND INVERTEBRATES

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091 *DEVELOPMENT OF A REFINED UNDERSTANDING OF RICE WATER WEEVIL BIOLOGY TO OPTIMIZE MANAGEMENT EFFICACY*
Godfrey, L.; Lewis, R.; University of California-Davis; **USA**; Tuesday 11; Martes 11; 13:50; CANCUN; Pág: **81**

106 *STRATEGY DEVELOPMENT FOR RICE DAMAGE CAUSED BY BLACKBIRD (Agelaius ruficapillus)*
DESARROLLO DE UNA ESTRATEGIA PARA LA DISMINUCIÓN DEL DAÑO DE PAJAROS NEGROS (*Agelaius ruficapillus*) EN ARROZ
Tiscornia, G.; Rodríguez, E.; Korenko, V.; Ferrazzini, H.; Camacho, A.; Arballo, E.; M.G.A.P., D.S.S.A.A.; **Uruguay**; Tuesday 11; Martes 11; 14:30; CANCUN; Pág: **81**

147 *INSECT FAUNA OF RICE CROP IN URUGUAY*
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Carballo, R.; Facultad de Agronomía; **Uruguay**; Tuesday 11; Martes 11; 13:30; CANCUN; Pág: **81**

174 *IDENTIFICATION OF THE BLACKBIRD PROBLEM AND ITS CAUSES IN THE RICE PRODUCTION AREA OF SOUTHERN RIO GRANDE DO SUL*
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Centeno Da Silva, J.J.; Embrapa; **Brasil**; Tuesday 11; Martes 11; 14:50; CANCUN; Pág: **82**

176 *ASSOCIATION AMONG SILICA CONCENTRATION, RICE WATER WEEVIL POPULATION AND DAMAGE, IN IRRIGATED RICE PLANTS*
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198 *PRELIMINARY STUDIES OF THE ENVIRONMENTAL SOCIOECONOMIC IMPACT OF INSECTS (ORDER ISOPTERA) IN RICE AREAS*
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Aber, A.; Crosara, A.; Dirección Nacional de Medio Ambiente (MVOTMA), Facultad de Ciencias, Montevideo Uruguay; **Uruguay**; Pág: **83**

PA - PRECISION AGRICULTURE

Oral

011 *SPATIAL NITROGEN MANAGEMENT IN AUSTRALIAN RICE FIELDS*
Pringle, T.; Russel, C.; Angus, J.; Yenda Producers Cooperative; **Australia**; Wednesday 12; Miércoles 12; 16:50; PUNTA 1; Pág: **85**

037 *MEASURING THE EFFECT OF LOW WATER TEMPERATURE ON BLANKING AND GRAIN YIELD ON CALIFORNIA RICE PRODUCTION*
Mutters, R. G.; Eckert, J.; Roel, A.; Plant, R.; Cooperative Extension, Butte Country; **USA**; Wednesday 12; Miércoles 12; 18:10; PUNTA 1; Pág: **85**

038 *PRECISION FARMING FOR SITE-SPECIFIC CROP AND RESOURCE MANAGEMENT*
Plant, R.; Roel, A.; Univ of California Davis; **USA**; Wednesday 12; Miércoles 12; 17:10; PUNTA 1; Pág: **86**

039 *SPATIAL AND TEMPORAL ANALYSIS OF RICE YIELD VARIABILITY IN CALIFORNIA*
Roel, A.; Plant, R.; Univ of California Davis; **USA**; Wednesday 12; Miércoles 12; 17:30; PUNTA 1; Pág: **86**

040 *FACTORS UNDERLYING GRAIN YIELD SPATIOTEMPORAL VARIABILITY IN TWO CALIFORNIA RICE FIELDS*
Roel, A.; Plant, R.; INIA Treinta y Tres; **USA**; Wednesday 12; Miércoles 12; 17:50; PUNTA 1; Pág: **86**

044 *ESTABLISHING A SYSTEM OF GEOGRAPHICAL INFORMATION WHITH A PROFILE APPLICABLE TO RICE AREAS.*
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Fleitas, R.; Bachino, R.; Ramirez, A.; Rosas, E.; Estudio Bachino & Fleitas, Ingenieros Agrimensores; **Uruguay**; Wednesday 12; Miércoles 12; 18:30; PUNTA 1; Pág: **87**

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035 *SPATIAL AND TEMPORAL YIELD VARIABILITY ANALYSIS OF A RICE FIELD IN CALIFORNIA*
Roel, A.; Plant, R.; INIA; **USA**; Pág: **85**

036 *INTERPRETING YIELD PATTERNS FOR CALIFORNIA RICE PRECISION FARM MANAGEMENT*
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082 *AN INTEGRATED RICE YIELD FORECASTING SYSTEM IN EUROPE*
Bocchi, S.; Canfalonieri, R.; Genovese, G.; Mariani, L.; Martin, S.; Orlandi, S.; University of Milan; **Italia**; Pág: **87**

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053 *IMPACT OF THE ASIA-PACIFIC ECONOMIC COOPERATION AGREEMENT AND THE FREE TRADE AREA OF THE AMERICAS AGREEMENT ON INTERNATIONAL RICE TRADE*
Durand Morat, A.; Wailes, E.; University of Arkansas; **USA**; Wednesday 12; Miércoles 12; 15:40; CANCUN; Pág: **89**

090 *NARROWING THE RICE YIELD GAP FOR FOOD SECURITY AND POVERTY ALLEVIATION UNDER THE ENVIRONMENT OF GLOBAL WARMING*
Nguyen, V. N.; Crop and Grassland Service, FAO; FAO; Wednesday 12; Miércoles 12; 15:20; CANCUN; Pág: **89**

110 *COMPETITIVENESS BETWEEN IRRIGATED AND UPLAND RICE IN BRAZIL*
COMPETITIVIDADE ENTRE O ARROZ IRRIGADO E DE TERRAS ALTAS NO BRASIL
Mendez Del Villar, P.; Gameiro, A.; Ferreira, C.; Centre de Coopération Internationale en Recherche Agronomique pour le Développement; **Brasil**; Wednesday 12; Miércoles 12; 17:30; CANCUN; Pág: **90**

111 *BRAZILIAN RICE IMPORTS IN THE LAST TEN YEARS*
IMPORTAÇÕES BRASILEIRAS DE ARROZ NOS ÚLTIMOS 10 ANOS
Gameiro, A.; Mendez Del Villar, P.; Ferreira, C.; Barata, T.; Centre de Coopération Internationale en Recherche Agronomique pour le Développement; **Brasil**; Wednesday 12; Miércoles 12; 16:50; CANCUN; Pág: **90**

126 *FORECASTING AUSTRALIAN RICE YIELDS*
Angus, J.; Farrell, T.; Lewin, L.; Williams, R.; CSIRO Plant Industry; **Australia**; Wednesday 12; Miércoles 12; 17:10; CANCUN; Pág: **91**

171 *WHAT IS THE REAL FOOD SECURITY FOR JAPAN?*
Ito, S.; Faculty of Agriculture, Department of Agricultural Economics; **Japón**; Wednesday 12; Miércoles 12; 16:30; CANCUN; Pág: **92**

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097 *INFORMATION SYSTEMS IN BRAZILIAN RICE SECTOR*
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Rossmann, H.; Barata, T. S.; Gameiro, A. H.; NATURAL SOLUCOES SETORIAIS; **Brasil**; Pág: **89**

112 *RELATIONS BETWEEN IRRIGATED AND UPLAND RICE PRICES IN BRAZIL*
RELAÇÃO ENTRE PREÇOS DO ARROZ DE TERRAS ALTAS E IRRIGADO NO BRASIL
Ferreira, C.; Almeida, P.; Gameiro, A.; Centre de Coopération Internationale en Recherche Agronomique pour le Développement; **Brasil**; Pág: **91**

130 *JOB AND INCOME GENERATED BY RICE PRODUCTION IN RIO GRANDE DO SUL (BRAZIL)*
GERAÇÃO DE EMPREGO E RENDA PELA OIRIZICULTURA NO ESTADO DO RIO GRANDE DO SUL, BRASIL
Gameiro, A.; Barata, T.; Mendez Del Villar, P.; Centro de Estudos Avançados em Economia Aplicada, Escola Superior de Agricultura Luiz de Queiroz, Universidade de São Paulo; **Brasil**; Pág: **91**

165 *RICE-PASTURE-LIVESTOCK FARM DECISION-MAKING UNITS*
SISTEMAS DE PRODUCCIÓN-DECISION ARROZ-PASTURAS-GANADERIA
Ferreira, G.; Ibarburu, M.; Morales, V.; Visca, M.; INIA Tacuarembó; **Uruguay**; Pág: **92**

195 *MODEL FOR ESTIMATION OF COST AND BENEFITS OF RICE CULTIVATION IN URUGUAY.*
MODELO PARA LA ESTIMACION DE COSTOS Y BENEFICIOS DEL CULTIVO DE ARROZ EN EL URUGUAY
Lavecchia, A.; INIA; **Uruguay**; Pág: **93**

EV - ENVIRONMENT AND SUSTAINABILITY

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013 *AUSTRALIAN RICE TAKES THE LEAD IN ENVIRONMENTAL AND INDUSTRY REFORM*
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DEVELOPMENT OF HYBRID RICE IN CHINA / DESARROLLO DEL ARROZ HÍBRIDO EN CHINA

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Hybrid rice research was initiated in 1964. The genetic tools. viz. cytoplasmic male sterile (CMS), maintainer and restorer lines, essential for producing F1 hybrids, were developed by 1973. Hybrids with strong heterosis were developed by 1974 and a whole package of seed production technology was perfected by 1975. Hybrid rice was released for commercial production in 1976. The yield advantage was 20% over the inbred rice. In recent years, hybrid rice covers half of the rice area but contributes to 59% of the rice production in China.

Due to the discovery of photo(thermo)-sensitive male sterile rice, a research program on development of two-line system hybrid rice was launched in 1987. After 9 year's hard work, the development of two-line system hybrid rice was achieved. Generally two-line hybrid rice has a yield advantage of 5-10% over three-line hybrid rice.

In view of population growth pressure and reduction of arable land in China a super rice breeding program was set up by China Ministry of Agriculture in 1996 with the following yield targets on large scale:

Phase ¢ñ (1996-2000): 10.5 t/ha.

Phase ¢ò (2001-2005): 12 t/ha.

By means of morphological improvement plus utilization of inter-subspecific (indica/japonica) heterosis, several pioneer two line super hybrid rice varieties had been developed by 2000, which achieved the yield target of the phase ¢ñ. There were more than 20 demonstration locations with an area of 6.7 ha or 67 ha each where the average yield was over 10.5 t/ha. The average yield per ha was 9.6t in commercial producton (235.000 ha) in 2000 and 9.2 t/ha (1.2 million ha) in 2001.

Efforts are now focused on breeding for phase ¢ò super hybrid rice and good progress is being made. There were three indica/japonica hybrid combinations outyielding the CK (the pioneer super hybrid rice) by 6-18% in replicated trials in 2001. Out of them, there were two hybrids yielding more than 12 t/ha in an area of about 8 ha each this year. And one hybrid created a new yield record (17.95 t/ha) in an experiment plot (800m²) in Yunnan Province last year.

Utilization of favorable genes from wild rice is another approach we use in our breeding program to develop super hybrid rice. Based on molecular analysis and field experiments, two yield enhancing QTLs from wild rice have been identified. By means of molecular marker-assisted backcross and field selection, an excellent R line (Q611) carrying one of these QTLs is developed. Its hybrid, J23A/Q611, outyielded CK hybrid by 35% in replicated trial in the late season rice in 2001 and yielded over 11t/ha on farmer's trials this year.

In addition to increasing yield, improvement of grain quality is also emphasized for breeding super hybrid rice. High yield is not a contradiction to good quality in rice. Actually one of the pioneer super hybrid rice varieties (Pei;ai 64S/9311) has both very high yield and good grain quality.

Super hybrid rice will play a very important role in ensuring the food security both in China and the whole world.

CONFERENCE / CONFERENCIA

GENE COMBINATIONS IN RICE FOR THE DEVELOPMENT OF DURABLE RESISTENCE TO Pyricularia grisea IN COLOMBIA / COMBINACIONES DE GENES EN ARROZ PARA EL DESARROLLO DE RESISTENCIA DURABLE A *Pyricularia grisea* EN COLOMBIA

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Rice blast caused by *Pyricularia grisea* (*Magnaporthe grisea*) is the main limiting factor of rice production in Colombia. Resistance breakdown occurs after one to three years of cultivar release, with the exception of the commercial cultivars Oryzica Llanos 5 released in 1989 and FEDEARROZ 50 released in 1998. With the objective of developing rice cultivars with durable resistance to blast we have analyzed the genetic structure of blast pathogen populations using techniques such as MGR-DNA and rep-PCR fingerprinting and studied the diversity and frequencies of avirulence/virulence genes in the fungus. *P. grisea* in Colombia is mainly clonal. Each clone or lineage exhibits a broad spectrum of virulence. However, some resistance genes are effective against all isolates of a linage. Avirulence genes vary in frequency, suggesting that these genes could be associated with pathogenic fitness. Therefore, the resistance genes corresponding to those avirulence genes would be more relevant for breeding durable resistance. Our studies are allowing us to identify and predict the durability of resistance gene combinations based on frequencies of avirulence genes. We have identified the possible resistance genes present in our commercial rice cultivars and initiated a backcrossing program for incorporating desired combinations of resistance genes in rice varieties of Latin America through marker assisted selection, controlled inoculations, and field evaluations.

Key words: Rice blast, *Magnaporthe grisea*, genetic structure, resistance genes, avirulence genes, isogenic lines.

El añublo del arroz causado por *Pyricularia grisea* (*Magnaporthe grisea*) es el principal limitante de la producción en Colombia. La perdida de la resistencia ocurre en períodos de uno a tres años, con la excepción de los cultivares Oryzica Llanos 5 liberado en 1989 y FEDEARROZ 50 liberado en 1998. Con el objetivo de desarrollar cultivares con resistencia durable al añublo hemos analizado la estructura genética de poblaciones del patógeno utilizando técnicas moleculares como MGR-DNA y rep-PCR fingerprinting y estudiamos la diversidad y frecuencias de los genes de avirulencia/virulencia del hongo. *P. grisea* en Colombia es principalmente clonal. Cada clon o linaje exhibe un espectro de virulencia amplio. Sin embargo, algunos genes de resistencia son efectivos contra todos los aislamientos de un linaje. Los genes de avirulencia varían en frecuencia, sugiriendo que dichos genes de avirulencia pueden estar asociados con la supervivencia y reproducción, y por lo tanto, los genes de resistencia correspondientes a dichos genes de avirulencia serían mas relevantes en el mejoramiento para una resistencia durable. Nuestros estudios nos permiten identificar y predecir la durabilidad de combinaciones de genes de resistencia basados en las frecuencias de genes de avirulencia. Hemos identificado los posibles genes de resistencia presentes en nuestras variedades de arroz e iniciado un programa de retrocruzamiento para incorporar las combinaciones de genes de resistencia deseadas en variedades de arroz de América Latina, a través de una selección asistida por marcadores moleculares, inoculaciones controladas, y evaluaciones de campo.

Palabras claves: Añublo, *Magnaporthe grisea*, estructura genética, genes de resistencia, genes de avirulencia, líneas isogénicas.

RICE PRODUCTION SYSTEMS IN TEMPERATE CLIMATES AND THEIR SUSTAINABILITY
SISTEMAS PRODUCTIVOS DE ARROZ DE CLIMA TEMPLADO Y SU SUSTENTABILIDAD
***Coordinator* / Coordinador: Enrique Deambrosi, INIA**

SUSTAINABILITY OF RICE PRODUCTION SYSTEMS IN THE TEMPERATE CLIMATE OF SOUTH EASTERN AUSTRALIA

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The Australian rice industry is located in the Murray Darling Basin of south eastern Australia. The industry has traditionally been the most important non-horticultural one in this area. It has sustained the regional community and earned valuable returns from competitive national and international markets. A fully grower owned co-operative processes and markets the crop for domestic and export consumption. It is important that sustainability of the land and water resource base be addressed if the industry is to remain viable with current pressures on markets, land and water resource base and maintenance of the diverse flora and fauna of the local ecosystem.
Rice is grown in a semi arid environment as a fully ponded irrigated crop on riverine soils of low permeability. It is grown in variable rotations as a component of a farming system with winter cereals, annual pastures and other summer crops. Sustainability is threatened by increasing costs of production, increasingly competitive national and world markets, yields increasing at a slower rate, wide seasonal yield variability due largely to reproductive cold stress, increasing competition for water because of reduced availability, increased price and the needs of other crops, high water tables and land salinisation, and demands for greater community stewardship of the impacts of agriculture on the environment. Current research, development and extension programs aim to improve varietal potential, improve grain quality and quality assurance to compete in a full range of mainstream and niche markets, reduce seasonal yield variation by lowering the threshold at which reproductive cold stress affects yield, improve water use efficiency by improving and/or maintaining yields whilst reducing growth duration. Resource focussed programs aim to lower accessions to the water table and reduce net groundwater recharge to minimise land salinisation and degradation, to combat soil acidification and structural decline, to maintain the diversity of natural ecosystems, their land, vegetation and fauna base, and reduce the impact of production management practices including chemical residue contamination of the natural environment. Future challenges for sustainability include the development of innovative bed systems of ricegrowing that reduce the need for ponding, increase the opportunity for more adaptable and flexible crop rotations, further improve water use efficiency, whilst maintaining productivity, profitability and the socio economic stability of the dependant communities.

RICE PRODUCTION IN TEMPERATE REGION OF BRASIL AND ITS SUSTAINABILITY

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About 60% of the Brazilian rice crop is produced in its temperate region. The State of Santa Catarina produces around 9% under monoculture and pre-germinated system. The State of Rio Grande do Sul is responsible for 50% of the total production under flooding irrigation system and in fallow periods fields are used for cattle raising. The most important problems faced by rice farmers are low incomes specially by lease-hold farmers; qualitative and qualitative problems related to irrigation water as well as certain crop pests that are increasing with time, insects, diseases and weeds, specially red rice. Among the alternatives suggested to minimize these problems and aiming to give sustainability and higher seed yields it can be mentioned: crop rotation, animal production on lowland areas, specially cattle raising on winter pastures, rice-fish and raising Pekin ducks, besides other products such as the ones produced under agroecologic certification. Among the challenges that irrigated rice farmers must confront in the environmental aspect there is: the conservation of non- renovable resources such as water without polluting its sources. On the technical side: to increase average yields and decrease costs through technological transference, higher professionalism of people involved in the production process as well as great emphasis on quality. In regard to policy it can be mentioned a wide discussion with everybody implicated in the production chain and governmental policies aiming to organize and assure a lucrative activities for all segments involved for the competitively maintenance of the Brazilian rice producers; regulating the use of transgenic plants without risk for producers and environment and consumers; and a standardization of quality of the products and differentiated production procedures aiming to add value to the product and high consumer safety. Therefore in order to obtain more information about those questions more investment for research is needed.
Keywords: Oryza sativa, production systems, lowlands.

SUSTAINABILITY OF CALIFORNIA RICE PRODUCTION

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California produces about 20% of US rice on 16% of the planted area, averaging 202,500 ha annually. Dry summers and high solar radiation in the Sacramento Valley, where 96% of the rice is grown, promote yields about 20% above the national average, about 9000 kg/ha. The growing season spans April through October. Irrigation water is about 80% from snowmelt stored in reservoirs. Rice soils are mineral based, have high clay and/or impeded sub layers, are mostly acidic, with good fertility and only a limited extent of salinity or alkalinity. Most California rice is direct seeded and permanently flooded. Aircraft are used extensively for seeding and some pesticides, and ground rigs for much weed control. Over 90% of plantings are high quality medium grain varieties, about 53% of which is sold domestically, with small amounts of long, short and specialty grains. Domestic markets include table rice, beer, and processed foods, which are 28, 16 and 9%, of annual production, respectively. About 46% is exported to Pacific Rim, Middle Eastern and European countries.
California faces a range of sustainability issues. Production, drying, storing and milling costs are all highest in the nation and place producers in a vulnerable liquidity position. Demand is strong but can easily be oversupplied from other US and foreign production. Prices remain marginal for profitability. Most producers are dependent on government subsidies, which are trending downward in the face of changing national priorities. California's unique strengths are high product quality and reliable supply. But, severe yield drops in four of the last ten years questions our ability to sustain consistently high yields. Likewise, the resource base is being challenged. For example, air quality regulations changed straw management practices resulting in increased pest levels and production costs, and slightly lower yields. Increased water demand from a rapidly growing and affluent state population, and environmental enhancement programs compete with rice for limited supplies while raising cost. Public demand for clean water requires diligent management and regular monitoring to comply with requirements. Production problems, such as weed resistance to herbicides and introduction of exotic pests challenge our researchers to provide solutions made more difficult by a zealous state and federal regulatory climate that limits availability and increases cost to California growers of new pest management chemicals. Furthermore, prevention of pesticide drift to nontarget crops has necessitated extensive use of ground rigs at the expense of money and time.
Several research and industry programs are in place to sustain our industry. The California Rice Commission, a grower and processor organization aggressively fights at all governmental levels for beneficial public policy. They have also implemented a public law to combat exotic pests and ensure varietal purity as agriculture moves into the era of genetically modified crops. An industry funded research

program supports university and USDA research in vital production areas, protection of the environment and quality enhancement. Finally, an industry funded research station, in collaboration with university and USDA personnel, has the pivotal responsibility of developing improved varieties which are the key to productivity and quality gains.
Research, education and aggressive participation in public policy will be the keys to solutions that will determine the future competitiveness of the California rice industry.

THE URUGUAYAN RICE PRODUCTION SYSTEM AND ITS SUSTAINABILITY

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An agroecosystem is an ecological system that is managed for the purposes of producing food and/or feed, and fiber. Sustainability is the capacity of agroecosystem to maintain the production through time without threatening its structure and function. Rice production in Uruguay, located between 30 and 35 parallels south latitude, is relatively new; it started in 1920 decade. Only one crop per year is grown, with risk of cold temperature ocurrence during the reproductive phase of the crop. One hundred sixty thousands hectares have been seeded lately, 68% in the East, 12% in the Center and 20% in the Northwest region of the country. About 500 farmers plant varieties released in Uruguay (97,5%), using certified seed (85%). In reference to size, 31% of the farmers grow between 1-300 ha, 20% 301-500 ha, 23% 501-1000 and 26% more than 1000 ha, and production is highly mechanized.The crop is drill or broadcast seeded into dry soil (drained surface conditions). According to rainfall, flushing (1 or 2) is required to prevent water stress, before establishing the permanent flood 35-55 days after planting. Phosphorus and nitrogen, and potasium in some cases, are applied at planting. One or two nitrogen top dressings are used (tillering /panicle initiation). Type of soil, rotation system, land preparation, method and time of seeding, diseases history and weather conditions, are considered to decide crop fertilization. In general, 40-70 kg P_2O_5 ha^{-1} and no more than 70 kg N ha^{-1} are applied. Although crop yield shows a slow but sustained increase in the last 15 years (4.815 kg ha^{-1} in 1987/88; 6.704 kg ha^{-1} in 2000/01), climatic instability and world market prices variation threaten the economic sustainability of rice production. Rice crop shares the use of soils with cattle production, accountig for 25-30% of the time. After rice harvest, it is recommended no till plantig of forage species (by airplane), to increase beef/sheep production, during the period without rice (3-4 years). Grasses and legumes presence improve soil conditions, which has big impact on the next crop. Due to the shared use of the soils, rice pesticides (herbicides and fungicides)are applied with low frequency through time. Otherwise, satisfactory environmental results were found in 1992-94 in a monitoring study of pesticide residues in rice farms (soil, water and grain). Increased use of gliphosate has modified soil management, and there is a strong tendency to reduce land preparation. No tillage plantig of rice at spring is also increasing, dependig on the production region that is considered.

EL SISTEMA DE PRODUCCION DE ARROZ EN URUGUAY Y SU SUSTENTABILIDAD

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Un agroecosistema es un sistema ecológico que es manejado con el propósito de producir alimento y/o fibra. Se entiende como sustentabilidad la capacidad del ecosistema de mantener la producción a través del tiempo sin amenazar su estructura y funcionalidad. En Uruguay, ubicado entre los paralelos 30 y 35 de latitud sur, la producción de arroz es relativamente nueva habiendo comenzado en la década de 1920. Se siembra un solo cultivo por año, con probabilidad de ocurrencia de bajas temperaturas durante la fase reproductiva del cultivo. En los últimos años se han sembrado aproximadamente 160.000 ha localizadas en las regiones este (68%), centro (12%) y noroeste (20%) del país. Cerca de quinientos productores siembran variedades liberadas en el país (97,5% de la superficie), utilizando semilla certificada (85%). El 31% de los productores siembra entre 1-300 ha, el 20% 301-500 ha, 23% entre 501-1000, y 26% más de 1000 ha, con un alto grado de mecanización. Los productores siembran el arroz en líneas o al voleo, en un suelo seco (drenado en superficie). Dependiendo de la ocurrencia de lluvias, es necesario realizar 1 o 2 baños para prevenir estrés hídricos, antes de establecer la inundación permanente 35-55 días después de la siembra. Se aplica fósforo y nitrógeno basal, y en algunos casos potasio. Posteriormente se realizan una o dos aplicaciones de nitrógeno en cobertura. La fertilización se realiza de acuerdo al tipo de suelos, sistema de rotación, preparación del suelo, método y época de siembra, historia de enfermedades y condiciones climáticas. En general se aplican 40-70 kg P_2O_5 ha^{-1} y no más de 70 kg N ha^{-1}. Aunque el rendimiento medio indica un lento pero sostenido incremento en los últimos 15 años (4.815 kg ha^{-1} en 1987/88; 6.704 kg ha^{-1} en 2000/01) la inestabilidad climática y la variación de precios en el mercado internacional amenazan la sustentabilidad económica de la producción de arroz. El uso del suelo es compartido con la producción pecuaria, ocupando el arroz 25-30% del tiempo. Luego de realizada la cosecha, se recomienda la siembra de especies forrajeras por avión, sin laboreo, para incrementar la producción de carne en el período sin cultivo de arroz (3-4 años). La presencia de gramíneas y leguminosas permite mejorar las condiciones del suelo, lo que tiene alto impacto sobre el cultivo de arroz posterior. Dado el uso compartido del suelo los plaguicidas del arroz (herbicidas y fungicidas) son aplicados con baja frecuencia a través de los años. Por otro lado, en 1992-94 se realizó un monitoreo de presencia de residuos de plaguicidas en la producción de arroz (suelos, aguas y granos), pudiéndose comprobar un estado satisfactorio desde este punto de vista ambiental. El uso creciente de glifosato ha modificado el manejo de suelos, existiendo una fuerte tendencia a la reducción del laboreo. Dependiendo de la zona de producción considerada, es también creciente la utilización de siembras con cero laboreo en la primavera.

RICE PRODUCTION SYSTEM IN ITALY AND ITS SUSTAINABILITY

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Sustainable Agriculture is becoming the answer to the needs of recovering the quality of rural life in industrial and post industrial societies, of conserving non renewable resources such as soil, water and air, improving biodiversity, recovering traditional and global respect towards the land. The European Rice production system along its long history has decreased progressively its similarity to the original ecosystem, becoming a very specialized and simplified agroecosystems with a low level of sustainability. After centuries during which the single, main goal has been to increase yield and after few decades of growing awareness about grain quality, few steps have taken along the way towards higher level of sustainability. This new approach is probably due to the new EU policy and a new economical and ecological perception on the part of farmers and citizens regarding the quality of natural resources, food chain and products.
The paper, after having recalled some principles related to the concept of sustainability at different complexity scales (crop, cropping system, farming system, agricultural system), describes the Italian/European rice production system and its historical, geographical, agrotechnical evolution, by taking into consideration three dimensions of sustainability: economic, environmental and social. After decades of stabilty, the European rice grower feels his own economic sustainability threatened by the new international trends.
The multifunctional activities and the related incomes, EU subsidizes, higher prices of special purposes and traditional rices will together make a sort of social agreement possible for the conservation of quality farming and, consequently, the conservation of natural resources.

Satellite Symposium - Simposio Satélite - Rice Tec
HYBRIDS - A NEW GENERATION OF RICE IS BORN
HÍBRIDOS - NACE UNA NUEVA GENERACIÓN DE ARROZ

HYBRID RICE BUSINESS – U.S.

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Rice is grown on approximately 1.5m ha in the United States, two-thirds in the southern United States and the remainder in California. Both market areas are dominated by publicly-developed varieties, temperate japonica types in California and javonicas (tropical japonica) in the southern areas. RiceTec, Inc. began developing hybrid cultivars for the southern U.S. market in 1990 and commercialized the first rice hybrid in 1999.

Although RiceTec, Inc. was incorporated in 1990, it evolved from an existing organization, Farms of Texas, with operations dating to 1983. It is a wholly-owned subsidiary of RiceTec, AG, a Liechtenstein corporation and includes three functional units: a Consumer Products group with 35 employees which sells the Rice Select® brand of rice products in U.S. supermarkets, a Seed Business unit with 41 employees, responsible for selling rice hybrids to U.S. farmers, and a Research and Technology (R&T) group with 55 employees responsible for developing products and practices required by the other units. The functional departments are supported by an administrative unit of 16 employees.

RiceTec, Inc. is headquartered near Alvin, TX, 80km south of Houston, with satellite operations in Arkansas, Puerto Rico, and Hawaii. In addition to headquarter's operations, RiceTec's milling and packaging operations are located in Alvin as are a majority of the R&T staff. Most Seed Business Unit employees are located in Arkansas, the largest rice growing state in the U.S., where about half of U.S. rice is grown. The R&T group is split, with significant presence in Alvin, Lajas, Puerto Rico, and Newport, Arkansas.

Commercial seed sales began in 1999 with the release of XL6, the first rice hybrid grown commercially in the Western Hemisphere. It was characterized by very high yield, moderate agronomic traits, and relatively poor quality. This was followed in 2001 by XL7 and XL8, characterized by having high yields, good agronomics and quality. In 2003, a Clearfield version of XL8 is being released, and two additional products are in the final stages of evaluation for potential sales in 2004. RiceTec hybrids were grown on approximately 4,000ha in 2002, are expected to reach 12,000ha in 2003, and are projected to double or triple each year for the foreseeable future.

RiceTec, Inc. is the technical center for the RiceTec family of companies, and now serves as a resource for sister companies in Brasil, Argentina, and Uruguay. The commitment of RiceTec to serve rice farmers extends from Essex, Missouri to Treinta y Tres, Uruguay, is farmer focused, and is driven by great people using the most advanced technology available.

Keywords: Hybrid rice

HYBRID RICE TECHNOLOGY – U.S.

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Hybrid rice technology was first developed in China in the 1960's. The germplasm base used in China from that time has consisted of in large part *indica* lines from South China on the female side, and *indica's* from IRRI on the male side. It was this genetic background that was available to RiceTec when breeding efforts started in 1990 with publicly available A-lines (V20A, ZH97A) and IRRI R-lines such as R24. The pace and the germplasm both increased in 1993 and 1994 with the signing CMS and EGMS agreements with Prof. Yuan Longping of the HHRRC in Changsha, China, and the addition of a second breeder to the staff. Additions to the staff over the next 5 years have brought the total breeding staff to 7, and the total technical staff to about 55.

The technical challenges facing RiceTec breeders were based both on the germplasm available in the early years and the very different farming systems in China and the U.S.. Among the challenges based on introducing *indica* germplasm into a temperate *japonica* rice market were lower than acceptable milling yield, different amylose and Alkali Spreading Value (ASV) than required by the market, high chalk, and grain dimensions outside acceptable norms. In addition, many of these *indica*s bred and grown in transplanted environments had unacceptable straw strength in the high plant population environments of drill seeding.

The differences in farming systems offered perhaps the greatest challenge to RiceTec breeders. The intensive farming systems of China and Asia in general used lower seeding rates, and resulted in higher seed production yields than would ever be possible in the extensive systems used in the U.S. and other mechanized agricultural systems. Required changes included improvements in seedling vigor, enhanced female outcrossing ability, and many changes to the production systems common in the U.S.

Breeding strategies have evolved over time, but currently focus on a combination of classical pedigree selection, enhanced by marker assisted selection, overlaid by a developing genomics program focus on making RiceTec breeders more efficient and effective.

For hybrids to be successful, they must provide the farmer and the seed company with additional income, and fit the expectations of the marketplace. Today, RiceTec breeders, using both the CMS and EGMS systems, have solved most of the problems facing them in producing parent lines and hybrids which fit the rice grain markets and work well both for farmers and RiceTec as a seed producer.

Keywords: Hybrid rice

OUTLOOK FOR RICE HYBRIDS IN SOUTH AMERICA

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RiceTec's hybrid development program in the Mercosur Region is primarily targeted towards the irrigated rice in the temperate zone, namely in Brazil in the Federal State of Rio Grande do Sul, Uruguay and Argentina. Irrigated rice in this region is cultivated on approximately 1 235 000 ha.

Although the legal entities of the sister companies in Argentina, Brazil and Uruguay have been created only in 2000, first hybrid testing initially aimed as a support to the US business started back in 1992. Since the sister companies in the Mercosul were created almost 3 years ago, RiceTec has gradually improved its operational base and resources for hybrid testing and seed production. RiceTec has developed a large testing network with standardized testing protocols across the region. Hybrids are screened in Yield Trials at 11 locations. Successful hybrids are advanced to strip tests and currently are tested at 40 locations under farm-like conditions.

This season, we have started with the first commercial hybrid seed production of two hybrids aiming at a commercial launch for next season.

a) The experimental hybrid XSP116 will be launched under the commercial name of AVAXI ®. A hybrid that out yielded IRGA 417 last season (2002/03) in strip tests by 1,06 ton/ha and EL Paso 144 by 1.42 ton/ha averaged over 22 locations. AVAXI ®, a hybrid with a yield potential of 13.56 tons/ha (Mercedes, Argentina), is targeted towards the leading farmer community interested in obtaining maximum benefits from their crop. Milling studies in Argentina and Brazil with the hybrid AVAXI ® resulted in a whole milling of 59 %.

b) The experimental hybrid XP701 is the first Clearfield ® * hybrid being launched in South America, which is targeted in Brazil specifically for red rice infested fields. In the other countries (Argentina and Uruguay), where red rice is less of a problem, we are working on the development of Hybrid + Clearfield ® as a new concept for high yield performance and broad spectrum weed control.
In last year's trials, XP701 outyielded IRGA 422-CL by 1.01 ton/ha in low red rice infestation situations with post-emergence applications of Clearfield ®.
The XP701 + Clearfield ® system was compared to conventional cultivation i.e. varieties and conventional herbicides in farms tests under medium to high red rice infestation. The average benefit of the hybrid was 1,24 ton/ha compared to the conventional cultivation (3 plots of 0.5 ha each). Milling tests concluded at five mills in Brazil averaged whole milling results of 65.1% for XP701.

Our biggest challenge is now to turn hybrid rice into a viable business option for the rice growers and develop hybrid rice as an economic viable business activity. This will depend on a number of factors mainly: i) technology adoption by the farmer ii) farmers ability to improve and adapt farming practices to hybrid cultivation systems iii) the ability to produce consistently high quality seed.

* Clearfield, a brand owned by BASF.

Keywords: Hybrid rice

RESEARCH PROGRESS REPORT SOUTH AMERICA

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Although the climate conditions of the Southern USA are relatively similar to the conditions in our target market in Southern Brazil, Argentina and Uruguay, there are still major differences for which we have to account for. In particular we have to create and to develop hybrids that meet the specific climatic and quality differences, and are adapted to the overall agronomic practices applied in our region.

The program started with the screening of the hybrids developed in the USA in the attempt to identify suitable hybrids for our market. More recently we started to make hybrid combinations in South America, using locally adapted germplasm after having established agreements with some public rice breeding institutions. The key objectives are high yield performance, yield stability and milling and cooking qualities as desired by the local mills and consumers.

Currently we are testing approximately 400 new hybrids each year. In our small plot yield tests, we are obtaining yield advantages in the range of 2.0 tons/ha of the hybrids over the checks. In strip tests, i.e. under farm like conditions, the hybrid AVAXI® obtained maximum yields of 12.59 tons/ha (Dom Pedrito/Brazil).

The increased robustness and high tillering potential of hybrids leads often to greater yield advantages over varieties under farm conditions than under small plot research conditions. In specific cultivation studies we found that under current practices seed densities can be reduced to 60 kg/ha. However to increase the cost/benefit ratio of hybrids, we have to improve cultivation practices, in particular soil preparation and water management, in order to further reduce seed densities.

Our research with the hybrid AVAXI® has indicated that with heading nitrogen yields can be improved substantially compared to mid-season nitrogen applications. We have some indications, that in addition, heading nitrogen also improves whole milling results by 1 – 2%.

Milling quality for hybrids has been a long debated issue. We can now also report good progress, as we have achieved average milling results for AVAXI of 69.9 % total milling and 58.9 % whole grain milling.

Keywords: Hybrid rice

RICE ECONOMY AND MARKET
ECONOMÍA Y MERCADO DEL CULTIVO DE ARROZ
***Coordinator* / Coordinador: Luis Sanint, FLAR**

INCREASING COMPETITIVENESS OF THE LATIN AMERICAN RICE SECTOR BY SUSTAINING INNOVATIONS

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Competitiveness in world trade has become, by most standards, the rule of thumb to judge if an agricultural activity should be viable or not. The world markets are filled with distortions that place competitiveness more in the realm of policy than that of economics. And, more importantly, the negotiations that lead to specialization of trade imply also adaptation to unfamiliar patterns of production, resource use and exploitation that not only carry huge reconversion costs but have also led to increased unemployment, more poverty and deeper differences between rich and poor in Latin America. In the end, competitiveness has to do with social values and skills, with culture, tradition and use of resource endowments, i.e., with people. The XXth century brought immense material progress to mankind. The Malthusian concerns that exponential population growth was going to outrun linear growth in food production were slashed by the impressive performance of agriculture. Governability of the rapidly expanding masses is at the heart of the emergent social and economic challenges. A deeper question also remains unanswered: how to conciliate the interests of these masses with those of powerful, small groups with huge lobbying capacity. The attack on rural traditions and ancestral forms of life in the name of economic ideologies, progress and globalization represented an enormous challenge to rural communities everywhere by the end of the XXth century. Producers associations have been a powerful response to the issue of governability and of innovation and diffusion of new technologies. A myriad of impressive technological advances and their respective synergisms allowed annual rates in productivity to surpass population growth. Progress, "with its bark and its pits", has been beneficial to the natural resource base as area harvested barely grew in a time span when cereal production was quadrupled. While, at the world level, rice production stagnated in the first half of the century, in LAC, it grew quite fast, as rice became a preferred pioneer crop in the frontiers of the Brazilian Cerrados and the Colombian, Venezuelan and Bolivian savannas as well as in forest margins throughout the region. These early settlements took advantage of the new advances in mechanization. By the 1970s, the new semidwarf rice varieties arrived in farmers fields and flooded rice production gradually replaced upland rice areas. IRRI and CIAT became the prime sources of new germplasm and the hub for international efforts in the field of technology generation and innovations for the rice sector. By the 1990's, CIAT signaled its intention to diminish its support to the rice program. Rice producer associations from Colombia, Venezuela, Brazil and Uruguay reacted to this situation and, together with CIAT, took the torch of innovation and created FLAR in 1995. By 2002, 13 countries have contributed funds to this novel mechanism and the program is now growing from a primarily germplasm based effort into crop management and post harvest activities as well. With the approval from CFC of a grant for US$975,000 for three years that represents an increase of 70% of the incomes from fees, FLAR's resource base is well consolidated and it emerges as a viable and stable international model to sustain innovations for the rice sector of Latin America.

CHINA AND THE GLOBAL ECONOMICS OF JAPONICA RICE

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China has long been the world's largest rice producer and consumer. However, the relative balance between production and consumption and China's history of trade barriers has limited China's role in global rice markets. China is primarily an indica rice producers but is, nonetheless the world's largest producer and consumer of japonica rice. For more than a decade, China's production and consumption of japonica rice has grown rapidly (6 percent per year) as government limits have been relaxed and producers have increased incentives to respond to consumer preferences.
Japonica rice is produced and consumed mainly in Northern China and has been expanding rapidly in the broad area around Shanghai. One key question for global markets is the potential for japonica production growth to outpace consumption growth in China. Our analysis indicates some limits on the growth potential for high-quality japonica production and opportunities for high-quality japonica rice to be imported by China, especially in the Shanghai region.
Cost of production data show that costs in California and costs in China are in the same general range. Productivity growth is proceeding rapidly in China and new biotech varieties for rice are soon to be available. It is not yet certain that these will be released soon, however. As rural labor costs rise in China, farm consolidation will be required for China to remain competitive. A further issue relates to the degree to which the Chinese market is truly open to imports. The Chinese system of value- added taxes applied to imports and refunded for exports can create a price wedge of almost 30 percent and the transparency of the system is also a concern to traders.
In summary, we find potential for China to become a net importer of high-quality japonica rice, though the possibility for exports also exists. Implications for global japonica prices depend, in part, on the substitution between japonica and the much larger market for indica rice. If substitution is a significant factor in some major markets, China's participation in global markets will have small and mainly temporary impacts on japonica rice prices.

RICE SUBSIDIES AND THE ECONOMICS OF RICE TRADE AND TRADE NEGOTIATIONS

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The past decade has seen important changes in international trade rules and farm subsidy programs. The 1994 Uruguay Round Agreement, which revised the General Agreement on Tariff and Trade and created the World Trade Organization, reduced agricultural trade barriers and export subsidies and included limits on internal subsidy programs. In addition, several major trading nations revised their programs for supporting agriculture. Rice trade barriers played a key role in trade negotiations and rice subsidies have been the subject of much international attention.
Despite the changes, rice remains one of the most heavily subsidized crops in the world. Measured by the share of farm receipts attributed to government support, including trade barriers, Organization for Economic Cooperation and Development (OECD) data show subsidy shares ranging from more than 80 percent for Japan and Korea, to more than 40 percent for the United States and the EU and down to a low of about 5 percent for Australia. Japan and Korea both provide direct payments and other subsidies, but the main source of support for the domestic rice industry in each case is high trade barriers that allow domestic prices to exceed border prices by between several hundred percent. The European rice policy also consists in a variety of subsidy programs, but relies heavily on border protection. In the United States border barriers are low and the main policy instruments are several forms of direct payments.
Subsidy programs in the United States evolved gradually from 1985 to 1996 to reduce government participation in farmers' planting decisions. These policy changes remain largely in place, but starting in 1998 subsidy rates were increased markedly. Under the 2002 farm bill, high subsidy rates continue while the degree of production incentives tied to the payments has increased. Changes in farm programs have also occurred in Japan, Korea the EU and other nations that affect rice production and trade.
This paper reviews farm programs for rice in selected countries and discusses their implications for trade and trade negotiations.

RICE ECONOMY AND MARKET
ECONOMÍA Y MERCADO DEL CULTIVO DE ARROZ
***Coordinator* / Coordinador: Luis Sanint, FLAR**

REGULATION OF THE RICE TRADE AND THE WTO'S DOHA ROUND NEGOTIATIONS ON AGRICULTURE

Dr Dan HOROVITZ,
Theodore Goddard, Brussels

With the growing pace of international trade liberalisation, both developed and developing WTO Members are pushed to the limits of their respective ability and readiness to liberalise their agricultural trade. Developed Members are being pressed to improve access conditions in their own markets as a basic condition to the acceptance by less developed Members to allow into their own territories industrialised and other sophisticated products originating in the developed world, as well as undertake sweeping liberalisation reforms of their trading systems and accept most demanding trade related "open market" disciplines. As first designed by the WTO's Agreement on Agriculture and as further required by certain agriculture intensive constituencies, developed WTO Members are called to ease down additional aspects of their relevant agricultural policies, such as in relation to domestic support and export competition.

The various negotiation positions that have so far been formulated or even tabled by leading WTO Members (EC, US, Japan, the Cairns Group), as well as by the WTO itself (e.g. Harbinson's recent draft) demonstrate the large divisions that still exist between the various positions and the important effort that Members should still make to respect the DDA targets in time.

In parallel with these global initiatives, steps are also being taken at regional level to liberalise agricultural on a more limited geographical basis, although these prove to be almost equally difficult to agree between parties of similar, let alone different development levels (e.g. Mercosur and the FTAA). Particularly in relation to the EU's RTAs, regional pacts, primarily the ACP arrangements and also others, have been causing similar difficulties to WTO Members who are not direct parties to such RTAs, for example in view of the sweeping concessions given to some developing countries (in ACP) often to the detriment of other developing countries' interests.

The paper highlights certain ways and methods whereby WTO Members may deal with such global and regional difficulties. As the case may be, those methods can relate to various types of aided and unaided negotiations, new initiatives such as in the context of the DDA and in regional fora, and, if and where necessary, the initiation of regional or WTO dispute settlement proceedings.

The paper presents the above issues with the rice sector and the rice trade particularly in mind, while highlighting some practical cases and experiences to support and illustrate the arguments made.

LOS ESPACIOS DE EFICIENCIA Y CRECIMIENTO AL INTERIOR DE LA CADENA PRODUCTIVA DEL ARROZ

ROGERIO ORTIZ PORTO

Las desigualdades de comportamiento de los Gobiernos frente a la total apertura del comercio mundial identifican poderes diferenciados de intervención para proteger los intereses de los productores específicos de cada país y de cada rubro. Más poder, más protección, más subsidios.

A nivel sectorial, aún en los PED las políticas económicas son manifiestamente proteccionistas de los sectores urbanos. Es importante, por lo tanto, que continúen las acciones de defensa de los intereses de los productores agropecuarios, en especial de los arroceros. A los cuestiones de política económica no deben ser, en ningún caso, olvidadas o menospreciadas en su importancia central.

Sin embargo, hay mucho que hacer en la cadena productiva del arroz como tal, desde un cambio de mentalidad respecto al uso de los factores productivos, especialmente el suelo y el agua, en la utilización de las potencialidades de los subproductos y derivados del arroz y de la cáscara y en las relaciones que intermedian los varios segmentos que componen la cadena. Lo que se busca identificar son las deficiencias y las potencialidades que el sistema productivo del arroz ofrece a los productores que deseen abandonar la actividad como fuente de ingresos y pretendan enfrentarla como una manera de obtener ganancias y afirmar su posición en el mercado como un competidor eficiente y eficaz. Las pérdidas que son acumuladas y las agresiones ambientales que resultan de la ineficiencia son enfatizadas y son identificadas como ingresos negativos para el sector y para la sociedad como un todo. La absorción de la información, de la cual la tecnología es una parte, es un elemento esencial de un nuevo porvenir.

Encontrar salidas implica también considerar alternativas de cómo ver el mundo y la sociedad específica en la cual se trabaja. En lugar de los antagonismos que fueron claramente vinculados a las luchas de clases, talvez se pueda diseñar una sociedad de cooperación y de integración entre sus agentes. Se sugiere que las dificultades de la cadena productiva del arroz sean superadas a través de un proceso que se inicia con la convicción de que la producción de un bien básico para la población es importante, pero es un negocio que solo sobrevivirá se llega a ser rentable para todos, si los factores de producción son utilizados en su potencialidad máxima para reducir la agresión ambiental y alcanzar sistemas integrados y auto-sostenidos ambiental y socialmente, en lo que se incluye una administración capaz que lleve en cuenta todas las etapas de la financiación, de la producción, de la comercialización y del uso de los excedentes.

RICE GENOME, BEYOND THE GENE MAPS
GENOMA DEL ARROZ, MÁS ALLÁ DE LOS MAPAS GENÉTICOS
Coordinators / Coordinadores: Fabián Capdevielle (INIA) - Susan McCouch (Cornell University)

PROGRESSES OF THE CHINESE SUPERHYBRID RICE GENOME PROJECT (CSRGP) AND GENE EXPRESSION STUDIES

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CSRGP has entered its second phase, to refine the gene-centric sequence map and to develop gene arrays for gene expression studies. We have re-assembled the sequence of the rice genomes from both *indica* and *japonica* subspecies, which is estimated to cover over 97% of the rice genes. Nearly 94% of such sequences have achieved 99.99% basepair accuracy and the gene map is being improved constantly by adding supplementary new sequence data from PCR products and ends of large-insert genomic clones. With vigorous finishing strategies and gene-identification software development, we are able to evaluate the DNA composition dynamics and nucleotide diversity of the rice genes and to define most of the genes as well as their chromosome locations and unique sequence signatures. The second goal of the project is to develop a genome-wide, gene-based microarray system for expression studies. In this exercise, we have gone through a few generations of chip designs with a goal toward which we produce both an all-purpose array system and subsets of specific genes, using synthesized oligonucleotides. Proteomics data are also incorporated to verify gene expression profiles discovered.

T-DNA INSERTIONAL MUTAGENESIS FOR ACTIVATION-TAGGING IN RICE

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We have developed a new T-DNA tagging vector, pGA2715, which can be used for both trapping and activation-tagging of rice genes. The binary vector contains the promoterless *glucuronidase* (*GUS*) reporter gene next to the right border. In addition, the multimerized transcriptional enhancers from the cauliflower mosaic virus (CaMV) 35S promoter are located next to the left border. A total of 13,450 T-DNA insertional lines have been generated using pGA2715. Histochemical GUS assay has revealed that the GUS-staining frequency from those lines is about twice as high as that from lines transformed with binary vector pGA2707, which lacks the enhancer element. This result suggests that the enhancer sequence present in the T-DNA improves GUS-tagging efficiency. RT-PCR analysis of a subset of randomly selected pGA2715 lines has shown that expression of the genes immediately adjacent to the inserted enhancer is increased significantly. Therefore, we suggest that the large population of T-DNA-tagged lines transformed with pGA2715 could be used for trapping a gene using the *gus* reporter, as well as for isolating gain-of-function mutants.

Key Words: Activation tagging, insertional mutagenesis, T-DNA, japonica rice

NEW HORIZONS IN RICE QUALITY AND PROCESSING
NUEVOS HORIZONTES EN CALIDAD Y PROCESAMIENTO DE ARROZ
***Coordinator* / Coordinador: Alberto Varela, LATU**

NOVEL RICE PROCESSING TECHNOLOGIES: AN ENVIRONMENTALLY FRIENDLY WAY

Harmeet S. Guraya[1,2], Charles James[1] and Elaine T. Champagne[1],
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Consumption of brown rice is extremely valuable to health. The bran fraction accounts for 5-8% of the brown rice weight and is the most nutritious part of the seed. The problem is that brown rice takes long time to cook (40-45 min), due to slow rate of hydration. This long cooking time produces sticky, soft texture on the surface unlike white rice. Consequently, the consumption of brown rice has been significantly limited in the United States. A novel process for increasing the rate of hydration of food crop seeds without loss of the nutritious and beneficial portions of the seeds has been discovered. In this process, rice is bombarded with rice flour sufficient to create microperforations in the water resistant outer coat of the seed. These microperforations in the treated rice significantly increase the rate of hydration and hence decrease cooking time to about 15 min. A patent has been filed and the technology has been licensed to several U.S. companies.
A new environmentally friendly process for manufacture of rice starch was developed. Rice starch (<0.5% protein) is not manufactured in the US. It is primarily being imported from Europe. In a recent development in our lab, starch-protein agglomerates of rice are physically disrupted in presence of water by use of high pressure homogenizer called microfluidizer® followed by density base separation. This process is licensed and currently being scaled up for commercialization by Sage V Foods from California. The history of development, problems and current status of these two technologies will be discussed.

APPLYING GLASS TRANSITION PRINCIPLES TO BETTER UNDERSTAND RICE QUALITY REDUCTION DURING DRYING

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In this presentation, a property commonly used in polymer chemistry, the glass transition temperature (Tg), is introduced as the basis of a hypothesis explaining rice kernel drying behavior and fissure occurrence during the drying process. Glass transition data obtained from tests conducted in the University of Arkansas Rice Processing Program labs on both long- and medium-grain cultivars are presented. This data shows an inverse, linear relationship between Tg and kernel moisture content in the moisture content range of approximately 8 to 25%w.b. Based on this relationship, a hypothesis is presented that postulates the scenarios under which a kernel could fissure during the drying process. Current research in our program is outlined that is furthering this concept. In the field, a commercial-scale, cross-flow drier has been instrumented in a novel approach to enable measurement of air temperature and relative humidity, as well as rice moisture content and quality, at various elevations and cross-sections within the grain column. This data indicates large gradients in temperature, relative humidity, and moisture content from the heated air plenum to the exhaust sides of the grain column. In the laboratory, tests are simulating conditions observed in the commercial-scale drier. These tests have shown the harmful effects of drying for extended periods of time without subsequent tempering under proper conditions, as is explained by the Tg hypothesis. Another laboratory study is described in which a video microscopy system has been assembled that allows observation of fissures during their formation in brown rice kernels. In conjunction with this video system, a chamber has been built that allows air temperature and relative humidity around kernels to be controlled, thus allowing direct observation of fissure occurrence under various scenarios. Observations of fissure development are presented.

THE MODERN RICE MILL AS THE CENTER OF A RICE BIO-REFINERY

N. Bond

As competition increases and margins shrink for commodity millers, the industry needs to redefine the role of the mill. The mill is not to be seen as producing only a "commodity", but several products that can be "refined" from the raw materials and by-products associated with rice milling. At the same time, the mill itself, the center of this "bio-refinery" must change in order to profitably provide the volume that supports the refinery process.

EL MOLINO COMO CENTRO DE LA BIO-REFINERÍA DEL ARROZ

N. Bond

Asi como aumenta la competencia, y los margenes para las comodities se reducen, la industria necesita redefinir el rol de su molino. Este molino no debe ser visto solo como productor de commodities, sino de varios productos "refinados" de la materia prima y los sub-productos asociados al procesamiento de arroz. Al mismo tiempo, el molino mismo, el centro de esa bio refinería, debe cambiar para suministrar en forma beneficiosas el volumen que se necesita para el proceso de refinería.

AGRONOMIC CHALLENGES OF PRODUCING PREMIUM QUALITY RICE

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Quality is based on a combination of subjective and objective factors. California growers are interested in producing high quality varieties of rice for export and domestic specialty rice markets that have rigorous quality standards. To meet this challenge, the impact of on-farm practices on grain quality must be understood. The objectives were to study the effects of agronomic practices on the physicochemical properties of rice. The paper is a case study highlighting critical on-farm practices required to meet the quality standards for the Japanese market. A series of experiments were conducted. The Japanese variety, Akitakomachi, was grown at N rates ranging from 0 to 100 kg/h applied as a preplant or split application at different growth stages. Productivity and chemical properties related to quality were evaluated. Akitakomachi was harvested at different moisture contents (MC; 20%, 22% and 24%) and dried with combinations of heated and ambient air (24 C, 32 C, and 45 C) to evaluate surface fissuring. Incubation studies to simulate the time from harvester to dryer (1 to 24 hours) were conducted to evaluate off-odor development. The 90 kg/ha treatment applied at preplant produced the highest yields, while the 60 kg/ha as a split application produced the highest taste scores. Yield was highest when tissue N levels were 2.8% at PI. MC above 24% resulted in undesirable protein levels and below produced high rates of fissuring. Periods of longer than 8 hours between harvest and aeration resulted in increased fissuring and off-odors. Results indicate that rice quality is affected by production practices at several points in the growing season. Modifications to conventional practices are needed to produce rice with the desired quality characteristics for the Japanese market.
Keywords: nitrogen, quality, specialty rice

COLD TOLERANCE
TOLERANCIA A FRÍO
Coordinators / Coordinadores: Pedro Blanco (INIA) - Kazutoshi Okuno (NARCH)

CHILLING INJURIES IN REPRODUCTIVE PHASE OF RICE PLANTS

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In a northern part of Japan, cool weather damage to rice plants has occurred over 25 times during the past 100 years (once every 4 years on an average). Especially, rice production at Hokkaido in 1993 was only 40 % of average value, a once-in-a-century, and the total loss amounted one billion US dollars in 135,000 ha paddy field .
The damage is of two types, delayed-growth and floral-sterile type. The former is that the growth and grain development is delayed by coolness from young seedling to ripening. The latter is that the sterility is induced by coolness at booting and flowering stages. Out of these damages, the floral sterility at booting stage is one of the severe disaster, because the protected seedlings to coolness are raised in transplanting cultivation and the severe damage to coolness is larger than that at vegetative stage.
At booting stage, the most sensitive one to coolness is young microspore stage (tetrad to early microspore phase). The cool tolerance is highly correlated to number of pollen grains of anther sampled just before flowering in the control plant (not cooled). Furthermore, number of pollen
grains per anther is highly correlated to anther length. Namely, anther length can be used as simple and convinent method to estimate and select the cool tolerant varieties at booting stage.
A physiological mechanism of the cool weather damage at booting stage and its countermeasure are discussed at point of view of pollen number and anther length.

FUNCTIONAL GENOMICS OF COLD TOLERANCE IN RICE

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Low temperature is the most serious cause among all meteorological damages to rice seedlings and plants in northern part of Japan. In the past 120 years, cool-weather damage has taken place a total of 29 times or once every 4 year. The frequency has been unchanged since 1880s. The difference in yield between ordinary years and cool-weather years is about 100kg/10a and is almost constant in the past 120 years. The ratio of the average yield in cool-weather years to that in normal years has increased from less than 50% to 80% by breeding efforts and improved technology. However, cool summer in 1993 unexpectedly occurred more than 60% loss of yield in usual years. Improvement of cold tolerance is always a main objective in rice breeding and production in Hokkaido. Since 1970s, genetics and breeding research of cold tolerance in rice has been undertaken to incorporate higher level of cold tolerance of foreign germplasm into Japanese elite cultivars. A few genes controlling higher level of the tolerance were statistically estimated but their chromosomal locations were not identified by conventional genetic analysis.
Since 1990s, rice genome research has provided diverse tools for the identification of quantitative trait loci (QTL) controlling cold tolerance of rice, isolation of the QTL and associated genes with cold tolerance and analysis of biological and physiological functions of these QTL and genes. Analysis of QTL controlling cold tolerance at a reproductive stage and positional cloning of each QTL, moderate low-temperature signaling pathway and biotechnology research on tolerance to cold stress will be discussed.

REDUCING COLD DAMAGE IN AUSTRALIA

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In Australia, rice is a highly productive crop as the entire crop is irrigated, solar radiation levels are high and there are no major pests and diseases. However, in some years low temperatures during the vegetative and reproductive stage lead have reduced N status and induced male sterility. Low temperatures between late January and early February coincide with the development of young microspores and this has led to a reduction of industry yields in Australia by up to 25% in extreme years. Cultivars from throughout the world have been tested in a range of facilities in Australia for cold tolerance during reproductive development. Temperature-controlled environments, cool water and sequentially sown field trials are now successfully identifying cold tolerant cultivars. Incorporating cold tolerant genes from cultivars originating from cooler climates is one strategy to increase the cold tolerance of commercial cultivars. Large anthers containing many pollen grains and large stigma size may be important flowering characteristics of cold tolerant rice cultivars. A second strategy to reduce cold damage is to increase the photoperiod sensitivity of Australia's rice cultivars. This provides more flexibility in planting time and is one way to possibly minimise the exposure of the rice crop to low temperatures during reproductive development. Australia's rice farmers currently have four strategies to reduce the occurrence of low temperature damage. Firstly, the planting of appropriate cold tolerant cultivars. Second is sown at a time that ensures reproductive development occurs when the night temperatures are historically the warmest. Thirdly, good N management to increase yields but not excessive N application that increases the susceptibility of cultivars to low temperatures during cool reproductive temperatures. Finally, depth of irrigation water is increased during reproductive development to protect the developing panicle from cool night temperatures. Reducing the impact of cold damage in Australia through the development of cold tolerant cultivars and cultural techniques can increase productivity and sustainability through increased water use efficiency.
Keywords: Australia, cold, tolerance, screening, rice.

ORAL COMMUNICATION AND POSTERS

ORALES Y CARTELES

001

PARTIAL RESISTANCE OF IRANIAN RICE GERMPLAST TO RICE BLAST DISEASE

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Blast, caused by Pyricularia grisea Sacc., is often an important constraint in the production of rice in temperate and tropical areas. It is also very important in Iran. To study components of partial resistance in some Iranian rice cultivars Anbarboo, Tarom mahalli, Domsiah, Nemat and Neda along with IR64, Moroberekan, San Huang Zhan-2, Co39 and Vandana from IRRI but different origins, were tested in greenhouse experiments and in an upland nursery experiment at IRRI, Philippines. The experiment was conducted in a Randomized Complete Block Design (RCBD) with three replications. Traits in this study were infection type(IT), lesion number (LN), lesion size (LS, mm2), percent diseased leaf area (DLA, or disease severity %), latent period (LP,day), and sporulation capacity (SC, spore/gram fresh wieght). Results showed that, the cultivars differed significantly for IT, LN, DLA, LP and SC. Nemat , Neda and Co39 had high rates of all traits and showed susceptible reaction. For these traits, IR64 and Vandana, two indica type cultivars, were intermediate and were considered as partially resistant cultivars. Anbarboo, Tarom mahalli, Domsiah, Moroberekan and San Huang Zhan-2 were resistant to single blast isolates in greenhouse and field races of blast. Using the area under disease progress curves as a measure of relative disease progress in the nursery disease development on Anbarboo, Tarom mahalli, Domsiah, and San Huang Zhan-2 was slight, on IR64 was intermediate and on Nemat, Neda and Co39 was high. There was good consistency between greenhouse and field results.We found that there was strong host-pathogen specificity in the germplasm under study and for achieving of durable resistance, cultivars with partial resistance is preferred.

009

RAPDS MARKER ANALYSES OF CULTIVARS AND STABILIZED LINES OF RICE (*ORYZA SATIVA* L).

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The description of cultivars has been based, initially, on the scoring of morphological and physiological characters. The analyses of cultivars with DNA methods have become a powerful tool for this purpose. Because of its simplicity, RAPDs markers have been used extensively for cultivars identification and phylogenetic analysis. A set of 16 arbitrary 10-mer primers was utilized to characterize eight cultivars and two stabilized lines of rice (*Oryza sativa* L). The reproducible bands of 11 primers were considered in the analysis. The number of bands for each primer varied from one (only one primer) to nine, with an average of six bands per primer. The size of amplified fragments ranged from 1700 bp to 320 bp. Among the 77 bands analyzed, 45 (58,4 %) were polymorphic. The data of all genotypes were utilized to generate Nei's similarity coefficients. These genotypes displayed a range of similarity indices between 0 and 0,56. The dendrogram (UPGMA cluster method) showed the separation between american genotypes and genotypes with tropical origin. Eight genotypes could be clearly identified from the set of varieties and lines using nine primers. RAPDs markers are a useful tool for reliable identification of samples, and analysis of genetic variation or relationship, under strict control of experimental conditions.

Key Words: RAPDs; molecular markers; rice; identification

009

ANÁLISIS DE CULTIVARES Y LÍNEAS ESTABILIZADAS DE ARROZ (*ORYZA SATIVA* L.) MEDIANTE MARCADORES RAPDS.

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La descripción de cultivares se basó, inicialmente, en la evaluación de caracteres morfológicos y fisiológicos. El análisis a nivel de ADN se ha convertido en una poderosa herramienta para este propósito. Por su simplicidad, los marcadores RAPDs han sido ampliamente usados en la identificación de cultivares y análisis filogenéticos. Un set de 16 primers arbitrarios de 10 bases fueron utilizados para caracterizar ocho cultivares y dos líneas estabilizadas de arroz (Oryza sativa L.). Las bandas reproducibles de 11 primers fueron utilizadas en el análisis. El número de bandas por primer varió entre uno (un solo primer) y nueve, con un promedio de seis bandas por primer. El tamaño de los fragmentos amplificados estuvo en un rango de 1700 pb y 320 pb. Sobre un total de 77 bandas analizadas, 45 (58,4 %) fueron polimórficas. Los datos de todos los genotipos fueron utilizados para generar índices de similitud genética de Nei. Los genotipos presentaron un rango de índices de similitud entre 0 y 0,56. El dendograma (método de agrupamiento UPGMA) mostró la separación entre genotipos americanos y genotipos de origen tropical Ocho genotipos pueden ser inequívocamente identificados del total de variedades y líneas utilizando nueve primers. Los marcadores RAPDs resultan una herramienta útil para la identificación de muestras y el análisis de variación y relaciones genéticas, bajo estricto control de las condiciones experimentales.

Palabras Claves: RAPDs; marcadores moleculares; arroz; identificación

010

INTROGRESSION OF DISEASE RESISTANCE FROM WILD RICE SPECIES INTO U.S. CULTIVATED RICE

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Wild rice species (Oryza spp.) are an important source of novel genes for cultivated rice (O. sativa L.) improvement. Sheath blight (Rhizoctonia solani Kühn) and blast (Pyricularia grisea Cav.) are the two major rice diseases in the USA. Approximately 55 Oryza spp. accessions representing O. alta, O. australiensis, O. barthii, O. glumaepatula, O. latifolia, O. meridionalis, O. nivara, O. officinalis and O. rufipogon are being evaluated for resistance to sheath blight and blast. Thirty of these accessions have been backcrossed to one or more of the following US cultivars: Bengal a medium grain developed by Louisiana, Ahrent a long grain developed by Arkansas, and M-201 a medium grain developed by California. Twenty-eight accessions and their available backcross progeny were tested for resistance to sheath blight isolate (95KBNT) and eight blast races (isolate), IB-1 (Zn15), IB-33, IB-49 (Zn51), IB-54, IC-17 (Zn48), IE-1K (Zn19), IG-1 (Zn39) and IH-1, which represent the endemic US blast population. An additional 30 Oryza spp. accessions are being tested for resistance to sheath blight and blast. Also, three sheath blight isolates collected more recently are being tested. The sheath blight resistance reported in the first 28 accessions was confirmed utilizing a growth chamber technique and O. nivara and O. rufipogon accessions were identified which had some blast resistance. Introgression of the Oryza sp. chromatin into the cultivated parent is being confirmed with microsatellite markers. Thirteen accessions have been crossed to the BC3 generation.

014

ASSOCIATION BETWEEN GRAIN FILLING RATE AND DURATION WITH PHYSIOLOGICAL TRAITS AND YIELD COMPONENTS IN RICE *(ORYZA SATIVA L.)*

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Association between grain filling rate and duration with physiological traits and yield components of rice investigated in 90 genotypes during the growing season of 2001-2002 at Rice Research Institute of Iran (RRII),Rasht-Iran.
Tagged panicles harvested with 3 day intervals and the major physiological traits (leaf area, flag leaf angle, specific leaf weight(SLW),leaf chlorophyll content, plant height, panicle length) were measured during the grain filling period.
A cubic polynomial model used to fit the grain dry weight data (R^2>0.94 for all genotypes) and the grain filling rate and duration were estimated for the genotypes. Correlation between the grain filling parameters with yield components showed that the grain filling rate was clearly distinct in comparison with filling duration in this experiment. Grain filling rate had a positive and highly significant correlation
with 100-grain weight and grain size and a negative correlation with grain number per panicle. Grain size had a major role in filling rate than the grain number per panicle , in addition there was a considerable correlation between physiological traits with grain filling parameters and yield components. According to stepwise regression analysis for grain filling rate, three major traits (maximum grain weight, grain
filling duration and flag leaf angle) were chose among other traits and the coefficient of determination was 99%.
Key Words: Rice, Filling rate, Filling duration

020

AVANCES EN MEJORAMIENTO GENÉTICO DE ARROZ POR RESISTENCIA A *PYRICULARIA GRISEA*

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Técnicas moleculares han sido usadas para la caracterización molecular de poblaciones de Pyricularia grisea, agente causal del quemado del arroz. La información generada puede ser usada para monitorear la enfermedad, dinámica y composición racial de la población y el mejoramiento para resistencia durable.
Secuencias repetitivas de ADN (MGR), usadas en RFPL-fingerprintig, agrupan aislamientos individuales en linajes genéticamente relacionados. Patrones de DNA-fingerprinting fueron generados a partir de 128 aislamientos monoconidio recolectados en Brazil, Argentina y Uruguay sobre cultivares y líneas durante el período 1997-2001.Siete linajes fueron identificados, A, B, C, D, E, F y G, siendo A y B los de mayor frecuencia. Los aislamientos clasificados como B fueron encontrados predominantemente sobre variedades de origen tropical japonica.
Los patrones de aislamientos originados de EL Paso 144 y otros cultivares relacionados de origen indica fueron clasificados como linaje A. Las comparaciones realizadas con otros patrones de aislamientos obtenidos en Latinoamérica muestran alta similitud entre este linaje y un linaje identificado en Colombia para el cual se conoce una fuente de incompatibilidad. La variedad Yashiro mochi sería la fuente de incompatibilidad (gen de resistencia Pi-ta). Las variedades El Paso 144 y Yashiro mochi inoculadas con aislamientos del linaje A, mostraron reacción de susceptibilidad y resistencia, respectivamente. Esto sugeriría que el gen Pi-ta podría ser utilizado para incorporar resistencia en El Paso 144. Poblaciones F^2 y R^1 del cruzamiento El Paso 144 x Yashiro mochi son evaluadas por resistencia a aislamientos del linaje A.
Palabras Claves / Key Words: MGR-fingerprinting; Pyricularia; resistencia; mejoramiento.

020

ADVANCES IN BREEDING FOR RESISTANCE TO PYRICULARIA GRISEA

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Molecular tools have been used for characterization of *Pyricularia grisea* populations, causal agent of rice blast. The information generated can be used to monitor disease, population dynamic, racial composition of pathogen populations and breeding for durable resistance. Repetitive DNA sequences (MGR), used to RFLP-fingerprinting, clusters individual isolates into lineages genetically related. DNA fingerprinting patterns were generated from 128 monoconidial isolates collected in Brazil, Argentina and Uruguay on cultivars and breeding lines during the period 1997-2001. Seven lineages were identified, A, B, C, D, E, F and G, being A and B the most frequently found. The isolates classified B, were originated, predominantly, on cultivars of tropical *japonica* origin. The patterns of isolates originated on El Paso 144 and other cultivars closely related to *indica* origin, were classified as lineage A. Comparisons made with other isolates fingerprints from Latin America showed high similarity between this lineage (A) and a lineage from Colombia, for which a source of incompatibility is known. The variety Yashiro mochi could be the source of incompatibility (resistance gene Pi-ta). The varieties El Paso 144 and Yahiro mochi inoculated with isolates of lineage A showed reactions of susceptibility and resistance respectively. This would suggest that Pi-ta gene could be utilized to incorporate blast resistance in El Paso 144. F^2 and BC^1 populations of the cross El Paso 144 x Yashiro mochi are evaluated for resistance to isolates of lineage A.
Palabras Claves / Key Words: MGR-fingerprinting; Pyricularia; resistance; breeding.

026

CHARACTERIZATION OF MUTANTS OF RICE (*Oryza sativa* L.) TOLERANTS TO LOW TEMPERATURES IN THE SEEDLING STAGE.

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In this paper is showed the characterization of 22 mutants of rice with tolerance to low temperatures in the seedling stage. The days to harvest in the mutants were similar in both, dry and wet season with differences between 6 and 13 days, while in the parent variety the difference was 31 days. In the dry season the variety J104 yielded more than all the mutants but in the wet season several mutants showed a good behavior. We found that 13 mutants presented resistance to *Tagosodes orizicolus* Muir and to Hoja Blanca virus. We observed many differences in relation to grain characters like thickness, translucency and percentage of head rice. All the mutants presented better behavior than the parent for increase in weight and volume of cooked rice, but only four of them showed good cooked quality.
Key words: Cuba, mutants, Oryza sativa Lin., resistance, rice.

026

CARACTERIZACIÓN DE MUTANTES DE ARROZ (*Oryza sativa* L.) TOLERANTES A LAS BAJAS TEMPERATURAS EN FASE DE PLANTULA.

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En el presente artículo se muestra la caracterización realizada a 22 mutantes de la variedad J104 con tolerancia a las bajas temperaturas en fase de plántula. Los mutantes mostraron un ciclo similar en las dos campañas de siembra con diferencias entre 6 y 13 días, mientras que en la variedad parental la diferencia fue de 31 días. En cuanto al rendimiento agrícola la variedad J104 mostró un rendimiento superior a todos los mutantes en la campaña seca, sin embargo en la campaña húmeda varios mutantes presentaron un comportamiento similar o superior a la variedad parental. Encontramos que 13 mutantes mostraron resistencia combinada al insecto *Tagosodes orizicolus* Muir y al virus de la Hoja Blanca. En relación a las características del grano se apreciaron diferencias bien marcadas en cuanto a grosor, cristalinidad y rendimiento industrial expresado como porcentaje de granos blancos enteros. Todos los mutantes presentaron mejor comportamiento que la variedad J104 para el incremento en peso y volumen del arroz cocinado, pero mostraron valores de álcali por encima de 4. En cuanto a la calidad de cocción solo 4 mutantes fueron superiores a la variedad parental.
Palabras claves: arroz, Cuba, mutantes, Oryza sativa Lin., resistencia.

027

IMPACTO DEL PROGRAMA DE MEJORAMIENTO EN LA TRANSFORMACIÓN DE LA ESTRUCTURA VARIETAL DEL CULTIVO DEL ARROZ EN CUBA.

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El cultivo del arroz fue establecido en Cuba alrededor del año 1750, pero el mismo alcanzó importancia económica en la segunda mitad del siglo XX, cuando fueron introducidas en el país algunas variedades norteamericanas, como Blue Bonnet 50 y Century Patna 231. Estos cultivares por ser de porte alto mostraron susceptibilidad al acamado y poca resistencia a enfermedades, por lo cuál fueron sustituidas por variedades de tipo índicas mejoradas, procedentes del Instituto Internacional de Investigaciones del Arroz (IRRI), en Filipinas y del Centro Internacional de Agricultura Tropical (CIAT) en Colombia. Las variedades semienanas presentaron alto potencial de rendimiento y alta respuesta a la fertilización nitrogenada. En este reporte también son mostrados los principales objetivos del programa de mejoramiento y los principales resultados en cuanto a cruzamientos realizados, introducción de germoplasma y obtención de nuevas variedades.
Palabras claves: arroz, Oryza sativa Lin., variedades semienanas, variedades altas.

027

IMPACT OF THE BREEDING PROGRAM IN THE TRANSFORMATION OF THE VARIETAL STRUCTURE IN THE RICE CROP IN CUBA.

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The rice crop was established in Cuba about 1750, but the cultivation reached a really economic importance during the second half of the 20th Century, when were introduced in the country some varieties, as Blue Bonnet 50 and Century Patna 231, from United States. These cultivars are tall and showed susceptibility to lodging as well as to several diseases, for that reason they were substituted by indica semidwarf varieties originated at the International Rice Research Institute (IRRI) in Philippines and in the International Center for Tropical Agriculture (CIAT) in Colombia. The indica semidwarf varieties presented high yield potential and high response to nitrogen. In this report are showed the main objectives of the rice breeding program and the major advances in relation to cross, introduction of new accessions and obtention of new varieties for cultivation in different conditions.
Key words: Oryza sativa Lin, rice semidwarf varieties, tall varieties.

029

GENETIC RELATIONSHIP AMONG ITALIAN RICE CULTIVARS AS DETERMINED BY AFLP AND SSR

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Cultivated rice has a great importance for European economy and Italy is the main rice producing country in Europe with 1.272.000 t of paddy production (2001 data). Breeding programs produced a large number of new varieties while some typical Italian old varieties are still grown on large areas. It causes a total of 126 registered cultivars in 2001. However precise genetic information on Italian rice germoplasm is lacking. Up to now breeding programs have been based on morphological characters, quality parameters and on incomplete or uncertain pedigree. A study on genetic relationship among 96 Italian rice cultivars by molecular markers is running, using AFLP and SSR. With 15 AFLP primers combination we produced 248 polymorphic bands out of 461(polymorphisms=53%; PIC=0.20); with 12 SSR we obtained 86 polymorphic bands (PIC=0.74). The binary matrix was analyzed to obtain a similarity matrix and UPGMA-dendrograms. Both the marker systems agree in splitting the Italian varieties in two main clusters: the first includes old local cultivars and derived ones, the second includes exotic cultivars introduced in Italy; moreover the two main clusters are split in subclusters based on their relationship.This work is the first effort to clarify the real genetic relationship among Italian rice cultivars. The results obtained will be of help for breeders and seed companies for variety identification, intellectual property protection and marker assisted selection.
Keywords: AFLP; SSR; rice; Italian cultivars; genetic variability
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033

GENE EFFECTS AND COMBINING ABILITY OF GRAIN QUALITY OF RICE (*ORYZA SATIVA)*

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Rice cooking quality is one of the important characteristics of rice varieties and is a restricting factor in rice breeding in Iran .Therefore ,any knowledge that can be gained on the genetic mechanism of cooking quality traits will be helpful in improving the breeding efficiency of *indica* rice.Diallel crosses used for estimate gens effect and combining ability of traits.Eating quality is directly related to three attributes of the physical and chemical characteristics of the starch in the endosperm;amly,amylose content,gel consistency,gelatinization temperature and grain length to width ratio.Eight Iranian and exotic rice cultivars were crossed in a half-diallel crossing system in year 2000. In following year, parental lines and progenies were sown in a Randomized Complete Blocks Design with three replications.The quantitative triats of rice cooking quality evaluated were amylose content(AC)by method of Perez and Juliana(1978), el consistency(GC)by the procedure of Cagampang et al.(1973), gelatinization temperature(GT)by the method of Little et al.(1958).Data of parent and progenis analyzed by method Haymen(1953) and Griffing (1956).Analyse of variance showed that differences due to genotypes and general and specific combining abilities were significant, indicating the presence of additive and non-additive variance. Relative amount of each type of variance with respect to each trait however, was not the same resulting in different heritability estimates.
Presence of addetive effect in genetic control of amylose content, gel onsistency, gelatinization temperature and grain length to width ratio.For example there is good chance for a successful selection for amylose content with heritability of 84% ,gel consistency 75%, gelatinization temperature80% , grain length to width ratio 60%.Dominant genes increase, amylose content but, decrease gel consistency, gelatinization temperature , grain length to width ratio. The predicated genetic effects indicated that some parents than better the others in improving the rice cooking quality traits of the prigenies.

070

IMPROVEMENT OF CALLUS INDUCTION IN RICE MICROSPORE CULTURE

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Isolated microspore culture is potentially the most effective system for the production of haploid plants for various applications in breeding programs and genetic research. In rice, isolated microspore culture has been successfully applied to several local cultivars. The main methods reported for the isolation of microspores are anther pre-culture, magnet bar stirring and squeezing; however these are low efficiency and time consuming. Our research has focused on the development of a highly efficient method for the isolation of microspores from rice anthers, and to improve callus induction. Two international japonica rice varieties 'Taipai 309', and 'Hitomebore' were used in this work. Anthers were collected from cold pre-treated panicles in a 1.5ml micro tube with blending medium. A micro-blender was used to briefly blend anthers at a high speed. Released microspores were then recovered by filtration and centrifugation. Callus induction was initiated in a liquid CHB medium. In this work, we found that microblending provided a quick and efficient method for the isolation of microspores. The cold pre-treatment was necessary, and prolonged cold pre-treatments improved the culture response. CHB medium either with or without plant growth regulators gave a higher frequency of callus induction than either I_2 or N_6 medium. Regeneration of callus was poor, and this may be partially caused by the liquid culture. Significant improvements in callus regeneration are required before microblending can be established as a high efficiency system for rice microspore culture.
Key words: microspore culture, micro-blending, haploid, induction medium.

042

LOW TEMPERATURE STRESS-INDUCED GENE EXPRESSION IN RICE SEEDLINGS: TOOLS FOR TRANSCRIPTOME ANALYSIS

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Cold stress is a perennial problem that affects stand establishment and seedling vigor of rice. The cellular basis of adaptive response is very complex and defined by a network of biochemical processes encoded by quantitative trait loci. Our current research aims to define the molecular mechanism(s) and regulatory pathway(s) involved in the expression of seedling cold tolerance in rice through gene expression analysis at the semi-global scale. We used a selective cDNA sequencing approach by subtracted probe hydridization to develop >3,000 Expressed Sequence Tags (EST) from the cold tolerant genotype PI560247 at different stages of germination and early seedling growth at 13°C/10°C. High-density dot blot and northern blot analyses of representative ESTs confirmed that the library is enriched with low temperature stress responsive genes. Bioinformatic analysis showed that many of the cold responsive ESTs represent novel genes. Additionally, a large number of the cold responsive ESTs have known biochemical functions with possible roles in abiotic and biotic stress response signaling, activation of transcriptional machinery, ion homeostasis, prevention of cellular injury and stress detoxification mechanisms. Analysis of the japonica genomic regions corresponding to selected ESTs showed that the gene promoters contain several cis-activators of stress-related gene expression, including the DRE (Drought Responsive Element), ABRE (ABA Responsive Element), ocs-like element (oxidative stress responsive), W-box and Myb. Thus, the enriched EST library provides a powerful tool to elucidate the gene regulatory circuit involved in the responses of rice to low temperature, water deficit and osmotic stresses.
Keywords: cold stress, seedling vigor, Expressed Sequence Tags, transcriptome, promoter, cold-regulated (COR) genes

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RHICO A NEW RICE TYPE FOR CONFRONTING FOOD INSECURITY IN THE MOUNTAINS AND A NEW OPCION FOR TEMPLATE UPLAND RICE – FROM PARTICIPATORY RECURRENTE SELECTION TO MARKETTING

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In the Colombian Andes rice is the main part of the diary diet of the poor communities of mainly native Indians minorities. So it is important for the CIAT-CIRAD Collaborative Project to develop a new kind of rice, i.e. upland rice with cold tolerance, for confronting food insecurity in the mountains. A new participatory breeding scheme using recurrent population with narrow genetic base is proposed. It is made to allow selection for farmer and consumer preferences, for natural stresses like soil acidity, drought and cold, for high level of partial resistance to rice blast disease using new methods, and for resistance to others diseases. A participatory process of evaluation leaded to the obtaining of the varieties Cirad 446 and Cirad 447. They are the first upland varieties in America with earliness, high tolerance to cold, drought and soil acidity, and with a high level of partial resistance to blast. So they are the first varieties of a new type of Rice for Hillsides with Cold tolerance, named RHICO type. RHICO is a new crop in the mountains, so participatory studies for cropping systems management are carried out. The improvement of a manual huller prototype was carried out through participatory evaluations, and it is now commercially available. The small holders cannot compete to the great mills. So a marketing study is carried out to identify niches for special type of rice like organic brown rice. RHICO should be a very good opportunity for the development of upland rice in temperate areas.
Key words: Upland rice, new type, cold tolerance, blast resistence, participatory selection, recurrent selection, mountain, template area, food security.

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GENETIC DIVERGENCE BETWEEN GENOTYPES OF IRRIGATED RICE ESTIMATED THROUGH MICROSATELLITES

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Knowledge of the genetic variability of available germplasm is very important for the rice breeder to plan the crosses in order to develop new hybrids and cultivars. In this way, the present study was carried out to estimate the genetic similarity between irrigated rice genotypes through microsatellite molecular markers and identify markers capable of distinguishing indica and japonica subspecies. The 38 genotypes surveyed came from the Germplasm Bank of Instituto Rio Grandense do Arroz (IRGA), Rio Grande do Sul State, Brazil. At least one primer pair was used per chromosome. Seventy three alleles were amplified with the average of 5,61 alleles per loci. The genetic similarity average between all the genotypes was 0,25 " 0,20. Eighteen groups were formed, and from these 11 groups had indica genotypes and 7 groups japonica genotypes. The locus RM261 was capable of separating the indica and japonica subspecies. With the microsatellite molecular markers is possible to obtain high discrimination among the genotypes. The genetic variability was higher in the indica subspecies than in the japonica subspecies.
Key words: rice, genetic divergence, microsatellites.

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DIVERGÊNCIA GENÉTICA ENTRE GENÓTIPOS DE ARROZ IRRIGADO ESTIMADA ATRAVÉS DE MICROSSATÉLITES

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É importante o conhecimento da diversidade genética existente no germoplasma disponível, para que o melhorista possa planejar adequadamente os cruzamentos para o desenvolvimento de híbridos e cultivares. Neste sentido, o presente trabalho objetivou estimar o grau de similaridade genética entre genótipos de arroz irrigado através de marcadores moleculares de microssatélites e identificar marcadores moleculares capazes de distinguir as subespécies índica e japônica de arroz. Os 38 genótipos utilizados foram provenientes do banco de germoplasma do Programa de Melhoramento do Instituto Rio Grandense do Arroz (IRGA), Rio Grande do Sul, Brazil. Para se obter uma amostra representativa do genoma, utilizou-se pelo menos um *primer* por cromossomo. Foram detectados 73 alelos com média de 5,61 alelos por loco. A similaridade genética média obtida entre os genótipos foi de 0,25 ± 0,20. Foram formados 18 grupos, sendo 11 constituídos por genótipos índica e 7 por genótipos japônica. A separação entre os genótipos das subespécies índica e japônica foi obtida com o loco RM261. Com os marcadores moleculares de microssatélites é possível obter-se boa discriminação entre os genótipos. A maior divergência genética ocorre entre genótipos da subespécie índica do que com genótipos da subespécie japônica. O grupo de genótipos estudado o loco RM261 permitiu a separação das subespécies índica e japônica.
Palavras chave: arroz, divergência genética, microssatélites

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APPLICATION OF MOLECULAR MARKERS TO ASSIST ON RICE BREEDING AND RESISTANCE TO BLAST DISEASE.

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The general objective of this study was to characterize rice germplasm and *Pyricularia grisea* population in Argentina using molecular markers to assist on development of breeding strategies for blast resistance. The rice blast fungus, *P. girsea*, is the most widespread and damaging pathogen on cultivated rice. The pathogen is notorious for rapidly overcoming the resistance of new cultivars due its great pathogenic variation. Development of resistant varieties is the most appropriate strategy for disease control. An understanding of crop structure and pathogen genetic diversity are a very useful tool in rice breeding programs.
Seventy rice varieties of historical significance to rice breeding in Argentina were analyzed with microsatellite markers, which detected a high level of polymorphism in the analyzed germplasm. Each accession could be univocally distinguished with 8 appropriate microsatellites. Simultaneously, during the last two campaigns (2000-2001, 2001-2002) more than 100 isolates of *P. grisea* were collected from different rice varieties grown in Argentina. The isolates could be grouped in twelve haplotypes after DNA fingerprinting through rep-PCR analysis. Also pathogenic variability was carried out with a set of isolates using international differentials, source with known resistance and Argentinian varieties. At least three races were identified and different compatibility was observed on remaining varieties. These data provide basis for a study to determine the complete genetic and pathogenic structure of the *P. grisea* population and identify germplasm resistant to native *P. grisea* isolates.
Key words: breeding-microsatellites-*Pyricularia grisea*- resistance-rice germplasm.

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RP-HPLC IDENTIFICATION OF RICE VARIETIES.

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Chromatografic profiles have been used extensively in different species for variety identification. Rice varieties identificacion in Argentina has been based, mainly, on physical characters. The variety identification using glutelin chromatographic profiles shows better resolution than other proteins because they are the most abundant in the endosperm of rice (73-94%). The pattern obtained for each variety is usually consistent through the different environments and growth conditions.
The objective of this experience was to identify closely related genotypes and test its consistence through different environments. Four genotypes EP144, RP2, Don Juan INTA and Ant 4774 were grown in four different locations, Entre Ríos Sur, Entre Ríos Norte, Corrientes Centro y Corrientes Norte, and used for RP-HPLC determination.
Rice flour was first, lipid extracted and the glutelins obtained after removing albumins and globulins. The samples were run in a Hewlett Packard 1050 RP-HPLC and processed by the HPCHEM Station Serie 2 software.
The chromatografic profiles obtained allowed to truly identify all the genotypes in all environments tested. The absorbance pattern of each genotype was consistent through the localities in qualitative terms. Quantitative variations particularly of some of the protein components and of the total chromatographic area in different environments could be due to different growth conditions.

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CULTIVARES DE ARROZ IDENTIFICADOS POR RP-HPLC.
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Los perfiles cromatograficos han sido utilizados extensamente en diferentes especies para la identificación varietal. Las variedades de arroz en Argentina son identificadas por características físicas. La identificación de los cultivares utilizando el perfil cromatografico de glutelinas presenta una mejor resolución que con el resto de las proteínas, por ser las glutelinas las de mayor presencia en el endosperma de arroz.(73-94%). . La consistencia de los perfiles a través de diferentes ambientes permite tener un patrón de reconocimiento de cada genotipo independiente de las condiciones de crecimiento de los individuos.
El objetivo de este trabajo es identificar genotipos de arroz estrechamente emparentados y verificar que esos patrones de caracterización son consistentes en diferentes ambientes. Se utilizaron cuatro genotipos correspondiente a los cultivares EP 144, RP2, Don Juan INTA, Ant 4774 crecidos en cuatro ambientes diferentes Entre Ríos Sur, Entre Ríos Norte, Corrientes Centro y Corrientes Norte.
Las harinas de arroz fueron delipidadas, las albuminas y globulinas separadas para la extracción de glutelinas y luego de purificadas inyectadas en un RP-HPLC Hewlett Packard 1050 para su determinación y lectura por el software HPCHEM Station Serie 2.
Los cromatogramas obtenidos permiten identificar inequivocamente los cuatro genotipos en los cuatro ambientes. El patrón de absorbancia correspondiente a cada genotipo es consistente en los cuatro ambientes en términos cualitativos. Variaciones cuantitativas del área de los diferentes picos y/o del área total reflejan condiciones de crecimiento diferenciales propias de cada ambiente.

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STUDY OF CALLUS INDUCTION AND PLANT REGENERATION FROM IMMATURE EMBRYO CULTURE IN RICE CULTIVARS
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This study was conducted to evaluate the response of 18 rice (Oryza sativa L.) genotypes to callus induction and plant regeneration from immature embryo culture, using three media (MS, LS and N6). To evaluate callus induction rate, the following criteria were used: callus diameter, callus fresh weight and callus dry weight. Percentage of callus water content was also measured. After transferring the produced calli from the induction media to a regeneration medium (MSR), percentage of plant regeneration was evaluated. A highly significant difference was observed among genotypes for both callus induction and plant regeneration (P<0.01). In callus induction phase, "Nemat" and "Cheram-2" cultivars were superior for callus diameter, having 4.83 and 4.6 mm callus diameter, respectively. "Nemat" , "Cheram-2", "Sepidrood" and "Taroum" cultivars as well as "33IRCTN91" and "IRFAON-30" lines were significantly superior to other cultivars for callus fresh weight. Among the genotypes "Nemat", "Zayandehrood", "33IRCTN91" had the highest percentage of callus water contents. Based on plant regeneration, "33IRCTN91" line and "Anbarbo", "Nemat", "Cheram-2" and "Taroum" cultivars showed highest rate of plant regeneration from callus. Significant differences were observed among media. While MS and N6 media did not showed any significant differences for callus diameter, callus fresh weight and rate of plant regneration, they were superior to LS medium (P<0.01). According to percentage of callus water content, MS and LS media ranked the best and the most inferior medium, respectively. In the present study, MS and N6 media were considered as suitable in vitro culture media of rice immature embryos. Among genotypes, "Nemat" and "Cheram-2" cultivars were ranked the best for both callus induction and plant regeneration. Also, the used Japonica rice cultivars were superior for percentage of plant regeneration. The calculated correlation coefficients between traits showed a non-significant correlation between callus induction and plant regeneration, which, in turn, indicated that these traits were independent.
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EFFECT OF WATER STRESS ON SEED GERMINATION AND SEEDLING GROWTH OF RICE (ORYZA SATIVA L.) GENOTYPES
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An experiment was conducted to compare fifteen Lowland rice (*Oryza sativa* L.) genotypes for drought tolerance based on some physiological parameters in germination stage. Five levels of water stress (0, -3.0, -5.0, -7.5 and -10 bars) treatments were given with polyethylene glycol (PEG 6000). The water solutions were replaced with fresh solutions regularly. Percentage seed germination and seedling growth decreased with increasing water stress in all the genotypes. Among the genotypes, Tarom, Khazar, Fajr and Nemat recorded better germination and seedling growth in terms of radicle and plumule length under stress conditions than other genotypes.
Key words: Water Stress, Germination, Seedling Growth and Rice.

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ADVANCES IN POPULATONAL RICE BREEDING IN ARGENTINA
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The genetic improvement in Argentina begins during the decade of the 40, with selection of introduced materials and later on with the cruzamientos realization, mainly for the south region of the rice area. This process of improvement contributes to the development of the cultivation and its expansion. When was carried out the study of existent variability at the moment in the commercial varieties in current use and past was found that this was diminishing along the time and according to the regions. With the beginning of the works in recurrent selection in 1996, and the introduction of three basic populations PCT-6; PCT-7 and PCT-8 a solution process begins to the decrease of variability inside the varieties. It is selected as population more adapted to our conditions PCT-8, to which was introduced new variability for the creation of the population PARG-3\0\0\0 in CIAT, where one also carries out the first recombination of the same one. In 1998 populations of the program of improvement of Chile are introduced, looking for bigger adaptation to the requirements of the cultivation of rice of the country. Jointly with the evaluation of the populations was carried out the process of material extraction for the obtaining of stable lines. As a result of these works there are more than 150 lines in different stages in the selection process. For the PARG 3\0\0\1, the process of improvement of the same one is beginning with the selection and recombination of the best fertile lines.
Palabras Claves / Key Words: Mejoramiento Poblacional, variabilidad, Selección Recurrente

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AVANCES EN EL MEJORAMIENTO POBLACIONAL EN ARGENTINA

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La aparente estreches de la base genética provocada por los métodos convencionales de mejoramiento y las dificultades de obtención e intercambio de germoplasma han estimulado al programa Argentino a invertir en el mejoramiento Poblacional utilizando selección recurrente. En 1996 se inician tales actividades con la introducción de las poblaciones PCT-6; PCT-7 y PCT-8 desde el CIAT. Luego de las evaluaciones realizadas en Villaguay, Entre Ríos, el mejor comportamiento de la PCT-8 hizo que fuera escogida como base para la creación de una nueva población. Con las otras dos poblaciones, se crearon dos nuevas poblaciones sólo como fuente de variabilidad para el proceso convencional de mejoramiento (PARG-1 y PARG-2). Usando la segunda recombinación de la PCT-8 (PCT-8\0\0\2)como base e introduciendo nueva variabilidad con 6 variedades en uso en los programas de mejoramiento en Argentina se crea una tercer población PARG-3, para iniciar un programa de mejoramiento Poblacional. Las poblaciones PCT-8\0\0\2 y PARG-3\0\0\1 fueron caracterizadas durante la campaña 2001/02 en la facultad de Corrientes, para averiguar los cambios provocados por la introducción de las seis variedades seleccionadas por sus características a la PCT-8. Además de las evaluaciones de todas las poblaciones introducidas se realizó el proceso de extracción de material para la obtención de líneas. Como resultado de estos trabajos hay más de 150 líneas en diferentes etapas en el proceso de selección. Con la población PARG-3\0\0\1, se inició el proceso de mejoramiento de la misma.

Palabras Claves / Key Words: Mejoramiento Poblacional, variabilidad, Selección Recurrente

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RELATION BETWEEN LEAF AND NECK BLAST RESISTANCE IN ITALIAN RICE VARIETIES.

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Leaf blast and neck blast are caused by *Pyricularia grisea*, the most dangerous pathogen for rice in Italy. The diseases affect rice production both by an indirect way (reduction of photosynthetic tissue) and by a direct way (reduction of carbohydrates flow to grain). The most convenient system control the pathogen is to use resistant varieties. For this reason the breeding activity must evaluate, at different steps, the resistance to *P. grisea* of lines in selection. To rapidly evaluate the resistance to *P. grisea* a leaf blast nursery is usually set up, where natural infection is favoured. Unfortunately, in Italy, the main symptom is neck blast. Neck blast and leaf blast resistance are frequently considered closely related. The present work shows that the resistance to the two symptoms is not always related.

Key words: leaf blast, neck blast, *Pyricularia grisea*

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RICE PLANT TRAITS RELATED TO YIELDING ABILITY UNDER WATERGRASS (*Echinochloa phyllopogon*) COMPETITION IN CALIFORNIA'S TEMPERATE CONDITIONS. I. COMPONENTS OF RICE RESPONSE.

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Herbicide-resistant weeds and environmental regulations have reduced the chemical weed control options available to California rice farmers. Weed competitive and/or allelopathic cultivars should be part of an integrated weed management approach. We sought to identify the most relevant rice plant characteristics associated with its ability to tolerate weed competition. Glasshouse studies were conducted at Biggs, CA, during 2000 and 2001. Rice cultivars M-202 (strong competitor), A-301 (weak competitor) and six experimental lines derived from a M-202/O.nivara//M-202///M-202 cross. A factorial combination of cultivars (RC) (6 plants/pot) and weed competition regime (WCR) (0 and 2 *Echinochloa* plants/pot) was arranged in a randomized complete-block design with five replications. Data were subjected to path analysis. Under our experimental conditions plants competed strongly for soil resources Overall, yield was associated (R^2=0.765**) with rice biomass accumulation at heading (BiomHd) (path coefficient, p_{BiomHd} = 0.77**) and with harvest index (HI) (p_{HI} = 0.48**). However, weed competition significantly affected yield attainment. Thus, in competition, both components had significant and equivalent paths to explain yield (p_{BiomHd}=0.61** and p_{HI}=0.60***), but in monoculture these values were p_{BiomHd}=0.52** and p_{HI}=0.74***. Early watergrass growth was a good predictor of final yields under competition. WG biomass at 36 DAS had a negative path (-0.18**) to rice BiomHd, but a less (*P*=0.10) significant negative path to HI. These results suggest that the higher sensitivity of BiomHd to WG competition determine its relevance as a selection trait in breeding for enhanced rice performance under competition. Keywords: breeding, rice competitiveness, weed competition, competition tolerance, weed management.

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REGIONAL EVALUATION OF IMPROVED CLEARFIELD LINES OF IRRIGATED RICE (*Oryza sativa* L.) IN THE RIO GRANDE DO SUL STATE, BRAZIL, SEASON 2001/2002

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Instituto Rio Grandense do Arroz (IRGA) in technical cooperation with BASF, is developing new lines of irrigated rice with tolerance to the BAS68800H herbicide, which belongs to the Imidazolinone group, as an alternative to red rice control. The objective of this work was to evaluate new herbicide tolerant lines in five locals all over the Rio Grande do Sul State, Brazil. Eleven herbicide tolerant lines in the BC_5F_4 generation were evaluated. These lines came from a backcross program including the 93AS3510 line, which it is the herbicide tolerance gene donor, and IRGA 417 cultivar as the recurrent genitor. IRGA 417 cultivar was used as check in the trials. Statistical analysis showed significant interaction between genotypes and locals for the character grain yield. In the average, the grain yield was higher in Uruguaiana, with 12,694 kg ha^{-1}, and lower in Santa Vitória do Palmar, with 4,682 kg ha^{-1}. The majority of the new herbicide tolerant lines showed similar results to the check cultivar for all the others characteristics. Considering the results of the grouped analysis of the five locals the herbicide tolerant line IRGA 22-7 showed the best grain yield, with 9,171 kg ha^{-1}, while the IRGA 417 showed intermediate performance, with 8,914 kg ha^{-1}.

Key words: rice, red rice, herbicide tolerance.

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AVALIAÇÃO REGIONALIZADA DE LINHAGENS DE ARROZ IRRIGADO CLEARFIELD (Oryza sativa L.) NO RIO GRANDE DO SUL, BRAZIL, SAFRA 2001/2002.

LOPES, M. C. B.; ROSSO, A. F.; LOPES, S. I. G.; LIMA, A. L. L.; CORDERO, E. J.; BARROS, J. de A. I. de; LEAL, C. E.; WARKEN, F.; CREMONESI, J. L; NEVES, G. Instituto Rio Grandense do Arroz. Cachoeirinha. Brazil.

O Instituto Rio Grandense do Arroz (IRGA), em cooperação técnica com a BASF, está desenvolvendo genótipos de arroz irrigado tolerantes ao herbicida BAS68800H, do grupo das Imidazolinonas, como uma alternativa para o controle do arroz vermelho. O presente trabalho teve como objetivo avaliar as linhagens tolerantes ao herbicida em cinco locais no Estado do Rio Grande do Sul, Brazil. Foram utilizadas 11 linhagens tolerantes ao herbicida, originadas da geração RC5F4 de um programa de retrocruzamento, envolvendo a linhagem 93AS3510, como genitor doador do gene de tolerância ao herbicida, e a cultivar IRGA 417 como genitor recorrente. A cultivar IRGA 417 foi utilizada como testemunha. A análise da variância conjunta para o parâmetro rendimento de grãos, mostrou que houve efeito significativo para a interação entre os tratamentos e os locais. Na média, o rendimento de grãos foi superior em Uruguaiana, com 12.694 kg ha-1, e inferior em Santa Vitória do Palmar, com 4.682 kg ha-1. Para as demais características a maioria dos genótipos testados apresentaram resultados similares aos da testemunha. Entre as linhagens que apresentaram melhor desempenho em termos de rendimento de grãos, quando todos os locais foram analisados conjuntamente, destaca-se a linhagem IRGA 22-7, com rendimento médio de 9.171 kg ha-1 e a testemunha apresentou comportamento intermediário, com 8.914 kg ha-1.

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INFLUENCE OF DIFFERENT COLD TREATMENTS ON THE SPIKELET FERTILITY AND PANICLE EXSERTION OF FIVE RICE GENOTYPES DURING REPRODUCTIVE STAGE

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Chilling temperatures (below 20°C) when occurring in the reproductive stage of the rice crop decrease spikelet fertility and panicle exsertion, leading to yield loss. Knowing the influence of cold nights and of continuous cold on the spikelet fertility is important to check if different genotypes vary in their reactions to these cold treatments. The objective of this study was to evaluate the effects of four different cold treatments on the spikelet fertility and panicle exsertion of five rice genotypes. These were Caloro and Cypress (Japonica) and the Indicas El Paso 144, IRGA 418 and IRGA 420, grown in plastic pots of 500 mL containing soil and kept in the greenhouse. Cold treatments included low temperature (15°C) during microsporogenesis applied only at night or continuously, for the period of four days. The same was done during anthesis stage. Each treatment had three replications including a control which consisted of plants kept in the greenhouse. At maturity panicles were harvested and spikelet fertility and panicle exsertion determined. Analysis of variance showed significance of genotype and cold treatments effects. Cold decreased significantly panicle exsertion during the anthesis stage in all the genotypes. Caloro was the only one to present complete panicle exsertion in all the treatments, including the control. Percentage of fertility was significantly lower in the continuous cold treatments both at the microsporogenesis and anthesis compared to the ones applied only at night. Among the genotypes Caloro was the most tolerant one and IRGA 420 the most sensitive.

Key words: Cold temperature, microsporogenesis, anthesis, spikelet fertility, panicle exsertion.

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EVALUATION OF THE COLD TOLERANCE OF THE GENOTYPES OF THE INTERNATIONAL RICE COLD TOLERANCE NURSERY AT THE GERMINATION STAGE

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In Rio Grande do Sul, Southern Brazil, cold tolerance at the germination stage is desirable in order to get uniform emergence and a good establishment of the rice crop in early sowings. The objective of this study was to evaluate the genotypes of the International Rice Cold Tolerance Nursery (IRCTN) using the germination methodology applied in the Rice Breeding Program of IRGA in order to select the most cold tolerant ones under low temperature conditions. Fifty five genotypes of the IRCTN were evaluated together with two testers, Quilla 64117 (tolerant) and El Paso 227 (sensitive). The seeds were placed on folded filter papers in such a way that each fold contained ten seeds and corresponded to one replication. The seeds were moisturized with Benomyl solution (0,027%) and placed under two germination conditions: cold treatment (13°C for 30 days) and control (28°C for seven days). Two replications were used per genotype per treatment. At the end of each period, the seeds were evaluated as to coleoptile length and germination percentage. Analysis of variance with the original data and with the data converted to percentage of reduction in coleoptile length due to cold revealed significance of the genotype, treatment and interaction effects. Based on the percentage of reduction in coleoptile length, the genotypes could be divided into highly tolerant, tolerant, intermediate, sensitive and highly sensitive, showing variability for cold tolerance. Fourteen genotypes were superior to Quilla 64117 and should be a good source of genes for cold tolerance at the germination stage.

Key words: Cold tolerance, low temperature, germination, coleoptile length.

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GENETIC DIVERGENCE BETWEEN THE GENITORS OF RICE POPULATION CNA 11 DETERMINED THROUGH MICROSATELLITES AND ALLELIC FREQUENCIES IN THE $S_{0:2}$ FAMILIES

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Genetic variability is an essential condition to obtain genetic gains in plant breeding programs. Advance in molecular biology is allowing to associate DNA information with phenotypic data to measure genetic variability. The objectives of this study were to determine the genetic divergence between the parents of CNA 11 rice population, and to measure allelic frequency changes as the result of the selection process. DNA of CNA 11 genitors and of the 133 $S_{0:2}$ families was analyzed with microsatellites molecular markers. The genitors demonstrated a wide genetic variability. The average of genetic similarity estimated by Jaccard coefficient was 0,19 ‴ 0,15. Based on Jaccard's matrix coefficients the genotypes were classified into three groups, corresponding to the subspecies indica, tropical japonica, and temperate japonica. In the $S_{0:2}$ families molecular markers characteristics of indica genotypes had their allelic frequencies increased and, in the other way, the alleles of japonica genotypes decreased, as the selection intensity increased. The best $S_{0:2}$ families displayed higher genetic similarity with indica genitors of CNA 11 population.

Key words: rice, genetic divergence, microsatellites, allelic frequency

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DIVERGÊNCIA GENÉTICA ENTRE OS GENITORES DA POPULAÇÃO DE ARROZ CNA 11 ESTIMADA ATRAVÉS DE MARCADORES MICROSSATÉLITES E FREQÜÊNCIAS ALÉLICAS NAS FAMÍLIAS $S_{0:2}$

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A variabilidade genética é uma condição essencial para a obtenção de ganhos nos programas de melhoramento de plantas. O avanço na área da biologia molecular está permitindo associar as informações ao nível de DNA aos dados fenotípicos no processo de quantificação da variabilidade genética. Os objetivos deste trabalho foram estudar a divergência genética dos genitores da população de seleção de arroz CNA 11 e quantificar as alterações nas freqüências alélicas das famílias $S_{0:2}$ como resultado do processo de seleção. O DNA dos genitores da população CNA 11 e de 133 famílias $S_{0:2}$ foi analisado com marcadores moleculares do tipo microssatélites. Os genitores da população CNA 11 apresentaram ampla divergência genética. A similaridade genética média estimada pelo coeficiente de Jaccard foi de 0,19 " 0,15. Com base na matriz de similaridade genética os genótipos foram classificados em três grupos, correspondendo as subespécies índica, japônica tropical e japônica temperada. Nas famílias $S_{0:2}$ as freqüências dos alelos de microssatélites característicos dos genótipos da subespécie índica aumentaram e as da subespécie japônica diminuíram à medida que a intensidade de seleção aumentou. As melhores famílias $S_{0:2}$ mostraram maior similaridade genética com os genitores da subespécie índica.

Palavras chaves: arroz, divergência genética, microssatélites, freqüências alélicas

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AVALIAÇÃO DOS PARÂMETROS GENÉTICOS DA POPULAÇÃO DE ARROZ IRRIGADO CNA 11 E GANHOS ESPERADOS PELA SELEÇÃO

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A seleção recorrente é um método alternativo de melhoramento que permite a recombinação cíclica de genótipos selecionados em uma população geneticamente divergente. O objetivo deste trabalho foi avaliar o potencial genético da população CNA 11 para fins de melhoramento para tolerância ao frio. A população CNA 11 foi sintetizada pela Embrapa Arroz e Feijão utilizando fontes de tolerância ao frio e alta produtividade. Foram conduzidos dois ensaios de campo compostos de 140 famílias $S_{0:2}$ derivadas da população CNA 11 e quatro cultivares testemunhas, no delineamento experimental de látice triplo 12 x 12 e em dois locais (Cachoeirinha e Santa Vitória do Palmar, RS, Brazil), onde avaliou-se dez caracteres fenotípicos. As estimativas dos vários parâmetros genéticos mostraram que a população CNA 11 tem potencial para fins de melhoramento, com ampla variabilidade em todos os caracteres avaliados. A estimativa do ganho pela seleção direta para rendimento de grãos foi de 65,7 % com um ciclo de seleção recorrente. Os caracteres estatura de planta, esterilidade de espiguetas e número de grãos por panícula apresentaram altas correlações genotípicas com rendimento de grãos, podendo ser usados como critérios de seleção indireta. A esterilidade de espiguetas mostrou ser um critério eficiente de seleção para identificação de genótipos de arroz com tolerância ao frio no estádio reprodutivo.

Palavras chaves: arroz, parâmetros genéticos, seleção fenotípica, tolerância ao frio.

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EVALUATION OF THE GENETIC PARAMETERS OF CNA 11 IRRIGATED RICE POPULATION AND PREDICTED GAIN BY SELECTION

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Recurrent selection is an alternative method of rice breeding that allow cyclic recombination of genotypes selected in a genetically divergent population. The objective of this study was to evaluate the potential of CNA 11 population for cold tolerance breeding. The CNA 11 rice population was synthesized by Embrapa Arroz e Feijão using sources of high yield and cold tolerance. It was carried out in two field trials composed of 140 $S_{0:2}$ families derived from CNA 11 recurrent population and four check cultivars in a triple lattice 12 x 12 experimental design, and in two locals (Cachoeirinha and Santa Vitória do Palmar, RS, Brazil). Ten phenotypic characters were evaluated in both trials. Estimative of several genetic parameters showed that CNA 11 population has potential for breeding purposes, with wide genetic variability in all the phenotypic characters evaluated. The estimative of grain yield gain was 65,7 % in one cycle of recurrent selection. The characters plant height, spikelet sterility, and number of grains per panicle had high genotypic correlation with rice yield and could be used as criteria for indirect selection. The spikelet sterility showed to be an efficient selection criterion to identify genotypes with cold tolerance in the reproductive stage.

Key words: rice, genetic parameters, phenotypic selection, cold tolerance

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INDICA BASE-BROADENING FOR TEMPERATE RICE

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For over 15 years high-yielding indicas have been available, but grain quality, especially amylose content, has not been suitable for USA markets. Traditional approaches of hybridizing tropical japonicas with indicas have been challenged by difficulty in recovering recombinants possessing both high yield and suitable grain quality. Therefore a base-broadening program, working only within indicas, was initiated to develop high yielding indicas with intermediate amylose content (21-22%). Two approaches, hybridization and induced mutation, are being used. In the hybridization approach, the very early, high yielding, high amylose (25%), indica cultivar Zhe733, was crossed with late maturing, intermediate amylose accessions from IRRI. The IRRI materials are close to USA long grain quality standards, but generally are too late in the USA. Stepwise selection for early maturity and intermediate amylose level was done for several generations. In F7 yield tests in 2001, 59 early maturing lines which had intermediate amylose content yielded from 6550 to 9450 kg/ha, compared to 5020 and 5800 for two tropical japonica checks and 6690 for the Zhe733 parent. Severe lodging in 2002 precluded use of yield data in that season. In the induced mutation approach, IRRI accessions were irradiated. Over 50 selections were identified which were 10 to 14 days earlier than their respective parents. Mutagenesis studies for early maturity also have been initiated in additional high-yielding indicas which have amylose content similar to USA cultivars. Indica germplasm adapted to temperate regions is being produced in the combined hybridization and mutagenesis programs.

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DETECTION OF CROSSOVER INTERACTIONS IN MULTI-LOCATION RICE TRIALS

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The occurrence of crossover interaction in multi-location trials is of major concern for crop growers and breeders. Crossover interactions change the rank order of genotypes across locations. In this paper, we investigated the occurrence of crossover interactions in a Uruguayan rice data set (3 years, 4-5 locations). We combined two approaches; informal graphical biplot analysis (GGE-biplot) and formal statistical testing for crossovers (Gail-Simon test). The biplots allowed a quick informal overview of possible crossover interactions. The formal test identified most of the crossover interactions found by the biplot analysis, although some crossover interactions were found significant that were not identified in the biplot. Therefore, the informal biplot procedure is certainly useful, but cannot completely replace the formal testing procedure. The existence of significant crossover interactions indicated that no simple reductions in the number of testing locations for rice in Uruguay are possible.

Keywords: variety testing, multi-location trials, crossover interaction, biplot

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RICE PLANT TRAITS RELATED TO YIELDING ABILITY UNDER WATERGRASS (*Echinochloa phyllopogon*) COMPETITION IN CALIFORNIA'S TEMPERATE CONDITIONS. II. TRAITS AND YIELD TRADE-OFF.

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It had been demonstrated that under strong watergrass (WG) competition, rice-yielding ability was strongly determined by rice biomass (BiomHd) accumulation at heading and to a somewhat lesser extent by harvest index (HI). BiomHd was more affected by weed competition than HI. Here we discuss the relative importance, and negative impacts, of early rice traits that contribute to BiomHd and HI. Glasshouse studies were conducted at Biggs, CA, during 2000 and 2001. Rice cultivars M-202 (strong competitor), A-301 (weak competitor) and six experimental lines derived from a M-202/O.nivara//M-202///M-202 cross. A factorial combination of cultivars (RC) (6 plants/pot) and weed competition regime (WCR) (0 and 2 *Echinochloa* plants/pot) was arranged in a randomized complete-block design with five replications. Data were subjected to path analysis. A significant multivariate model explained 65.4% of variability in rice BiomHd. Rice characteristics with significant and positive path coefficients to BiomHd, were the number of tillers per plant (TPP_{36DAS}), early biomass ($Biom_{36DAS}$), relative growth rate to heading (RGR_{36-Hd}), and the canopy traits leaf area (LA_{36DAS}), leaf weight ratio (LWR_{36DAS}) and relative leaf area expansion rate ($RLAER_{36-Hd}$). With their larger direct path coefficients, LA_{36DAS} and LWR_{36DAS} were the main contributors towards rice growth until heading. A multiple regression model including shoot length (SL_{36DAS}), TPP_{36DAS}, SLA_{36DAS}, LA_{36DAS}, LWR_{36DAS}, RGR_{36-Hd} and $RLAER_{36-Hd}$ as variables explained 35.7% of the variability in HI. Of those, the canopy traits LA_{36DAS}, SLA_{36DAS}, LWR_{36DAS} and $RLAER_{36-Hd}$ negatively affected HI. Our results indicate that early leafiness supports BiomHd, the most weed-sensitive component of rice performance under competition, but it also negatively affects the efficiency of biomass allocation to grain. Therefore, breeding for certain traits that would enhance rice performance under WG competition could involve yield penalties resulting from a lowering of the HI. Keywords: rice competitiveness, breeding, trade-off, yield penalty, harvest index.

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RICE VARIETIES ADAPTED AND CREATED IN MOROCCAN CONDITIONS.

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On 1948 rice crop was introduced in Morocco to evaluate the heavy and flat soils of the Gharb region (North West). Actually, it's extended to the extreme north (Loukkos) with 1300 ha. The total area is about 9000 ha. The average yield is 5 tons/ha . The consumption is about 1, 5 kg/person/year of paddy. In Morocco, rice is cultivated under irrigation conditions from April to September and it's represented by Indica and Japonica. Thaibonnet, Elio and Lido represent now more than 90% of cultivated areas. The strategy of Rice breeding program is to improve varieties with high potential of production, short duration, resistant to blast, tolerant to various environmental stress and good quality. The prospect of research has 3 levels: development of cooperation with international organization, application of technology for breeding and cultivation and transfer of technology to the farmers. To improve varieties two methods are adapted: cross between local varieties and selected materiel and introduction of foreign. This year 118 rice genotypes are introduced into Morocco from CIRAD France. Those varieties were adapted and evaluated for there behavior, yield components, quality and resistance to blast. Several trials and experimentation are conducted in Allal Tazi Experimental station (50 km from Kénitra). The result indicates 11 perform ante varieties with a good potential already unregistered in the catalogue official. The agronomic and quality performance of INRA varieties will be giving on the paper.

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GENETIC VARIABILITY BY INDIRECT ORGANOGENESIS IN RICE

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Rice in Brazil shows a narrow genetic bases. In the Rio Grande do Sul state only six ancestrals contribute on 86% of the genes from the majority cultivated varieties. cultived. By means of tissue culture is possible to induce genetic variability. This work aimed toestabliment establish an efficient protocol to callus induction and a in vitro regeneration of rice plants (BRS 7 "Taim" variety). Explants from meristematic section of tip shoots plantlet were utilized. The shoots shoot regeneration, by indirect organogenesis, was developed in twophasis phases: callus induction and shoots regeneration. For callus induction were used salts and vitamine vitamin' MS plus inositol (100 $mg.l^{-1}$) e , sucrose (30 $g.l^{-1}$), Agar (7,0 $g.l^{-1}$) and Fitagel (2,5 $g.l^{-1}$).compound the following traits: MS; MS + 2,0 $mg.l^{-1}$ 2,4-D; MS + 4,0 $mg.l^{-1}$ 2,4-D; MS + 2,0 $mg.l^{-1}$ 2,4-D + 12mM prolin + 2,0 $mg.l^{-1}$ casein + 30 $g.l^{-1}$ sorbitol + 5mM MES. Agar (7,0 $g.l^{-1}$) and fitagel (2,5 $g.l^{-1}$). For shoots regeneration, callus obtained weretransfferred transferred todifferents different basicmedium medium, compound by MS and N_6 (Chu et al., 1975).: MS + 30 $g.l^{-1}$ sucrose; MS + 5,0 $mg.l^{-1}$ KiN + 1,0 $mg.l^{-1}$ ANA + 30 $g.l^{-1}$ sucrose; MS + 3,0 $mg.l^{-1}$ KIN + 0,2 $mg.l^{-1}$ ANA + 30 $g.l^{-1}$ sucrose; MS + 2,0 $mg.l^{-1}$ BAP + 0,5 $mg.l^{-1}$ ANA + 30 $g.l^{-1}$ sucrrose; MS + 1,0 $mg.l^{-1}$ TDZ + 0,1 $mg.l^{-1}$ ANA + 2,0 $mg.l^{-1}$ casein + 30 $g.l^{-1}$ sorbitol + 5mM MES + 12 mM prolin +10 $g.l^{-1}$ sucrose; MS + 80 $g.l^{-1}$ sucrose; N_6 + 80 $g.l^{-1}$ sucrose e N_6 + 30 $g.l^{-1}$ sucrose The results showed that all treatments with 2,4-D formed callus, but only those supplemented with sorbitol, prolin, casein and MÊS MES obtained regeneration, wich which was better when fitagel Fitagel was used. The treatments formed with MS' salts and vitamines vitamins showed better shoots regeneration than N_6 medium.
Key Words: indirect organogenesis, tissue culture, plant breeding

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VARIABILIDADE GENÉTICA ATRAVÉS DA ORGANOGÊNESE INDIRETA DE EXPLANTES DE ARROZ
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A cultura do arroz no Brazil apresenta uma estreita base genética. No Rio Grande do Sul, apenas seis ancestrais contribuem com 86% dos genes das variedades de arroz mais plantadas. Através do cultivo "in vitro" de plantas é possível induzir variabilidade genética. Este trabalho teve como objetivo estabelecer um eficiente protocolo para indução de calos e regeneração in vitro de plantas de arroz (cultivar BRS 7 "Taim"). Foram utilizados explantes da região meristemática de ápices caulinares. A regeneração de brotos, via organogênese indireta, foi desenvolvida em duas partes: indução de calos e posterior regeneração de brotos. Para indução de calos, utilizou-se meios de cultura composto por sais e vitaminas de MS, acrescidos de mio-inositol (100 mg.l^{-1}) e sacarose (30 g.l^{-1}), perfazendo os seguintes tratamentos: MS; MS + 2,0 mg.l^{-1} 2,4-D; MS + 4,0 mg.l^{-1} 2,4-D; MS + 2,0 mg.l^{-1} 2,4-D + 12mM prolina + 2,0 mg.l^{-1} caseína + 30 g.l^{-1} sorbitol + 5mM MES. . Os agentes solidificantes, também constituíram fatores experimentais, sendo utilizados Ágar (7,0 g.l^{-1}) e Fitagel (2,5 g.l^{-1}). Na segunda etapa de regeneração de brotos, os calos obtidos foram transferidos para diferentes meios de regeneração, compostos pelos meios básicos de MS e N_6 (Chu et al., 1975) conforme descrito a seguir: MS + 30 g.l^{-1} sacarose; MS + 5,0 mg.l^{-1} CIN + 1,0 mg.l^{-1} ANA + 30 g.l^{-1} sacarose; MS + 3,0 mg.l^{-1} CIN + 0,2 mg.l^{-1} ANA + 30 g.l^{-1} sacarose; MS + 2,0 mg.l^{-1} BAP + 0,5 mg.l^{-1} ANA + 30 g.l^{-1} sacarose; MS + 1,0 mg.l^{-1} TDZ + 0,1 mg.l^{-1} ANA + 2,0 mg.l^{-1} caseína + 30 g.l^{-1} sorbitol + 5mM MES + 12 mM prolina +10 g.l^{-1} sacarose; MS + 80 g.l^{-1} sacarose; N_6 + 80 g.l^{-1} sacarose e N_6 + 30 g.l^{-1} sacarose. Os resultados mostraram que todos os tratamentos com 2,4-D formaram calos, porém somente aquele suplementado com sorbitol, prolina, caseína e MES foi capaz de regenerar plantas, regeneração esta que foi melhor na presença de Fitagel. Os tratamentos formados pelos sais e vitaminas de MS apresentaram uma regeneração superior àquela observada para o meio N_6
Palavras-chave: organogênese indireta, cultura de tecidos, melhoramento genético.

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AVALIAÇÃO DE GENÓTIPOS DE ARROZ IRRIGADO SOB LÂMINA DE ÁGUA PERMANENTE
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A partir de 1994 o sistema de semeadura de arroz pré-germinado tem evoluído nas áreas orizícolas do Rio Grande do Sul (RS) atingindo, atualmente, cerca de 110 mil hectares, o que representa aproximadamente 11% da área total de cultivo. Este sistema tornou-se viável ao produtor por apresentar as vantagens de maior eficiência no controle do arroz vermelho, menor custo de produção e acréscimos na produtividade, além de propiciar a semeadura na época recomendada. Além de aspectos de manejo, é prioritário o desenvolvimento de genótipos adaptados às condições de semeadura e emergência sob lâmina de água permanente. Com base nisto, é prioritário identificar genótipos com elevado vigor inicial e tolerância a baixa concentração de oxigênio no solo, para permitir a emergência de plântulas sob lâmina de água permanente. Avaliou-se o desempenho inicial de 28 linhagens promissoras de arroz irrigado do programa de melhoramento da Embrapa Clima Temperado, usando-se como testemunha a BRS 6 "Chuí". Quanto a velocidade de emergência destacaram-se os genótipos G12, G13, G28, G7 e G26. Para peso de matéria seca da parte aérea destacou-se apenas o genótipo G28. Quanto ao peso de matéria seca de raiz destacaram-se G28, G18, G12, G22, e G14. Alguns genótipos mostraram alta percentagem inicial de emergência, ou seja, valores que garantiram, do 2º ao 5º dia após a emergência (DAS), um estande de plantas que variou entre 55 a 87,9%. Os resultados indicaram, a *priori*, que alguns genótipos de arroz irrigado apresentaram alto potencial de desenvolvimento de plântulas no período semeadura-emergência, sob condições de lâmina de água permanente.
Palavras-chave: Oryza sativa L., cultivar, sistema pré-germinado, melhoramento

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EVALUATION OF IRRIGATED RICE GENOTYPE UNDER PERMANENT FLOODING.
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Since 1994, pre-germinated system is enlarging its participation on rice production in Rio Grande do Sul (110 thousands of ha or 11% of the total area). The viability of this system is due to a better Red-rice control, reduction of cost production and increase of production, besides the possibility of sowing at proper time. To improve such system, apart from management aspects, it is important to develop genetic material adapted to sowing conditions and emergence under a water layer (high initial vigour and tolerance to lower concentration of oxygen on soil). Twenty-eight lines, from the Embrapa Temperate Climate Research Centre, were compared with BRS 6 "Chui" (check). G12, G13, G7 and G26 showed faster emergence; G28 was the only highlighted material in relation to shoot dry content. G28, G18, G12, G22 and G14 showed the highest root dry content. Some materials showed high percentage of initial emergence. Those materials had a stand of 55 to 87,9% from the 2º to the 5º days after emergence (DAE). A *priori* result is that some genotypes (irrigated rice) have high sprouts development than others, under permanent flooding conditions.
Key words: Oryza sativa, lines, pre-germinated system, breeding.

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DEVELOPMENT OF RICE VARIETIES FOR THE WATER SEEDING SYSTEM, IN THE TEMPERATE CLIMATE RESEARCH CENTER OF EMBRAPA, RIO GRANDE DO SUL STATE, BRAZIL.
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The rapidl acreage increase of the water seeding rice system in Rio Grande do Sul state, Brazil, brough about research need to solve the problems associated. One of the most important is varieties development suitable to soil and climatic conditions found in the state. Nowadays, the used varieties come from Santa Catarina State or were developed to the conventional system of sowing and are not well adapted to the water-seeding one. Thus, since 2000/01, the irrigated rice breeding program of Embrapa Clima Temperado Research Center, located at the extreme-south of Brazil, has directed part of the program to the development of varieties adapted to this system. The first step was to define which characteristics must be improved and to identify germoplasm sources to be used in the crosses. In 2001/02, 111 rice lines were evaluated under greenhouse conditions. Forty of them showed high vigor and were tested in the field in 2001/02. From these lines, 28 will be evaluated again to vigor and other important characteristics like emergence speed, root development, heading date (cycle) and lodging resistance. The varieties BRS Chuí, BRS Firmeza, BRS Pelota, BRS Taim, BR-IRGA 413, IRGA 417, EPAGRI 108, EPAGRI 109, EPAGRI 111 e SCS 112 were used as parent in the first crosses. In this crossing cycle were obtained 180 hybrid seeds (F_1) from twelve different combinations. Program expectation is to obtain new better adapted varieties to the water seeding system in six years.
Key words: *Oryza sativa* L., breeding, inbred lines, vigor.

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DESENVOLVIMENTO DE CULTIVARES DE ARROZ IRRIGADO PARA O SISTEMA PRÉ-GERMINADO, NA EMBRAPA CLIMA TEMPERADO, BRAZIL

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O rápido crescimento da área cultivada de arroz (*Oryza sativa* L.) irrigado no sistema pré-germinado, no estado do Rio Grande do Sul, Brazil, demanda pesquisas visando resolver problemas associados ao sistema. Destaca-se a necessidade de desenvolvimento de cultivares a ele adaptadas, uma vez que as cultivares inicialmente utilizadas ou não foram desenvolvidas para o mesmo ou foram introduzidas de Santa Catarina, estado onde o sistema predomina. Com base nisto, o programa de melhoramento de arroz irrigado da Embrapa Clima Temperado, a partir do ano agrícola 2000/01, direcionou parte de suas atividades para este fim. A primeira etapa constou da definição das características a serem melhoradas nas novas cultivares, como ciclo adequado à região, bom vigor inicial, sistema radicular vigoroso e resistência ao acamamento. Em 2001/02 foram avaliadas, em casa de vegetação, para vigor, com base na velocidade de emergência, 111 linhagens do programa de melhoramento. Foram selecionadas as 40 melhores linhagens para avaliação, no campo, em 2001/02. Destas, foram selecionadas 28 para nova avaliação na safra 2002/03. Como fontes para os primeiros cruzamentos, realizados em 2001/02, foram utilizadas as cultivares BRS Chuí, BRS Firmeza, BRS Pelota, BRS Taim, BR-IRGA 413, IRGA 417, EPAGRI 108, EPAGRI 109, EPAGRI 111 e SCS 112. Neste primeiro ano, foram obtidas 180 sementes provenientes de 12 diferentes combinações. A expectativa para obtenção de novas cultivares adequadas ao sistema pré-germinado, com base neste trabalho e com o auxílio de técnicas que permite acelerar o processo de melhoramento, como o cultivo de anteras, é de seis anos.

Palavras-chaves: *Oryza sativa* L., melhoramento, linhagens, vigor.

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GENETICS OF HERBICIDE RESISTANCE IN CLEARFIELD RICE

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This study was conducted to determine the genetics underlying the herbicide resistance traits in two types of CLEARFIELD Rice. The inheritance of the herbicide resistance genes in 93AS3510, a moderately resistant germplasm, and PWC-16, a highly resistant germplasm, was studied. 93AS3510 is the herbicide tolerant parent of CLEARFIELD Rice cultivars CL121 and CL141. PWC-16 is the original resistant germplasm from which a seed increase was conducted to produce the cultivar named CL161, which will be released in the United States in 2003. CL161 is very similar to the rice cultivar Cypress, from which it was derived. Both 93AS3510 and PWC-16 have been used extensively for crossing and backcrossing to transfer herbicide resistance into leading rice cultivars. Resistance evaluations were conducted on parents, F_1 hybrids, and F_2 plants derived from reciprocal crosses between CLEARFIELD Rice lines and susceptible rice varieties. A low concentration of imidazolinone (imazethapyr) herbicide discriminated between three response types in 93AS3510 crosses. A higher concentration was required to differentiate the three response types in PWC-16 crosses. At those respective concentrations, susceptible (S) plants were killed and resistant (R) plants were unaffected, whereas plants characterized as intermediate (I) in response grew slowly but recovered. Treated F_2 plants segregated in a 1:2:1 (R:I:S) ratio, indicating that the resistance trait was based on a single nuclear gene. This result was confirmed by selfing F_2 plants and screening several F_3 families. Families derived from intermediate F_2 plants segregated for the 3 characteristic response types, whereas those derived from resistant F_2 plants were uniformly resistant. Chi-square analyses indicated that the F_2 segregation ratios fit those expected for a single co-dominant nuclear gene.

Palabras Claves / Key Words_herbicide-resistant rice, imdazolinones, red rice control, broad spectrum weed control

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BREEDING FOR COLD TOLERANCE IN IRRIGATED RICE TO SOUTHERN CONE IN SUD AMERICA.

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Occurrence of low temperature reduces the adaptation of high yielding tropical germoplasm in the southern cone. FLAR and his partners have designed a new breeding strategy for the objective of producing new lines with cold tolerance and high yield potential in addition to other desirable characteristics such as grain quality, blast resistance, iron toxicity tolerance and straighead tolerance. Initially, we are interested in cold tolerance in the stages of germination/emergence and seedling. This makes possible early planting to take advantage of the high temperatures and higher luminosity present in December, January and February in reproductive and ripening stages. Tolerance in the reproductive stage is treated as a complement. The program involves the use of indica/japonica triple crosses, the screening of segregating populations for cold tolerance, the use of pedigrí method, and of anther culture to produce double haploid lines. Preliminary data show that selection for cold tolerance in germination/emergency stages could be effective. And there are no restrictions to combine it with another desirable characteristics like good plant type. New sources of cold tolerance have been identified, new crosses done and double haploid lines have been produced

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MEJORAMIENTO PARA TOLERANCIA A FRIO EN ARROZ IRRIGADO PARA LA ZONA SUB-TROPICAL DE SUR AMERICA.

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La ocurrencia de bajas temperaturas en el cono sur, reduce la adaptación del material tropical con elevado potencial de rendimiento a esta zona. FLAR y sus socios han diseñado una estrategia de mejoramiento con el objetivo de producir germoplasma que combine elevado potencial de rendimiento con tolerancia a temperaturas bajas y otras características como calidad molinera y culinaria, resistencia a Piricularia (*Magnaporthe grísea*), tolerancia a toxicidad de hierro y a Espiga Erecta. Se busca incorporar inicialmente tolerancia en las etapas de germinación/emergencia y plántula con el fin de poder adelantar las fechas de siembra y aprovechar las mejores condiciones de luz y temperaturas de diciembre, enero y febrero en los períodos reproductivo y maduración. La tolerancia en el periodo reproductivo es enfocada como complementaria y está sujeta a la disponibilidad de una metodología adecuada de evaluación. El programa está basado en la utilización de cruzamientos triples (indica/japonica), la evaluación de generaciones tempranas por tolerancia a temperaturas bajas, el avance de generaciones segregantes por pedigrí, y la producción de líneas dobles haploides por cultivo de anteras. Los resultados preliminares de dos evaluaciones por tolerancia a frío en germinación en las generaciones F1 y F2 provenientes de un primer grupo de cruzamientos, muestran que la selección es efectiva y no hay dificultad en combinar esta tolerancia con buen tipo de planta y otras características. Igualmente, se han identificado nuevas fuentes de tolerancia, se han producido líneas dobles haploides y realizado nuevos cruzamientos.

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ANALYSIS OF GENETIC DIVERSITY IN THE ORYZA OFFICINALIS COMPLEX

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The *O. officinalis* complex is of particular interest because, in contrast to the single AA genome of all species in the *O.sativa* complex to which the rice cultigens belong, the *O.officinalis* complex has 4 of the 10 genomes so far designated for species in the genus *Oryza.* In addition, the *O. officinalis* complex includes both diploid and allotetraploid species. In the genus *Oryza*, all the other species complexes include either diploid species, such as species in the *O. sativa complex*, or allotetraploid species such as species in the *O. ridleyi* complex. Thus the *O. officinalis* complex not only furnishes broad *Oryza* genomic diversity for study but also may give insights into polyploidy in the genus *Oryza.* Genetic relationships among 34 accessions of wild rice from Asia, Africa, America and Australia were analysed using RFLP technique. After southern blotting, DNA digestion pattern was detected following hybridization with a highly repetitive DNA sequence from a "gypsy" family of mobile elements. This report includes some different accessions than previously reported by Shcherban (2000), representing all *O. Officinalis* species and genomes. Also, another set of enzymes was tested. A dendrogram was constructed from RFLP data, clustering species according to their genome designation (CC, BB, BBCC and CCDD genomes). Some species did not appear in the same group, for example, *O. eichingeri* from Africa and Sri Lanka clustered separately from each other. The same situation was observed for the accessions from China of *O. officinalis*, which clustered together showing a close relationship with *O. rhizomatis*, and *O. eichingeri* (both of CC genome). Also, the tetraploid BBCC from India of *O. officinalis* appears in the same cluster of *O. eichingeri* and *O. punctata* (both from Africa) suggesting close phylogenetic relationship with the African genomes BB, CC and BBCC. The results obtained confirmed previous studies but also gave new insights into phylogeny in the complex and the origin of some taxa.

Keywords: Oryza officinalis, phylogeny, RFLP, gypsy mobile element

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DATA MINING APPROACHES USING MOLECULAR MARKER INFORMATION FROM GERMPLASM COLLECTIONS OF RICE

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Data Mining (DM) approaches are applicable towards classification for large amounts of data, sorting objects into two or more labeled classes and deriving functions to optimally assign new object to the labeled classes. This study is part of an ongoing project focused on development and application of DM based on molecular marker information. Classification techniques were used to predict allocation of lines into predefined groups using two different datasets. In one case groups based on germplasm classes (*indica*, *japonica*-temperate, and *japonica*-tropical) and agronomic traits were used as training samples to evaluate a KNN classification approach using RAPD marker data from a collection of diverse rice accessions. In another case, classification procedures were applied to SSR marker data from a collection of breeding lines, and used to construct and evaluate predictive models for classification into different phenotypic groups. A stepwise discriminant analysis procedure was used in both cases to identify sets of markers that best reveal differences between predefined groups. A KNN algorithm using five to ten selected markers produced 90 % to 98 % correct classification of rice lines into *indica*, *japonica*-temperate or *japonica*-tropical germplasm classes. Percentages of correct classification into groups with contrasting phenotypes across and within germplasm classes were estimated for different traits. Using five markers, values ranged from 80 % (days to heading, cold tolerance, and seedling vigor) to 90 % (plant height) correct classification into groups defined without consideration of germplasm classes. Potential applications of DM classificatory approaches in germplasm improvement include marker-assisted allocation of accessions and development of classification models using marker information from reference genotypes. Association mapping within structured populations, using a set of unlinked markers to infer details of population structure and estimate ancestry of sampled individuals, is suggested based on the existence of differentiation at the molecular level among germplasm classes (*japonica* temperate, *japonica* tropical and *indica*).

Keywords: data mining, bioinformatics, germplasm, association, population structure

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MARKER-ASSISTED CLASSIFICATION OF LEMONT X TEQING RILS INTO DISEASE RESPONSE GROUPS: COMPARISON OF DISCRIMINANT ANALYSIS AND NEURAL NETWORK ALGORITHMS

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Modern information technology, based upon the availability of powerful computer-based systems, is providing new tools to collect, transfer, store and combine agronomic and molecular data from breeding lines and germplasm collections. As a consequence, data mining approaches, based on techniques such as clustering, classification and association analysis, could be applied to help researchers discover useful patterns in their data. A discriminant analysis procedure coupling agronomic information and molecular marker profiles of breeding materials has been applied in our study to a population of recombinant inbred lines (RILs) of rice derived from a cross between Lemont and Teqing rice varieties. The main objective is to allocate breeding lines into "targeted" groups for selection using a classificatory approach based on molecular markers as predictors of resistant or susceptible response to blast disease, caused by *Pyricularia grisea* (Cooke) Sacc. (syn. *Magnaporthe grisea*). Two data mining approaches, namely K-Nearest Neighbor Discriminant Analysis (KNN) and Artificial Neural Networks (ANN), were selected for this study to treat the task of classification of rice lines into groups reflecting disease resistance as a learning problem. This comparison was based on training samples from extremes of the underlying distribution of a quantitative trait (Area Under Disease Progress Curve) reflecting the response of breeding lines to the blast pathogen and a set of measurement vectors (based on marker information) and their corresponding group assignment (resistant or susceptible), based on phenotypic information. ANN trained using a back-propagation algorithm to predict the allocation of lines using marker information was better (more than 94 % correct classification) compared with the KNN algorithm (84 % correct classification) in the case of groups with reduced differentiation. This is probably consequence of the learning process (error back-propagation) included in the adjustment of the ANN to recognize specific patterns in the data. In contrast, the KNN procedure relies only in the information provided by similar cases in the training sample used to define the groups.

Keywords: data mining, marker-assisted, classification, blast disease

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APPLICATION OF IN VIVO EXPRESSION TECHNOLOGY (IVET) FOR THE STUDY OF RICE INFECTION BY THE NITROGEN-FIXING ENDOPHYTIC BACTERIUM PSEUDOMONAS STUTZERI A15

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A bacterium repeatedly isolated from rice in China is *Pseudomonas stutzeri* A15 (Vermeiren *et al.*, 1999). This nitrogen-fixing endophyte may provide the rice plant with fixed nitrogen and hence promote plant growth. At present, the mechanisms which enable strain A15 to colonize and infect rice roots and survive within rice plants, are not known. To identify bacterial promoters specifically induced during the interaction with the host plant, the '*in vivo* expression technology' (IVET) is used (Rainey, 1999; Rainey and Preston, 2000). IVET is a promoter trapping technique based on the complementation of a mutation in an essential biosynthetic gene (Mahan *et al.*, 1993). The prerequisite for applying this technique under these circumstances is that the mutation cannot be complemented by production of plant metabolites. Therefore a *P. stutzeri* A15 *dapB* mutant was constructed. The *dapB* gene encodes a dihydrodipicolinate reductase and is involved in diaminopimelic acid biosynthesis. Diaminopimelic acid is an essential component of peptidoglycan and the precursor of lysine. A genome library was constructed by inserting DNA fragments in front of a promoterless *dapB* gene with the *P. stutzeri* A15 *dapB* mutant as the host strain. The screening of this library for specifically *in vivo* expressed promoters is in progress. Already, a number of genes with specific *in vivo* expression could be identified. These genes seem to be involved in stress response, nutrient acquisition, adaptation to different environments or regulation. In addition to these genes, some genes without significant homology to genes in the database or genes with unknown function were isolated as well.

Keywords: Pseudomonas stutzeri, endophytic, IVET, promoters, nitrogen-fixation

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DIFFERENTIATION OF URUGUAYAN WEEDY RICE AND CULTIVARS USING MARKER-ASSISTED CLASSIFICATION

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Accurate genetic differentiation of weedy rice from true-to-type modern cultivars could be a valuable tool towards keeping high seed quality standards for the Uruguayan rice industry. Genetic diversity from 26 accessions of weedy rice and 6 Uruguayan cultivars was assessed using AFLPs. The objectives of this study were: i) to explore genetic relationships among weedy rice and Uruguayan cultivars, and ii) to provide insights into weedy-cultivated rice differentiation in Uruguay. Using multivariate methods of analysis three main clusters were detected among weedy rice accessions and cultivars. Associations between clusters and morphological descriptors were also detected. One group had black hull, purple apex and long awn (wild type traits) while another group had straw hull and apex, and short or no awn (domestication traits). The third group included mostly cultivars and some weedy rice samples, presumed to closely mimic cultivated rice. Accessions from the later group may be difficult to differentiate from cultivars using only morphological traits. Consequently, AFLP data was used to evaluate a classification algorithm (k-Nearest Neighbor) based on markers selected by discriminant analysis to differentiate between weedy types and rice cultivars. More than 98 % of correct classification was achieved using a reduced set of informative markers. A marker-assisted classification procedure could be useful for assessing basic seed stocks from different cultivars in order to prevent weedy rice genetic contamination. The use of marker-assisted classification models could be further extended to differentiate groups of cultivars or breeding lines of economic value.

Keywords: AFLPs, weedy rice, genetic diversity, discriminant analysis, marker-assisted classification

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DESARROLLO DE CULTIVARES EN EL PROGRAMA DE MEJORAMIENTO GENÉTICO DE ARROZ DE INIA – URUGUAY

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El mejoramiento público de arroz comenzó en Uruguay en 1971, dentro del Ministerio de Ganadería Agricultura y Pesca (MGAP), continuando en la órbita de INIA, a partir de 1991. Enmarcado en un sector orientado a la exportación, se enfatizó, desde el comienzo, en el desarrollo de cultivares precoces de grano largo, de tipo Japónica tropical, y en la calidad de grano. Mediante cruzamientos y selección, se obtuvieron siete variedades de calidad culinaria similar a los granos largos del sur de EEUU, estando actualmente en cultivo INIA Tacuarí, INIA Caraguatá e INIA Zapata. INIA Tacuarí ha sido la más exitosa, ocupando 25 a 30% del área de cultivo, destacándose por su tolerancia a fríos en la etapa reproductiva. Temperaturas nocturnas entre 12 y 17ºC, en el período de 10 días previos a floración, resultaron en esterilidad superior a 70% en cultivares susceptibles e inferior a 25% en INIA Tacuarí. También se trabaja en el desarrollo de cultivares tropicales (Indica), introduciendo germoplasma de centros internacionales, del Fondo Latinoamericano para Arroz de Riego (FLAR), y realizando cruzamientos y selección localmente. Como resultado, fueron liberadas las variedades El Paso 144 (MGAP, 1985), INIA Cuaró y, recientemente, INIA Olimar (2002). El Paso 144 alcanzó a ser la variedad más sembrada en América del Sur, ocupando 60 a 70% del área de cultivo de Uruguay. El rendimiento de INIA Olimar supera al de El Paso 144 en 12%, destacándose también por su gran estabilidad y baja incidencia de granos Yesados. En un análisis de estabilidad (1998/99 a 2001/02) la nueva variedad mostró un rendimiento promedio de 8855 kg/ha con un coeficiente de regresión b=0,91, y El Paso 144 de 8163 kg/ha con b=1,14. También se trabaja en el desarrollo de cultivares de grano corto y de líneas Clearfield en acuerdo con BASF.

Palabras clave: Arroz, Mejoramiento, Resistencia a frío, Análisis de estabilidad

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CULTIVAR DEVELOPMENT AT THE RICE BREEDING PROGRAM OF INIA – URUGUAY

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Public rice breeding started in Uruguay in 1971, under the Ministry of Livestock, Agriculture and Fisheries (MGAP), continuing under INIA after 1991. With local rice production oriented to exportation, the breeding program emphasized, from the beginning, in the development of long-grain short-season cultivars, of Tropical Japonica type, and in grain quality. Seven varieties were obtained from local crossing and selection, all of them having cooking quality similar to Southern US long grains. Currently, INIA Tacuarí, INIA Caraguatá and INIA Zapata are grown in the country and the first one has been the most successful, with 25-30% of rice acreage. INIA Tacuarí has good cold tolerance during the reproductive phase and high milling yield. Average night temperatures between 12 and 17º C, during a 10 days period before heading, resulted in grain sterility higher than 70% in susceptible varieties and below 25% in INIA Tacuarí. Another area of work is the development of Indica cultivars, by introducing germplasm from international centers and from the Latin American Fund for Irrigated Rice (FLAR), and by local crossing and selection. As a result, the varieties El Paso 144 (MGAP, 1985), INIA Cuaró and, recently, INIA Olimar (2002) were released. El Paso 144 was the most widely grown variety in South America in the 90's, with 60-70% of rice acreage in Uruguay. Grain yield of INIA Olimar is 12% higher that that of El Paso 144, showing also good yield stability and low incidence of chalky grains. In a stability analysis (50 trials from 1998/99 to 2001/02), the new variety showed an average yield of 8855 kg/ha, with a regression coefficient b=0.91, while grain yield of El Paso 144 was 8163 kg/ha, with b=1.14. Other areas of work include the development of short-grain cultivars and of Clearfield lines, in agreement with BASF.

Keywords: Rice, Breeding, Cold tolerance, Stability analysis

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DOUBLED HAPLOID BREEDING OF SOUTHERN U.S. LONG-GRAIN RICE (*ORYZA SATIVA L.*)

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Doubled haploid (DH) production in rice is a fast and highly efficient technology in varietal improvement, especially in *japonica* germplasm. Initially, U.S. long-grain populations showed low anther culturability similar to *indica* rice (0.5%). By optimizing culture medium and using bridging parents with high regeneration ability, thousands of DH plants have been regenerated, and the mean anther culturability of U.S. long-grain crosses has increased from 0.5 to 8%. Annually, thousands of DH lines have been planted in progeny rows for evaluation, and hundreds of elite DH lines were selected based on agronomic performance, including high grain yield, good grain quality, and stress tolerance. Superior DH lines were advanced to preliminary yield (PY) tests, the Uniform Regional Nursery (URN), and the Commercial-Advanced yield (CA) tests based on high breeding and commercial value. These DH lines were used as bridging parents, and recombinations among the elite DH lines were obtained to further improve target traits. Therefore, the DH breeding is a complementary component in current breeding efforts. Efforts in the breeding program at the LSU AgCenter's Rice Research Station have resulted in the development of several leading long-grain rice varieties, such as Cypress, Cocodrie, and Cheniere, that are currently grown on over 65% of acreage in the southern U.S. rice growing region.

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TEMPERATE RICE IMPROVEMENT IN SOUTH KOREA: CHALLENGES AND VISION

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The indica subspecies of rice (*Oryza sativa* L.) is widely cultivated and produced in the humid tropics but the japonica subspecies is produced in the temperate regions and high altitudes of tropics as well as subtropics of the world. South Korea, located between 37°N latitude and 127.3°E longitude and with 1,100,000 ha of rice land, has become self-sufficient in rice production since 1975. However, increasing population and decreasing farm land, make further increases in production necessary. Low temperature stress and pressure of certain insects and diseases limit production increase and cause about 20 % yield loss annually. In addition to a strong national research program, international efforts in collaboration with IRRI have been initiated to solve some intractable problems of temperate rice improvement. Identification of new sources of resistance to biotic and abiotic stresses, use of molecular tools for favorable gene tracking and their incorporation into Korean rice cultivars through conventional and molecular breeding approaches would help to increase rice production. These efforts will not only widen the temperate rice gene pool but contribute to research efforts in countries with a similar ecosystem like high elevation areas of the tropics and central Asia through international exchange of new germplasm.
Keywords: Temperate rice, South Korea, improvement

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EFECTO DE LA ARQUITECTURA DE LA PLANTA SOBRE CARACTERÍSTICAS AGRONÓMICAS Y COMPONENTES DEL RENDIMIENTO DE 5 LÍNEAS DE ARROZ *(Oryza sativa L.)* Y DE 2 VARIEDADES TESTIGAS EN CALABOZO – VENEZUELA.

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Con el fin de evaluar el efecto de la arquitectura de la planta sobre características agronómicas y componentes del rendimiento de 5 líneas de arroz (***Oryza sativa L.***) y de 2 variedades testigas, un estudio agronómico fue llevado a cabo durante el invierno 2002 (periodo de lluvias) en la Estación Experimental de la Universidad de los Llanos de Calabozo en Venezuela.
En experimentación habia 3 líneas con una arquitectura abierta y 4 lineas cuyo arquitectura era cerrada. Este estudio fue llevado a través un dispositivo de bloques al azar compuesto de 7 tratamientos, 9 repeticiones y de parcelas de 8 m². Las variables agronómicas estudiadas fueron : vigor al inicio, macollamiento, altura de planta, madurez, senecencia, volcamiento y los 4 componentes del rendimiento (número de paniculas/m², número de granos/panicula, fertilidad de las espiguillas y peso de 1000 granos).
Los resultados estadísticos realizados por el programa SAS (versión 6.03) han mostrado que las líneas cuyo arquitectura es cerrada son las que han tenido el peor vigor al inicio pero la mejor capacidad de macollamiento y el mejor rendimiento. Sin embargo, una de estas líneas cerradas obtiene el rendimiento más bajo. Se trata de una línea que guarda sus hojas verdes hasta la cosecha (fenómeno de stay green). Las líneas que tienen una fenótipo abierto sont las que obtienen el mejor vigor al inicio pero el más bajo rendimiento. Para todas las líneas estudiadas, el macollamiento favorecería el número de paniculas/m² y el rendimiento final en grano.
Palabras claves : línea, arroz, arquitectura, fenótipo, variables agronómicas, vigor, macollamiento, rendimiento.

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THE EFFECT OF PLANT ARCHITECTURE ON THE AGRONOMICAL CHARACTERISTICS AND YIELD COMPONENTS OF 5 LINES OF RICE *(Oryza sativa L.)* AND OF 2 CONTROL VARIETIES AT CALABOZO, VENEZUELA.

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An agronomic study was carried out during the winter of 2002 (the rainy season) at the University des Llanos de Calabozo's Experimental Station in Venezuela in order to measure the effect of the structure of the plant on the agronomic characteristics and the yield components of 5 varieties of rice (***Oryza sativa L.)*** and 2 control varieties.
There were 3 open structured varieties and 4 closed structured varieties being tested. The study was carried out by means of a system of random units made up of 7 treatments, 9 repetitions and basic parcel of 8 m². The agronomic variables studied were: the sturdiness on sprouting, the tillering, plant height, maturity, senescence, the laying and the 4 yield components (number of panicles/ m², number of grains/ panicle, fertility of the little ears and weight of 1000 grains).
The statistical results reached by the S.A.S. (version 6.03) programme demonstrated that the varieties whose structure is closed are those which have the least robustness on sprouting but have the best off-shooting capacity and the best yield. Nevertheless, one of these varieties gave the worst yield. It is a variety whose leaves remained green until harvest (stay green phenomenon). On the other hand, the varieties with an open phenotype show good strength on sprouting but give a poorer yield. For the varieties as a whole, the tillering favours the number of panicles per m² and the final grain yield.
Key words : variety, rice, arquitecture, phenotype, agronomic variables, sturdiness, tillering, yield.

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INFLUENCE OF PHYSICOCHEMICAL CHARACTERISTICS AND SENSORY ATTRIBUTES ON LOWLAND RICE COOKING QUALITY
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The technological and sensory qualities of rice strongly affect its economic value during domestic and international trade. Although amylose content is considered the most important factor in rice's texture quality, when cultivars present similar amylose levels within the same range, the importance of their texture properties increases as well as the importance of the physicochemical analysis which help in the prognosis of their cooking quality. The objective of this work was to assess the cooking quality of promising breeding lines and varieties of lowland rice obtained from the Rice Breeding Program carried out by Embrapa Rice & Beans in Goiânia, GO. The results were analyzed by Principal Components Analysis (PCA) and stepwise regressions. In the PCA, the two first components concentrated low variation among the studied variables and no generalized tendency was observed in the obtained conformations. Sensory attributes were better explained than empirical attributes by phenomenological models using stepwise regression models. In general, It was concluded that the studied rice's physical, chemical and physicochemical properties are not sufficient to describe or explain its sensory attributes, implying that these properties still are not sufficient to estimate such attributes.
Key Words : Physicochemical characteristics; cooking quality, PCA, regressions

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INFLUÊNCIA DAS CARACTERÍSTICAS FÍSICO-QUÍMICAS E ATRIBUTOS SENSORIAS NA QUALIDADE DE COCÇÃO DE ARROZ DE VÁRZEA
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A qualidade tecnológica e sensorial do arroz afeta fortemente seu valor econômico no comércio doméstico e internacional. Embora o teor de amilose seja considerado o fator mais importante na qualidade da textura do arroz, quando as cultivares apresentam valores próximos dentro de uma mesma faixa, cresce a importância das suas propriedades de textura, bem como, de análises físico-químicas que nos auxiliem a prognosticar a qualidade de cocção do arroz. Este trabalho teve como objetivo avaliar a qualidade de cocção de linhagens em fase final de desenvolvimento e variedades de arroz de várzea procedentes do Programa Nacional da Rede de Melhoramento Genético do Arroz da Embrapa Arroz e Feijão em Goiânia, GO. Os dados foram tratados por análise de componentes principais (PCA) e regressões "stepwise". Na PCA os dois primeiros componentes concentraram pouca variação das variáveis estudadas e não foi evidenciada nenhuma tendência generalizada nas conformações obtidas. Pelos modelos de regressão "stepwise" os modelos fenomenológicos explicaram melhor os atributos sensoriais que os empíricos. De uma forma geral, concluiu-se que as propriedades físicas, químicas e físico-químicas estudadas, não são suficientes para descrever ou explicar os atributos sensoriais abrangidos pelo arroz, o que também implica que estas propriedades não são suficientes para estimar os atributos sensoriais do arroz.
Palavras Chaves : Propriedades físico-químicas; qualidade de cocção; PCA; regressões.

052
QUALITY OF RICE VARIETIES GROWN IN SPAIN
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The characterization of grain quality of the Spanish varieties and the identification of grain characters that have to be used as selection criteria in specific Spanish rice improvement programs are of some importance. Published studies in the matter are actually lacking in Spain. With this purpose, 40 quality attributes were measured over 13 rice varieties present in Spanish rice fields during last years. Studied attributes refers to milling, cooking and eating characteristics. Principal component analysis was made and the relationships between quality attributes were determined. The results showed four different rice quality types in Spain. Shape of grain, chalkiness, texture of cooked grain, gelatinization temperature of starch and cooking characteristics were the most important attributes for this classification. The use of undefatted milled flour for measuring amylose content was proved to be useful for screening breeding lines in quality improvement programs. Determination of cooked rice stickiness was more useful than hardness to test texture differences among spanish varieties. Gel consistency and alkali spreading measurements should be included to identify Spanish breeding lines with nonsticky and firm cooked grains.

052
CALIDAD DE LAS VARIEDADES DE ARROZ CULTIVADAS EN ESPAÑA
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La determinación de las características cualitativas de las variedades actualmente cultivadas en los arrozales españoles y el conocimiento de qué atributos de calidad deben ser utilizados en los Programas de Mejora Varietal son de gran importancia. La bibliografía existente al respecto es escasa en España (Carreres 1982 y 1988; Benedito de Barber 1997). Con este propósito, se analizaron 40 atributos de calidad durante tres años sobre 13 variedades cultivadas en España. Las características estudiadas se refieren al grano en espícula y elaborado e incluyen parámetros de molinería, calidad de cocción y culinaria. Se realizó un análisis de componentes principales y se determinaron las correlaciones entre los diferentes parámetros de calidad. Los resultados muestran que son 4 los tipos de arroz presentes en el arrozal español, siendo la forma del grano, las características de perlado, la textura del grano cocido, la temperatura de gelatinización del almidón y el comportamiento en la cocción los criterios de calidad más importantes para su clasificación. Se confirma la posibilidad de utilizar harina no desengrasada de arroz elaborado para la medida del contenido en amilosa con fines comparativos y se reafirma a la adhesividad como el criterio de elección para la medida directa de la textura del arroz cocido en los programas de mejora españoles. La medida de la consistencia del gel y la dispersión en álcali debe incluirse en los procesos de selección en España de líneas genealógicas productoras de un grano cocido poco adhesivo y muy consistente.
Palabras clave: Variedades, atributos de calidad, caracterización

079

AROMA PROFILE OF THREE BREEDING LINES OF BRAZILLIAN AROMATIC RICE BY HEADSPACE SOLID-PHASE MICROEXTRACTION AND GC/MS

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The use of aromatic rice, quite common in Southeast Asia, is increasing in Europe and United States. Its characteristic flavour, similar to popcorn, is associated to the presence of 2-acetylpyrroline in the rice. The objective of this work is analyse the aroma profile of three breeding lines of brazillian aromatic rice using solid-phase microextration, a simple and solventless extraction technique. One gram of aromatic rice and 1 mL of distilled water were heated to 80 ºC in a 4 mL vial for 20 min. The headspace was sampled at 80 ºC using a 50/30 Carboxen/DVB/PMDS fiber for 15 min. Dessorption and GC/MS analysis were performed in an Agilent 5973 system, using a 30mX0.25mm HP5-MS capillary column. Acetylpyrroline was detected in all samples of aromatic rice, but not in common rice. Linear saturate and unsaturated aldehydes from C6 to C12 and paraffins from C12 to C16 are the major compounds in the aroma. Using a simple technique, it was possible to analyse the aroma composition and to differentiate between an aromatic and a non aromatic varieties, due to the presence of 2-acetylpyrroline.
Keywords: aromatic rice, SPME, 2-acetylpyrroline, aroma.

092

RICE PARBOILING EFFECT ON BROMATOLOGICAL MEASURES OF NUTRITIONAL INTEREST.

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The effect of parboiling was evaluated on measures of nutritional interest in ten rice cultivars (BR-IRGA 409, BR-IRGA 410, IRGA 416, IRGA 417, IRGA 418, IRGA 419, IRGA 420, IRGA 421, Blue Belle and Formosa) produced in the Estação Experimental do IRGA. Parboiled rice had higher content of neutral detergent fiber (NDF; Van Soest et al., 1991), and minerals (MM; AOAC, 1995) than white rice (13.1±4.3 vs. 3.5±1.1% and 0.8±0.1 vs. 0.5±0.1%, respectively) ($P<0.05$). Conversely, parboiled rice had a lower content of digestible starch (DS; AOAC, 1998) ($P<0.05$) than white rice (73.3±5.7 vs. 79.9±6.8%), while crude protein (CP; AOAC, 1995) content was similar in both groups. Moreover, different cultivars showed variation in NDF, MM, CP and DS levels, independent of the grain processing. The higher content of NDF and the lower content of RS, show that parboiling can increase resistant starch (RS) content in rice grains, which may be relevant to human health. Moreover, phenotypic variation among rice cultivars could be used to guide their utilization in specific nutritional approaches. Biological studies are being conducted to corroborate such hypothesis. Keywords: NDF, Minerals, Digestible starch, Crude protein.

093

DETERMINATION OF RICE RESISTANT STARCH: A PRELIMINAR STUDY.

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Resistant starch (RS), which is not digested in small intestine, induces health benefits currently attributed to dietary fiber. Hence, the precise measurement of RS fraction may contribute to the identification of functional foods. RS is currently determined after removal of digestible starch by amylolysis, followed by solubilization of RS using either dimethyl sulfoxide (AOAC, 1998) or KOH (Asp et al., 1983). However, there is no comparison of such procedures. Parboiling may increase RS levels of rice. Therefore, in the present study RS fraction of white rice (WR, n=5) and parboiled rice (PR, n=5) obtained using AOAC method was compared to that obtained using Asp method. Results showed that RS values obtained using AOAC method were similar for WR and PR (4.2±0.7 vs. 4.0±0.2%). However, RS obtained using Asp method were lower for WR when compared to PR (1.5±0.9 vs. 3.8±1.5%). Parboiling reduced digestible starch fraction (73.9±6.5 vs. 82.4±4.2% of WR), suggesting a possible increase of RS. Therefore RS data obtained using Asp method seems more soundly than those obtained using AOAC method. However, the cause of discrepancies between these methods deserves further investigation. Keywords: Resistant starch, Rice, Parboiling.

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EFFECT OF TRANSPLANTING DATE ON GRAIN QUALITY CHARACTERISTICS IN DIFFERENT RICE (Oryza Sativa L.) VARIETIES

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In order to study the effect of different transplanting dates on quality characteristics between four modern and native varieties a field experiment was carried out in Rice Research Institute (Amol, Iran). A factorial design was arranged in completely randomized block with three replications, in which transplanting date in three levels (including May 13, May 23 and June 1) and rice genotypes in four levels (Tarom, Nemat, Sahel and Fajr) were the treatments. The results showed that different varieties have significant difference in all the milling and cooking characteristics except hull weight and hull percentage. Among the varieties Tarom registered the highest amount of hull weight, hull percentage, brown rice weight, head rice weight, degree of milling and protein content. Transplanting dates and interaction between transplanting dates and varieties have a significant effect on all traits of milling and cooking characteristics. A delay in transplanting by 1 June reduced the brown rice weight and gel consistency but did not observed any regular trend for other traits.
Keywords: Rice, Transplanting date, quality

124

CARACTERIZACIÓN DE TRES VARIEDADES DE ARROZ CULTIVADAS EN URUGUAY.

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Tacuarí, El Paso 144 and 404 are the three varieties of rice of major production in Uruguay. The Laboratory of SAMAN at Montevideo, elaborated the samples and assays were performed at LATU. Through this joint study we intend to characterize these varieties with some chosen parameters. This article shows the variation of the following parameters: grain dimension (length, width), weight of 1000 grains, fat content, alkali test, gelanitization time. The middle value in the degree of elaboration was taken as a reference in this assessment, and was used to demonstrate that as fat content decreases, the processing degree increases, and inversely to the grain dimension. No noticeable differences are observed in the cooking characterization tests for the degrees of elaboration under study.

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CARACTERIZACIÓN DE TRES VARIEDADES DE ARROZ CULTIVADAS EN URUGUAY.

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El presente trabajo muestra la variación de diferentes parámetros: dimensiones del grano (largo y ancho), peso de 1000 granos, materia grasa, alkali test y tiempo de cocción en las tres variedades de arroz de mayor producción en Uruguay (Tacuarí, El Paso 144, 404) para tres grados de elaboración diferentes. El grado de elaboración normal para cada variedad fue utilizado como base de comparación de los resultados.

Las muestras fueron elaboradas en el Laboratorio Saman Montevideo y los ensayos realizados en el LATU. A partir de los resultados obtenidos se observa el decrecimiento en el porcentaje de materia grasa a medida que aumenta el grado de elaboración así como la disminución de las dimensiones del grano. No se observan diferencias significativas en los test que destermina la calidad culinaria de las muestras.

Las técnicas de análisis utilizadas fueron: Alkali test for white milled Rice Ref. Little R.R., B.G. Hilder and E.H. Dawson. Rice Evaluation of gelatinization time of kernels during cooking ISSO 14864. Parametros físicos y contenido de materia grasa determinados en Grain Check e Infratec

Palabras claves: Arroz, Grado de elaboración, alkali test, tiempo de gelatinización, temperatura de gelatinización.

Tacuarí, El Paso 144 and 404 are the three varieties of rice of major production in Uruguay. The Laboratory of SAMAN at Montevideo, elaborated the samples and assays were performed at LATU. Through this joint study we intend to characterize these varieties with some chosen parameters. This article shows the variation of the following parameters: grain dimension (length, width), weight of 1000 grains, fat content, alkali test, gelanitization time. The middle value in the degree of elaboration was taken as a reference in this assessment, and was used to demonstrate that as fat content decreases, the processing degree increases, and inversely to the grain dimension. No noticeable differences are observed in the cooking characterization tests for the degrees of elaboration under study.

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VARIATION OF FAT CONTENT IN DIFFERENT VARIETIES OF URUGUAIAN RICE, DEPENDING ON DATE OF HARVEST AND LOCATION

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The purpose of this study was to obtain information about the industrial quality of uruguaian rice varieties, following the previous work of the authors. Then this study includes the determination of Fat Content, Grain Size and Weight of rice kernels from 3 uruguaian rice varieties (El Paso144, Zapata and Tacuarí), related to date of harvest and location (Lascano and Río Branco). This work will be conducted for three years and this paper presents results of the first one.

Fat Content was determined with an Infratec 1241, and Grain Size and Weight was determined with an image analizer Graincheck 312. It was found that fat content decrease in this way: Tacuarí > Zapata > EP 144. Not significant differences were found related to date of harvest or location.

It was also found that the kernel weight decreases in this way: EP 144 > Zapata > Tacuarí. The kernel weight of rice produced in Lascano was higher than that of rice produced in Río Branco, and it was found that the weight decreased with a delay in harvest.

The length of rice kernels has a similar behavior than the weight: EP 144 > Zapata > Tacuarí. The Length/Width ratio was higher than 3, independently of rice variety, location and date of harvest.

The results show us that the differences found in Fat Content of the 3 rice varieties analized, can be used to improve industrial utilization of rice bran for oil extraction and animal feeds.

This preliminary results will be confirmed studing the next 2 rice harvests.

Keywords: Rice, Fat Content, Rice Bran

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VARIACION DEL CONTENIDO DE MATERIA GRASA EN VARIEDADES DE ARROZ URUGUAYAS, DEPENDIENDO DE LA FECHA DE COSECHA Y LOCALIZACION.

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Continuando con los estudios anteriores de los autores para determinar calidad industrial de variedades de arroz, se encaró el presente estudio atendiendo además a la necesidad de obtener información sobre estos aspectos para variedades uruguayas.

El objetivo del presente trabajo fue determinar el contenido de materia grasa, dimensiones y el peso de los granos en 3 variedades de arroz uruguayo (EP144, Zapata y Tacuarí), en función de fecha de cosecha y localidad de siembra (Lascano y Río Branco).

Este estudio abarca un período de 3 años, presentándose aquí los resultados del primero.

La materia grasa se determinó en un Infratec 1241, mientras que las dimensiones y el peso de los granos se realizó en un analizador de imágenes Graincheck 312.

Se constató que el contenido de materia grasa en las variedades diminuye en la siguiente forma: es mayor en Tacuarí, intermedio en Zapata e inferior en El Paso 144. No se detectaron diferencias significativas por fecha de cosecha ni localidad.

El peso de los granos disminuye según: es mayor en EP144, intermedio en Zapata e inferior en Tacuarí. Los granos de arroz de Lascano resultaron ser más pesados que los de Río Branco, observándose que dicho peso disminuye para fechas de cosecha posteriores.

El largo de los granos tiene un comportamiento similar al del peso: es mayor en EP144, intermedio en Zapata e inferior en Tacuarí. La relación Largo/Ancho fue superior a 3, independientemente de la variedad, locación y fecha de cosecha.

Conclusiones: Las diferencias detectadas fundamentalmente en el contenido de materia grasa de las 3 variedades en función de los parámetros analizados - las cuales serán verificadas en las cosechas de los próximos dos años - pueden ser utilizadas para optimizar el aprovechamiento industrial del afrechillo de arroz: extracción de aceite y uso en raciones animales.

Palabras Clave: Arroz, Materia Grasa y Afrechillo de arroz

008

EFFECT OF DIFFERENT TREATMENTS ON THE LIPIDS STABILITY OF RICE BRAN

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Rice bran is a by-product of the rice milling industry available in large quantities in many areas of the world. It constitutes a potential feedstuff to be used as animal feed and human food. Its nutritional quality is highly reduced due to the rapid deterioration of the bran oil, preventing its use as a component of the chicken diets. The acidity or hydrolytic rancidity and the oxidative rancidity are the most important chemical changes in lipids during processing and storage. The present study was conducted to determine the deterioration of the rice bran oil subjected to chemical and physical treatments, during storage under warm conditions. Five experiments were established in which raw, parboiled, autoclaved and stabilized (extrused) rice bran were stored in an oven at 36º C for different periods of time between 30 and 53 days. Samples were removed periodically and were assayed for free fatty acid (FAA, % of oleic acid) and peroxide value (PV, meq O/kg). Two different commercial antioxidant: one on the basis to ethoxyquin and another containing a mixture of phenolic, non-phenolic and chelants compounds, at levels of 300 and 400 ppm respectively, were evaluated. The samples of untreated rice bran did not develop rancidity during the experimental period (PV=2) but quickly became highly acid (FAA=65%). The heat processing of rice bran, stopped the oil hydrolysis but increased the susceptibility to oxidative rancidity (PV between 30-60 meq). The addition of both antioxidants was effective in reducing the PV in heat-treated rice bran.
Key words: Rice bran, rancidity, acidity, antioxidants.

008

EFECTO DE DIFERENTES TRATAMIENTOS SOBRE LA ESTABILIDAD DE LOS LÍPIDOS DEL AFRECHILLO DE ARROZ

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El afrechillo de arroz es un subproducto de la industria molinera abundante en muchas áreas del mundo, constituyendo un ingrediente potencial para ser utilizado en la alimentación humana y animal. Entre los principales inconvenientes de carácter nutritivo que restringen su uso se encuentra la inestabilidad de su aceite. Las alteraciones más importantes de los lípidos durante el almacenamiento y procesamiento de los ingredientes son de dos tipos: la acidez o rancidez hidrolítica y la rancidez oxidativa. El objetivo del presente trabajo fue determinar el deterioro del aceite del afrechillo, sometido a diferentes tratamientos físicos y químicos, durante el almacenamiento en condiciones de alta temperatura. Se realizaron cinco experiencias en las cuales afrechillos de arroz crudo, y procesado (parbolizado, autoclavado y estabilizado por extrusión) fueron acondicionados en estufa a 36ªC durante distintos tiempos que variaron entre 30 y 53 días. Se extrajeron muestras periódicas sobre las que se determinaron ácidos grasos libres (AGL, % de ácido oleico) y rancidez como Valor de Peróxido (VP, meq O/kg grasa). También se evaluó la efectividad del uso de dos antioxidantes comerciales, uno en base a etoxiquina y otro en base a una mezcla de compuestos fenólicos, no fenólicos y quelantes, agregados a niveles de 300 y 400 ppm respectivamente. El afrechillo crudo no se enranció (VP=2meq.) pero se acidificó rápidamente (AGL=65%). Los procesamientos con calor detuvieron la acidificación pero favorecieron, en distinto grado, el enranciamiento (VP entre 30 y 60meq.). El uso de ambos antioxidantes fue efectivo en reducir el enranciamiento en estos afrechillos.
Palabras Clave:Afrechillo de arroz, rancidez, acidez, antioxidantes

098

THE MILLING QUALITY AS INFLUENCED BY THE ROTOR SPEED OF THE WHITENER MACHINE AND MOISTURE CONTENT OF PADDY

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Rice losses during its processing is a major concern in Iran. Nothing the price decrease due to breakage, research on effects of effective parameters on rice breakage is a major need. Thus an experiment was conducted at a mill in Guilan province to investigate the effects of rotor speed of a Engleberg machine az a whitener and moisture content of paddy of the two varieties (Binam& Khazar) on breakage of rice in 2002. The rotor speed levels were 700, 800, 900 and 1000 rpm and that of moisture contents of paddy were 8-9%, 10-11%, and 12-13% The results revealed that the rotational speed of the whitener, paddy moisture content and variety had significant effects on rice breakage during milling at probability level of 1%. Rice breakage decreased with an increase in the rotor speed and decrease in paddy moisture content. The percentage of broken rice of Binam variety was greater than Khazar. Results showed that at probability level of 5%, the appropriate paddy moisture content and rotor speed for the two rice varieties are 8-9% and 900 rpm, respectively.
Keywords: Rice Milling, Losses, Mills, Whitener, paddy Moisture Content

099

A COMPARATIVE STUDY ON BREAKAGE OF RICE DURING MILLING USING RUBBER-ROLL AND ENGLEBERG MACHINES

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One of the main problem that beset the rice industry in Iran is the high loss during milling operations. It is mainly due to traditional processing methods and use of inefficient machinery. The type of rice mills significantly affect the recovery and quality of the milled rice. So research study on effects of type of mills on breakage to recommend an appropriate system is a major need. Thus an experiment was conducted to investigate the effects of the two types of mills on breakage of the three local rice varieties (Binam, Hashemi, and Alikazemi) in Rasht, Guilan in 2001. The first type is a Engleberg type huller that removes the husk and then polishes of the paddy. The second type is rubber-roll husker to remove the husk and using the Engleberg huller az a polisher. Samples were collected for the three varieties in each mill type after husking and whitening. The measurements were performed on unhulled paddy, broken brown and milled rice after hulling and polishing. The results revealed that the type of mill had significant effects on rice breakage at probability of 5%. The percentage of broken rice of Alikazemi variety was greater than the other two varieties. The results showed that the rubber-roll huller combined with an Engleberg type whitener gave an average over-all decrease in broken rice of 3.2% over the Engleberg type mill. The broken brown rice in the rubber-roll ttype averaged 3% lower than the broken in Engleberg machine.
Keywords: Broken Rice, Milling Quality, Engleberg Huller- Rubber-Roll Husker.

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HEAD YIELDS IMPROVEMENT IN HIGH MOISTURE RICE WITH HIGH TEMPERATURE FLUIDIZED BED DRYERS

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Antecedents: rice head yield is a key aspect to get good economic returns in milling operations. In last years it has been important advances in the application of fluidized bed dryers to reduce drying time and, in some cases, reduce breakage of rice kernels via a kind of "miniparbolization". Main papers on subject have been published by Dr. Somchart Soponronnarit, et al, School of Energy and Materials, King Mongkut's Institute of Technology Thonburi, Thailand. Objectives: to test procedures an equipment described by Dr. Soponronnarit in Colombian and Venezuela conditions to verify if head yields improvements could be obtained. Materials and Methods; research was done in commercial installations, during 2002. Lots of rice different average moisture and single kernel moisture standard deviations from 2.0 to 4 were dried in small commercial fluidized bed dryers, developed for purposes other than rice. Samples were processed in laboratory mills and commercial size mills to test changes in head yields. Results: laboratory and commercial milling results showed significant increases in head yields of rice lots with average moisture higher than 22%. Single kernel moisture analysis showed higher benefits when Standard deviation was higher than 2. Grains also showed lower single kernel moisture dispersion that could benefit storage and processing results. Discussion: results adjusted to Dr. Soponronnarit papers. Conclusions: fluidized bed dryers could be used to get better head yields with varieties used in Colombia and Venezuela. Keywords: : Drying, grain, fluidization, moisture dispersion

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APPLICATIONS OF GLASSY TRANSITION THEORY TO CONTINUOS FLOW AND STATIC DRYERS

CASTILLO-NIÑO, A.; EDIAGRO, BOGOTA, COLOMBIA

Antecedents: head yield is a key aspect to get rice milling good economic returns. In last years it has been important advances in theory development for understanding breakage mechanism and, new instruments to measure individual kernels moisture. In Colombia static drying systems ("pools"), using low temperature, have been improved during the years and produces higher head yields that any other commercial system available. Objectives: to use theory of transition from glassy to rubbery states, advanced in the University of Arkansas, to commercial rice drying procedures to increase milling head yields using continuos flow dryers and to understand good results of static "pools". Tg theory proposes inverse relationship between moisture and transition temperatures. Materials and Methods; research was done in commercial installations, during 2002, in Colombia and Venezuela. Rice lots with single kernel moisture standard deviations from 1.5 to 4 were dried in four passes, at different temperatures, in commercial tower dryers. Hypothesis was that high moisture kernels in lots of high Std.Dev. would have less milling breakage if first pass temperature would avoid crossing of low transition line (Tg). Results: laboratory and commercial milling results showed significant head yields increases in rice lots with high Std.Dev. when dried at lower initial temperatures. Total output of plant was reduced by 15%. Discussion: system proposed could be used commercially. Determination of moisture deviation would be needed. The very good results obtained with static "pool" dryers could be explained with Tg theory. Conclusions: results show that Tg. theory could be applied to design systems capable of produce better head yields.
Keywords: vitreous transition, moisture dispersion, static, continuos flow, head yield.

002

WARM ROOT CAN MITIGATE LOW TEMPERATURE INDUCED SPIKELET STERILITY

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Rice (*Oryza sativa* L.) is most sensitive to low temperature during microspore development. The objectives of this study were to determine whether low temperature experienced by the root, panicle or foliage is responsible for increased spikelet sterility. The problem was investigated under temperature-controlled glasshouse conditions. Water depth and water and air temperatures were changed independently to investigate the effects of low temperature in the root, panicle and foliage during microspore development on spikelet sterility. The numbers of total and engorged pollen grains per anther were measured. There was a significant combined effect of average minimum panicle and root temperatures on spikelet sterility which explained 86% of the variation in spikelet sterility. Total number of pollen grains per anther was detrimentally affected by low panicle temperature but root temperature had no influence in determining total pollen production. The number of engorged pollen grains per anther and engorgement efficiency (the percentage of pollen grains that were engorged) was determined by both root and panicle temperature. Of these, number of engorged grains per anther was the dominant component, explaining the largest variation in spikelet sterility.

Palabras Claves / Key Words Rice (Oryza sativa L.), microspore development, engorged pollen, engorgement efficiency

005

RICE STRAW PRESENCE AND CHEMICAL FALLOW PERIOD LENGHT EFFECT ON TWO RICE CULTIVARS IMPLANTATION AND INITIAL GROWTH, SOWN WITH NO TILLAGE.

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The no tillage adoption in the rice cultivation could result in a clear advantage letting increase the sown area in an optimal planting date. National experimental results are few and shows till 20% yield reductions related with implantation problems. The present work objective was to evaluate the rice straw and chemical fallow period lenght effect on two rice cultivars implantation and initial growth sown with no tillage. For each cultivar (El Paso 144 and INIA Caraguatá) an experiment was installed with the following treatments: two rice straw managament (the previous harvest remanent and completely retired), three herbicide (Glyphosate) aplication dates before sowing (90, 50, and 20 days presowing) and a test treatment with conventionall tillage (CT). For both cultivars the treatments with the straw retired achieved between 15% and 17% more plants/m2 at 12 days after the sowing, and the difference was 35% at 41 days. CT did not show differences with the no straw treatments. The pre-sowing weed control moment did not modify implantation, but affected the phenologycal development till 41 days after planting. The weed elimination 50 days before planting significatively increased the plant number with one tiller at 20 days after planting and reduced the plant number that yet have not initiated tillering at 41 days after planting.

005

EFECTO DE LA PRESENCIA DE RASTROJO DE ARROZ Y EL LARGO DEL PERÍODO DE BARBECHO QUÍMICO, SOBRE LA IMPLANTACIÓN Y CRECIMIENTO INICIAL DE DOS VARIEDADES DE ARROZ SEMBRADAS SIN LABOREO

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La adopción del no-laboreo en el cultivo de arroz resultaría en una clara ventaja al permitir incrementar el área sembrada dentro del rango óptimo de siembra. Los resultados de la experimentación nacional en el tema son escasos y señalan disminuciones en el rendimiento de hasta un 20% , asociadas con problemas en la implantación. El objetivo del presente trabajo fue evaluar el efecto del rastrojo de arroz y del largo del período de barbecho químico, sobre la implantación y el crecimiento inicial de dos variedades de arroz sembradas sin laboreo. Para cada variedad (El Paso 144 e INIA Caraguatá) se instalo un experimento en con dos manejos de rastrojo de arroz (el remanente de la cosecha anterior y retirado totalmente), tres fecha de aplicación de herbicida (Glifosato) previo a la siembra (90, 50 y 20 días presiembra) y un tratamiento testigo con laboreo convencional (LC). En ambas variedades los tratamientos sin rastrojo lograron entre 15% y 17% más plantas. m -2 a los 14 días pos siembra y esta diferencia aumentó a 35% a los 41 días El LC no presentó diferencias con los tratamientos sin rastrojo en superficie. El momento de control de las malezas pre siembra no modificó la implantación pero afectó el desarrollo fenológico hasta los 41 días pos siembra. La eliminación de las malezas 50 días antes de la siembra aumentó significativamente el número de plantas con un macollo a los 20 días pos siembra y redujo el número de plantas que aun no habían iniciado el macollaje a los 41 días pos siembra.

012

EFECTO DEL TIEMPO DE DESCOMPOSICIÓN Y DE LA CONDICIÓN HÍDRICA Y BIÓTICA DURANTE LA DESCOMPOSICIÓN DEL RASTROJO DE ARROZ SOBRE LA IMPLANTACIÓN Y CRECIMIENTO DE ARROZ SEMBRADO SIN LABOREO

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The national experimental results according to the no tillage effects on the rice cultivation are few and shows till 20% yield reductions , related to implantation problems. This kind of problems have been more frecuently seen when rice is planted with no tillage on the previous year rice straw, showing the probably interactions between the tillage system and the straw existence. In order to estimate the rice straw descomposition period effects and the edaphic environment hydric and biothic condition in wich this straw descomposition occurs, an experiment was installed, in pots with soil from a high and a low fertility field. The treatments were: three descomposition periods (three planting dates: F1=31/08, F2=26/09 y F3=31/10), two soil hydric conditions (S= satured soil and CC= field capacity during the 30 days prior the sowing) and two biothic conditions (with and without metilo bromuro sterilization: CB and SB respectively). Implantation, growth and phenologyc development periodic evaluations were done. The results showed marked planting date effects on implantation. In the early sowing, implantation was only a 47% from that achieved in the third sowing in the high fertility field, and only a 14% from the low fertility one. There were no soil hydric conditions effects and sterilization significatively increased the tillers/plant number in all planting dates and the leaves/plant number only in the earlier planting dates (F1 and F2).

012

EFECTO DEL TIEMPO DE DESCOMPOSICIÓN Y DE LA CONDICIÓN HÍDRICA Y BIÓTICA DURANTE LA DESCOMPOSICIÓN DEL RASTROJO DE ARROZ SOBRE LA IMPLANTACIÓN Y CRECIMIENTO DE ARROZ SEMBRADO SIN LABOREO

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Los resultados de la experimentación nacional relativos a los efectos del cero laboreo en el cultivo de arroz son escasos y señalan disminuciones en el rendimiento final de hasta un 20% , asociadas con problemas en la implantación. Este tipo de problemas ha sido mas frecuentemente observado cuando se cultiva arroz sin laboreo sobre rastrojo de arroz del año anterior señalando la existencia de posibles interacciones entre el sistema de laboreo y el rastrojo. Con el objetivo de estimar los efectos del tiempo de descomposición del rastrojo de arroz y de la condición hídrica y biótica del ambiente edáfico en el que ocurre esta descomposición, se instaló un experimento en tarrinas, con suelo de una chacra de arroz de fertilidad alta y de otra de fertilidad baja . Los tratamientos consistieron en 3 tiempos de descomposición (3 fechas de siembra : F1=31/08, F2=26/09 y F3=31/10), 2 condiciones hídricas en el suelo (S=suelo saturado y CC=capacidad de campo durante los 30 días previos a la siembra) y 2 condiciones bióticas (con y sin esterilización con bromuro de metilo: CB y SB respectivamente) Se realizaron evaluaciones periódicas de implantación, crecimiento y desarrollo fenológico. Los resultados señalaron marcados efectos de la fecha de siembra en la implantación. En la siembra temprana la implantación fue solo un 47 % de la alcanzada en la 3ª fecha en la chacra de alta fertilidad y de tan solo un 14 % en el caso de la chacra de baja fertilidad. No se observaron efectos de la condición hídrica del suelo y la esterilización aumento significativamente el número de macollos planta-1 en las 3 fechas de siembra y el número de hojas planta-1 solo en las fechas tempranas (F1 y F2).

015

RICECHECK BENCHMARKS YIELDS WATER USE EFFICIENCY AND PROFITS

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Ricecheck the Australian rice crop management extension program to improve yields and grain quality, continues to evolve and develop. The core of Ricecheck is 8 key checks or best practices focussing on yield, 2 environment checks and 2 grain quality checks. Ricecheck has documented the link between the adoption of the yield checks and improved yield. Hence greater farmer adoption of the checks is the key to improving rice yields. Farmers as participants and co-learners can improve check adoption through the learning steps of observing, monitoring, measuring, recording and analysing crop management.
New records now allow other key environmental and financial components to be benchmarked besides yield. These are grain yield per megalitre of water use and crop gross margins.
The records for 5800 crops have been entered into a PC based database software system that allows the records to be entered and analysed with crop comparison reports prepared for each crop. This allows farmers to compare their management with the top yielding crops. Results from 1994 to 2002 will be shown. A strength of the Riceckeck software is that it can be easily updated to develop and benchmark new targets. This process has led to the inclusion of 2 years of grain yield per megalitre comparative crop data and one year of comparative gross margin crop data. These results are presented.
In parallel with this development is that the PC database system is being converted to an internet compatible system which will be completed in 2003. This paper discusses the advantages of this system and how it will help farmers and agronomists to benchmark and improve crop productivity and environmental management.

021

SLOW RELEASE FERTILIZER EFFICIENCY IN IRRIGATED RICE

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Nitrogen fertilization is frequently applied on rice fields of Argentina. The agronomic efficiency of nitrogen, for the tropical japónica variety Don Juan INTA, is about 16(±3) y 22(±8) kg of paddy rice/kg N, for treatments of 50 and 25 kg of N/ha respectively with Urea as a Nitrogen source. Improving the efficiency of nitrogen applications will allow to reduce the amount of fertilizer and its potential negative effects on the environment. The thermoplastic resin coated Urea has the property of releasing N according with the temperature. This process will match the plant nutrition demand. The efficency of controlled –release fertilizer and Urea was evaluated in three experiments under different temperature regimes and rates of fertilizer (0, 25 and 50 kg N/ha). The average yield of the highest rate of Urea 50 kg N (urea)/ha, was not sadistically different from the lowest rate of CRF 25 kg N (CRF)/ha. The average efficiency was 23 and 47 Kg paddy rice/ Kg N respectively for the treatments mentioned above. The efficiency was not affected by the different temperature regimes. This kind of controlled-release fertilizer could be an alternative to improve the agronomic efficiency of N in paddy fields.
Palabras Claves / Key Words_rice, efficiency , nitrogen, yield, slow release

021

EFICIENCIA DE FERTILIZANTE DE LIBERACION CONTROLADA *PARA ARROZ IRRIGADO*

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En Entre Ríos, Argentina, la fertilización nitrogenada es una práctica de realización frecuente. La eficiencia obtenidas para el cultivar Don Juan INTA son del orden de 16(±3) y 22(±8) kg de arroz/kg N aplicado, para dosis de 50 y 25 kg de N/ha respectivamente, utilizando urea como fuente de N. Una mayor eficiencia por unidad de N aplicado permitiría reducir las dosis empleadas y limitar los posibles efectos negativos hacia el ambiente. El desarrollo de fertilizantes (urea) recubiertos con resinas termoplásticas presentan la particularidad de liberar N al medio en función de la temperatura, esta caracteritica permitiría mejorar la eficiencia del fertilizante empleado debido a que ambos, los requerimientos del cultivo por crecimiento y la disponibilidad de nitrógeno en el suelo están determinados por la temperatura. Se evaluó la eficiencia (kg arroz/ kg de N aplicado) del fertilizante de liberación controlada (FLC) y urea en 3 experiencias con incidencias térmicas diferentes y con tratamientos de 0, 25 y 50 kg N/ha. Los rendimientos obtenidos por el agregado de dosis de 50 kg N(urea)/ha, no se diferenciaron de los obtenidos por el agregado de dosis de 25 kg N(FLC)/ha. Los valores de eficiencia promedio resultaron de 23 y 47 kg arroz/ kg de N aplicado para los tratamientos mencionados. La incidencia de temperaturas diferentes no modificó la relación de eficiencia entre estos tratamientos. La utilización de FLC es una alternativa para mejorar la eficiencia de aprovechamiento del N agregado.

024
RICE UNDER SHALLOW IRRIGATION
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Evapotranspiration accounts for 50 to 60 % of the water used for irrigated rice. Water loses in flooded rice land could be prevented under a very shallow water conditions optimizing water use. Under this irrigating management, pumping costs and water consumption could be reduced. A tropical japónica variety, Don Juan INTA, was evaluated under shallow irrigation during two seasons. The variety was subjected to three different treatments of water availability. One hundred kg/ha of nitrogen fertilizer (urea) was applied on each treatment during the first season at PD. On the next season a factorial experiment was used where the elements of the main factor were, Urea 140 kg/ha split application, and no fertilizer. The water was supplied by sprinkler irrigation system. The yields on water restricted treatments were reduced by 23% and 40 % of the flooded check during the first season. No differences on yields, were detected among treatments with fertilization in the second season. However, without N fertilizer the flooded check was significantly different from the other treatments. Spikelets per panicle was the yield component reduced by the water-restricted treatments in both seasons. The significant interaction between irrigation treatments and nitrogen on yield suggested a key role of fertilization timing.

024
RIEGO DE ARROZ SIN INUNDACION
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Algunos antecedentes muestran que el agua consumida por evapotranspiración representa el 50 a 60% de lo utilizado para riego en arroz inundado. La condición de inundación genera importantes pérdidas en el sistema, por lo que si esta se evita es posible reducir significativamente el agua utilizada. De esta forma se vería disminuido el costo del riego, y se mitigaría el efecto sobre el ambiente al reducir la utilización de agua de pozos profundos. Se evaluó el comportamiento del cultivar Don Juan INTA en un sistema de riego sin inundación, en las campaña 2000/2001 y 2001/2002. Los tratamientos sin inundar consistieron en descensos del agua útil y luego recomposición a capacidad de campo. El primer año, se aplicó urea 100 kg/ha en iniciación de la panoja a todos los tratamientos. En el segundo año se efectuó un arreglo factorial sin y con el agregado de nitrógeno (140 kg urea/ha), con aplicación fraccionada. En ambos años los tratamientos de restricción hídricas se regaron por aspersión. En el primer año la restricción de riego produjo disminuciones del rendimiento entre un 23 al 40%. En el segundo año no hubo diferencias en el rendimiento entre tratamientos de riego con el agregado de N. El inundado presentó mayor rendimiento que los tratamientos sin inundar cuando no recibieron N. En el segundo año el rendimiento del tratamiento con inundación resultó inferior al primer año asociado a bajas temperaturas en el período reproductivo. En ambos años los tratamientos de restricción hídirca produjeron un menor número de espiguillas por panoja. La interacción riego x N hallada para el rendimiento en grano en el segundo año sugiere la necesidad de un manejo diferente de la fertilización para condiciones de restricción hídrica.

031
COMPETITION INTRA-SPECIFIES IN PLANTS OF RICE (ORIZA SATIVA L.), IN FUNCTION OF THE QUALITY OF THE SEEDS.
MELO, P. T. B. S.; SCHUCH, L. O. B.; ASSIS, F. N. de; JACOB JUNIOR, A.; CHRIST, R. da S. UFPel – FAEM / Pelotas, RS / Brazil.

Plants originated from seeds with relatively high vigor can present greater potential for competing with neighboring plants grown from lower vigor seeds and harming their development. This experiment, which was conducted both in the didactic field of the Phytothecnia Department of UFPel – FAEM and at the Didactic lab of seed analysis, aimed to evaluate the possible effects of different sequences of location of high (A) and low (B) vigor seeds along the seedling row: AA, ABA, ABB, ABBB, AAB, AAAB, BB. The seeds originated from two lots with 98% (high vigor) and 81% (low vigor) of germination were sown in trays. After 14 days they were moved to the field following the sequence described above. Collecting of 15 plants of each sowing position were performed in 43 and 86 days after the seedling and in the maturation, when the following parameters were evaluated: aerial part length, leaf dried biomass. Stem dried biomass, leaf area, spike number, panicle number and grain yield. The experimental approach utilized was random blocks, with four repetitions in three harvesting times being, the data, submitted to the Duncan test at 5%. The plants originated from high vigor (A) seeds tend to cause a competitive effect over the low vigor(B) seeds, affecting the growth parameters and grain yield. It was observed that the effects become more visible in the last third of the cycle.
Key words: physiology quality, seeds, rice

031
COMPETIÇÃO INTRA-ESPECIFICA EM PLANTAS DE ARROZ (*Oriza sativa* L.), EM FUNÇÃO DA QUALIDADE DAS SEMENTES.
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RESUMO: Plantas originadas de sementes, relativamente, alto vigor podem apresentar maior potencial para competir com plantas vizinhas oriundas de sementes de menor vigor, prejudicando o desenvolvimento de plantas Este experimento conduzido junto ao campo didático do Departamento de Fitotecnia da UFPEL - FAEM e no Laboratório de Didático de Análise de Sementes, teve por objetivo avaliar os possíveis efeitos de diferentes seqüências de alocação de sementes de alto (A) e baixo (B) vigor ao longo da linha de semeadura: AA, ABA, ABB, ABBB, AAB, AAAB, BB. As sementes originadas de dois lotes com 98% (alto vigor) e 81 % (baixo vigor) de germinação, foram semeadas em bandejas. Após 14 dias foram transplantadas no campo nas seqüências descritas. Realizaram-se coletas de 15 plantas de cada posição de plantio aos 43 e 86 dias após a semeadura e na maturação, quando foram avaliados os seguintes parâmetros: comprimento de parte aérea, biomassa seca folha, biomassa seca do caule, área foliar, número de perfilhos, número de panículas e rendimento de grãos. O delineamento experimental utilizado foi blocos ao acaso, com quatro repetições em três épocas de colheita e os dados foram submetidos ao Teste de Duncan a 5 %. As plantas originadas de sementes de alto vigor (A), tendem a provocar efeito competitivo sobre as plantas de baixo vigor (B), afetando os parâmetros de crescimento e rendimento de grãos; observou-se que os efeitos tornam-se mais visíveis no terço final do ciclo.
Palavras chave: qualidade fisiológica, sementes, arroz.

032

RICE FERTILIZATION IN CALCAREOUS SOILS OF ENTRE RIOS, ARGENTINA.

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In the Entre Ríos soils where rice is cultivated, is frequent to find areas where the plants when emerging, present a clorosis that slows its growth and in some cases it ends up causing them the death. These symptoms are associated to soils with neutral to alkaline pH, with visible and abundant concretions of carbonate of calcium in surface.
The results obtained in the last five years, starting from experiences carried out to field and in greenhouse, in those the yield and the chemical composition of the plants was evaluated, they allowed to conclude that: When rice is cultivated in soils of pH 7 or higher and a saturation with calcium that exceeds 85%, the plants will show a severe reduction in the growth, accompanied by a decrease of the stand of plants and yield loss. The high availability of Ca in the calcareous soils determines a high concentration of calcium in plant and an alteration in the relationships with the rest of the nutrients. The plants suffer of a deficiency of Zn induced by the excess of calcium, fact that is demonstrated by the significant response to the addition of this element. The Zn can be applied as solid fertilizer granulated in the moment of the sows, carrying out a treatment of the seeds or for postemergent foliar applications.
Keys Words: Rice, Zinc, Calcium, Clorosis.

032

FERTILIZACION DE ARROZ EN SUELOS CALCAREOS DE ENTRE RIOS, ARGENTINA.

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En los suelos donde se cultiva arroz en Entre Ríos, es frecuente encontrar áreas o lotes donde las plantas al emerger, presentan una clorosis que retarda su crecimiento y en algunos casos llega a provocarles la muerte. Estos síntomas están asociados a suelos con pH neutro a alcalino, con visibles y abundantes concreciones de carbonato de calcio en superficie.
A partir de experiencias realizadas a campo y en invernadero en las que se avaluó el rendimiento y la composición química de las plantas, llevadas a cabo en los últimos cinco años se obtuvieron resultados que permitieron concluir que:
Cuando se cultiva arroz en suelos de pH superior a 7 y una saturación con calcio que exceda el 85 %, es de esperar que se presente una situación en la cual las plantas mostrarán una severa reducción en el crecimiento, acompañada de una disminución del estand de plantas y pérdida de rendimiento. La alta disponibilidad de Ca en los suelos calcáreos determina una elevada concentración de calcio en planta y una alteración en las relaciones con el resto de los nutrientes. Las plantas sufren de una deficiencia de Zn inducida por el exceso de calcio, hecho que queda demostrado por la significativa respuesta al agregado de este elemento. El Zn puede ser aplicado como fertilizante sólido granulado en el momento de la siembra, realizando un tratamiento de las semillas o por aplicaciones foliares en postemergencia.
Palabras Claves / Key Words : Arrroz, Zn, Ca, Clorosis, Fertilización

034

GRAIN YIELD OF SPRINKLER IRRIGATED RICE, MAIZE AND SORGHUM CULTIVATED IN DIFFERENT SOWING TIMES

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The objective of this work was to determine the influence of different sowing times on grain yield of sprinkler irrigated rice, maize and sorghum in Rio Grande do Sul State - Brazil. The experiment was conducted in the experimental area of the Agricultural Engineering Department of the Federal University of Santa Maria, during the 2001/02 growing season. Treatments consisted of four sowing dates for rice (September 08th, October 04th, October 19th and November 05th). Maize and sorghum were sowed after harvesting the rice on the following dates: January 28th, February 08th, February 20th and March 05th. The rice sowing dates caused differences in grain yield. The maximum technical efficiency (5,35 Mg ha^{-1}) was observed for sowing on October 13th. The highest maize yield (7,82 Mg ha^{-1}) was obtained sowing the maize on January 31st (maximum technical efficiency). The highest sorghum yield (8,46 Mg ha^{-1}) was obtained sowing the sorghum on January 28th (maximum technical efficiency). The cultivation of rice followed by maize and sorghum during the same crop growing season increases the farm net propie. The total amount of grain yield production of both: rice + maize or rice + sorghum was obtained sowing the rice during the second half of September.

034

RENDIMENTO DE GRÃOS DE ARROZ DE SEQUEIRO, MILHO E SORGO CULTIVADOS EM SUCESSÃO E IRRIGADOS POR ASPERSÃO.

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A utilização das áreas agricultáveis com duas culturas no verão é altamente recomendada para potencializar a lucratividade de grande parte das propriedades rurais com irrigação. O objetivo deste trabalho foi determinar a influência de diferentes épocas de semeadura no rendimento de grãos do arroz de sequeiro, milho e sorgo, irrigados por aspersão na região de Santa Maria, RS, Brazil. O trabalho foi conduzido em área experimental do Departamento de Engenharia Rural da Universidade Federal de Santa Maria, no ano agrícola 2001/2002. O delineamento experimental foi de blocos ao caso com quatro repetições. Os tratamentos constituíram de quatro datas de semeadura do arroz (18 de setembro, 04 de outubro, 19 de outubro e 05 de novembro). O milho e o sorgo foram semeados (após a colheita do arroz) em 28 de janeiro, 08 de fevereiro, 20 de fevereiro e 05 de março. As datas de semeadura do arroz ocasionaram diferenças no rendimento de grãos, apresentando a máxima eficiência técnica (5,80 Mg ha^{-1}) para semeadura realizada em 13 de outubro. A máxima eficiência técnica para o rendimento de grãos de milho (7,82 Mg ha^{-1}) ocorreu para semeadura realizada em 31 de janeiro. Para o sorgo, a máxima eficiência técnica (8,46 Mg ha^{-1}) ocorreu para a semeadura realizada em 28 de janeiro. Para sucessão de culturas arroz e milho/sorgo, a época recomenda para a semeadura do arroz deve ocorrer na segunda quinzena de setembro. Sucessão de culturas, produção grãos.

041

EFFECT OF PLANT DENSITY ON RICE YIELD

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Modern rice varieties, with good tillering capacity, can become adapted to different seed density. The objective of this work was to determine crop response to different plant stand. A 3-years work was carried out at the Corrientes Experiment Station-INTA on an acuic Argiudol (Serie Treviño). Treatments were 20-25/year. A factorial experiment with 5 plant-stand (50, 150, 250, 350 y 450 plants/m²) and 4 ó 5 varieties was running. A completely randomized design with 3 replications was used every year. Planting system and cultural practices were the conventional used in the region. Seed amounts were calculated based on grain weight, germination and a recovery factor. As the amount of used seed rised (from 19,8 to 178,2 kg/ha) an increase in the gap between wanted and obtained stand was observed, showing an increment in the competition among plants in germination. Rice yields were not significantly affected by plant density in the range of 48 to 341 pl/m², corroborating rice capacity to adapt to different plant density. Panicle stand (pan/m²) increased as plant density did. At the same time the number of panicles/plant decreased significantly. On the contrary, the number of gr/pan showed a decreasing tendency when the amount of pan/m² increased. Grain weight and milling quality were not affected by plant density.

Index words: Oryza sativa, rice, plant density, plant stand, yield components.

041

EFECTO DE LA DENSIDAD DE PLANTAS SOBRE EL RENDIMIENTO DE ARROZ

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Las variedades modernas de arroz, de gran capacidad de macollaje, pueden adaptarse a distintas densidades de siembra. El objetivo del trabajo fue determinar la respuesta del cultivo a distintas densidades de plantas.

Se trabajó 3 años en la EEA Corrientes-INTA sobre un Argiudol ácuico (Serie Treviño). Se hicieron 20-25 tratamientos / año, en un factorial de 5 stand de plantas (50, 150, 250, 350 y 450 plantas/m²) y 4 ó 5 variedades. Se utilizó el sistema de siembra y prácticas culturales convencional para la zona. La cantidad de semilla se calculó en base al peso de granos, poder germinativo y un factor de recuperación. El diseño fue completamente al azar con 3 repeticiones.

Al aumentar la cantidad de semilla usada (de 19,8 a 178,2 kg/ha) se observó un incremento en el desfasaje entre stand buscado y stand logrado, evidenciando un aumento en la competencia entre plántulas en germinación. Los rendimientos no fueron afectados significativamente por la densidad de plantas en el rango de 48 a 341 plantas/m², corroborando la capacidad del arroz para adaptarse a distintas densidades de siembra. El número de panojas/m² se incrementó a medida que aumentó la densidad de plantas logradas, mientras que el número de panojas/planta disminuyó significativamente. Como contrapartida, el número de granos/panoja exhibió una tendencia decreciente a medida que aumentó la cantidad de panojas/m². El peso de granos y la calidad industrial no fueron afectados por la densidad de plantas.

Palabras claves: Oryza sativa, arroz, densidad de plantas, stand de plantas, componentes de rendimiento.

056

PREDICTING NITROGEN STATUS OF SOILS OF PUNJAB USING DIFFERENT NITROGEN AVAILABILITY INDICES FOR RICE

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Accurate prediction of the amount of inorganic N released from soil organic matter is essential for the development of farming practices that maximize N use efficiency and minimize adverse impacts of N on the environment. A few N availability indices for rice have been tested in this regard by different workers but no reliable results have been obtained for Punjab soils. The present study was undertaken with the objective to quantify the N supplying capacity of soils by creating no-N plots at the farmer's field and to identify the simple and best laboratory test method that relate the N supplying capacity of soils to N nutrition and yield of rice in Punjab. To fulfill the above objectives, surface (0-15 cm) soil samples were collected from no-N plots from different agro-climatic zones (19 sites) of Punjab. Grain yield (GY) and N uptake of rice from these plots were estimated as an index of N supplying capacity of soils. The soil samples were then subjected to 12 different N availability indices. Different indices varied in their ability to predict the status of soil-N. Acidified $KMnO_4$ gave the highest mean values of N as compared to other indices but gave poor correlation coefficient values with GY and N uptake. Of the 12 indices tested, only six (anaerobic incubation, 2M KCl, UV absorption at 200 and 260 nm, autoclaving in $CaCl_2$, alkaline $KMnO_4$, phosphate borate buffer) gave significant correlation coefficient values with grain yield (GY) and N uptake indicating that these indices can be used as the reliable indices for predicting the N status of soils for rice. Anaerobic incubation method gave the highest correlation coefficient value of 0.639 and 0.596 with GY and N uptake respectively signifying its use as a reliable index for determining N status of soil. The biological method being time consuming and UV method being costly, 2M KCl which was found to be more sensitive to changes in available N status than other chemical methods can be successfully used as a reliable index for predicting the N supplying capacity of Punjab Soils.

Key words: Soil nitrogen, availability indices, rice, Punjab soils

059

THE BUILD-UP OF AGRONOMIC REFERENCES FOR THE MANAGEMENT OF IRRIGATED RICE BASED ON A DIAGNOSIS OF YIELD ARIABILITY FACTORS IN THE CAMARGUE. FRANCE

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The recent tangible evolution in economic and technical phenomena has led to a crisis in French rice production with a decrease in the price paid to producers, a stagnation of paddy rice yields and a significant reduction of the area under rice cultivation. To confront this crisis, ricegrowers are faced with a double challenge: to increase and to improve production within the context of strong economical and ecological constraints. The research action that we present here is aimed at establishing an agronomic diagnosis of the rice production situation based on a space-time analysis of explanatory factors of yield variability in order to produce references useful to ricegrowers in their technical choices. The study is based on a multiannual agronomical monitoring of ricefields. These fields are situated on farms representing diversified farming systems : intensified cereal cropping, mixed cropping with or without animal rearing, conventional and organic. In addition, field selection takes into account geographical characteristics and cropping systems : the proceeding crop, crop management etc. Information gathered in the fields, used to characterise the states of the soil and of the plants, and cultivation practices, registered during interviews with ricegrowers, constitute a data bank of 246 fields, each characterised by around a hundred variables. Multidimensional statistical analyses and linear modelling of these variables are aimed to illustrate and rank the factors that explain the yields observed.Results obtained show that yields vary, for the same cultivation cycle, between 0.6 t/ha and 11.7 t/ha. A plant population at the establishment stage that varies between 24 and 838 plants/m² partly explains this variability. Our study also shows the very important effect of cultivation techniques on production levels : the sowing date, the date of the first nitrogen application after sowing and weed control, all partly influence paddy yield. Concerning soil fertility factors, our study illustrates the positive effects of the level of organic matter in the soil on paddy yield. However the content levels, noted in our samples, of phosphorus, potassium and zinc in the soil do not justify the quantities of these elements applied in general by ricegrowers.The partial conclusions of this continuing programme indicate that the control of cultivation techniques determines the variability of yield levels, whereas the main factors of soil fertility do not, in our observations, reflect unfavourable content levels for production. What is more, the results obtained show the necessity to realise studies already envisaged : to improve the germination and establishment phases of the crop and to optimise the use of fertilisers.

Palabras Claves / Key Words:Irrigated Rice, Agronomic References , Diagnosis, Yield, Camargue

061

SHADOW AND NITROGEN FERTILIZATION EFFECT ON RICE CROP

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Growth and development of rice plant is basically due to: genetic background, climatic conditions and crop management. Solar radiation has a great influence on rice yield. However, sunshine has not the same importance along different growing stages. The objective of this work was to measure the effect of low light intensity (shadow) and nitrogen rate during different rice phenological phases. Treatments were 15; a factorial combination of 5 levels of shadow (No Shadow; Shadow all the period; shadow form initial flooding to panicle differentiation (DPF); DPF-Heading; Heading-Harvest), and three levels of nitrogen (0, 45, 90 kg/ha N). A completely randomized block design with 4 replications in a split plot was used. Level of shadow was the main plot and N rate the sub-plot. Trial was conducted three years. Low solar radiation (shadow) reduced rice yield significantly, but in different way according to the phenological phase. During the vegetative growth stage, shadow reduced number of tillers and made taller plants. During the reproductive period, shadow decreased number of panicles, filled grains and harvest index. During the ripening stage, it caused reduction in filled grains, harvest index and increment in the percentage of blanking grains. Along all the growing period, shadow caused decrease in number of tillers and harvest index, and an increase in blanking spikelets. There were not differences due to N level.

Index words: Oryza sativa, rice, solar radiation, shadow, nitrogen rate, growth stages.

061

EFECTO DEL SOMBREADO Y DEL NITROGENO SOBRE EL CULTIVO DE ARROZ

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El crecimiento y desarrollo del arroz depende de: potencial genético, condiciones climáticas y practicas de manejo. El parámetro climático que más influye sobre el rendimiento es la radiación solar. Esta no tiene la misma importancia en las distintas etapas fenológicas del cultivo. El objetivo fue medir los efectos del sombreado sobre las distintas etapas fenológicas del cultivo y la fertilización nitrogenada. Los tratamientos fueron 15: combinación de 5 niveles de sombreado, Sin Sombra, Sombreado todo el ciclo, inicio de riego-diferenciación primordio floral, (DPF), DPF-Floración, Floración-Cosecha, y 3 dosis de nitrógeno 0, 45, 90 kgN/ha. El diseño fue parcelas divididas, en bloques completos al azar, con 4 repeticiones. Parcela principal nivel de sombreado y las sub parcelas dosis de nitrógeno, repetido tres años. La baja luminosidad redujo los rendimientos significativamente y de diferente manera según la etapa fenológica sobre la que se presento. En la vegetativa, provocó menor número de macollos y plantas más altas; en la reproductiva redujo, número de panojas, granos llenos e índice de cosecha. En llenado de granos mermas, en granos llenos, índice de cosecha y mayor porcentaje de granos vanos. Durante todo el ciclo, menor número de macollos, mayor porcentaje de granos vanos y bajo índice de cosecha. Las dosis de N no mostraron diferencias.

062

NITRIFICATION AND UREASE INHIBITORS IN WATER SEEDED RICE IN ITALY

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Several studies showed a very low efficiency of nitrogen fertilization in flooded soils. Nitrification-denitrification and ammonia volatilization are considered the main causes of nitrogen efficiency reduction. The use of nitrification and urease inhibitors has been proposed to increase nitrogen efficiency in paddy rice but both the international and the Italian literature report contrasting results. This study compares the effects of some old and new inhibitors with a traditional use of urea. The trial was located in a silt loam soil (2000-2001) and on a sandy soil (2001). The treatments considered two nitrogen rates, 100 and 140 kg/ha, and four fertilizers: urea + 3, 4–dimethylpyrazole-phosphate (DMPP), urea + N-long, calciumcyanamide and urea. Inhibitors were applied entirely 15 days before flooding (DBF), while urea was fractionated in 60 % 15 DBF, 20 % at tillering and 20 % at panicle initiation. In 2001 another treatment was added with the 60% of urea applied 1 DBF. In 2000 the experiment showed a great difference between the grain yields of the two nitrogen rates. Urea had a minimum grain yield at both nitrogen rates. Calciumcyanamide and N-Long had good performance at both nitrogen rates, while DMPP had a significant higher yield only at a 140 kg/ha of nitrogen. In 2001, in the silt loam soil, the best results were obtained by DMPP and Calciumcyanamide though there was no significant difference between inhibitors and urea at the higher nitrogen rates. In the sandy soil DMPP had the highest grain yield while the other inhibitors had no effects. Conclusions suggest that the use of inhibitors permit to reduce the number of nitrogen applications and obtain a higher grain yield in many cases, particularly, when weather conditions in the preflooding time were favorable to nitrogen loss.

Keywords: nitrogen, nitrification inhibitor, urease inhibitor, DMPP, Calciumcyanamide, N-Long, paddy.

063

RESPUESTA DEL ARROZ A LA FERTILIZACIÓN NITROGENADA EN DOS MOMENTOS DE INUNDACIÓN EN LA ZONA ESTE DEL URUGUAY

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The interaction between flooding time and nitrogen fertilization on rice (Oryza sativa L.) production was studied during three growing seasons in the East rice production region of Uruguay. The response in growth and yield of three different cultivars were studied. Flooding treatments were: early flooding (EF) and late flooding (LF), 20 and 42 days after emergence, respectively. For Nitrogen (N), three different moment of applications were used (planting, tillering and panicle initiation) with 4 doses between 0 and 120 Kg N/ha. The Phosphorous content was higher in plants subjected to the early flooding until they reach panicle initiation, when no differences among treatments were detected. The N content was not affected by the flooding treatments. Higher levels of dry matter were achieved in the EF plants, but in general no yield differences were detected among flooding treatments. The weather that is a factor that can not be regulated by the grower, affected yield response in each growing season, reassuring its importance in management practices. The more clear increases in dry matter production and yield per N applied coincided with the growing seasons with higher solar radiation and temperature, while a depression in yield was observed in low radiation years. The EF decreased the growth cycle of the crop which is an important advantage since it decreased the exposure of the crop to potential low temperatures during sensible stages of the crop, that are common in this region of the country.

Key words: Flooding moment, irrigation.

063
RESPUESTA DEL ARROZ A LA FERTILIZACIÓN NITROGENADA EN DOS MOMENTOS DE INUNDACIÓN EN LA ZONA ESTE DEL URUGUAY.
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En la zona Este de Uruguay se analizó la interacción entre momento de inundación y la fertilización nitrogenada en la producción de arroz (Oryza sativa L.) irrigado durante tres zafras. Se estudiaron las respuestas en crecimiento, desarrollo y rendimiento de 3 variedades. Los tratamientos de inundación fueron: temprano (ITE) y tardío (ITA), 20 y 42 días posemergencia respectivamente. Para el Nitrógeno (N) se manejaron 3 momentos de aplicación (siembra, macollaje y primordio floral) con dosis de 0 a 120 kg/ha. El contenido de fósforo fue mayor en las plantas inundadas temprano hasta la etapa de desarrollo de primordio, donde se igualaron ambos tratamientos. El contenido de N no fue afectado por el momento de inundación. La ITE produjo mas materia seca (MS), pero el rendimiento no fue afectado en general por el momento de inundación, ni existió interacción con el N aplicado.El clima factor no regulable, afectó las respuestas en cada zafra, reafirmando su importancia en las medidas de manejo. Los incrementos más claros en MS y rendimiento por N aplicado coincidieron con alta luminosidad y temperatura en la zafra, mientras que se encontró depresión del rendimiento con baja luminosidad. La ITE disminuyó el ciclo lo que es una importante ventaja al reducir la exposición del cultivo a bajas temperaturas, frecuentes en esta zona del país en períodos críticos para la determinación del rendimiento.
Palabras clave: Momento de Inundación, riego.

067
RICE RESPONSES TO COVER CROPS, RICE RESIDUES AND N FERTILIZER
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Incorporation of green manure and crop residues affects mobilization or immobilization of organic N, crop N uptake, and soil fertility status. A field experiment was conducted from 1995/96 to 1997/98 to determine the effects of three cover crop treatments (*Vicia villosa* Roth., *Triticosecale* Wittmack., and fallow), of two types of rice residue incorporated in the soil (below ground residue and above + below ground residue) and of N fertilization (at 0, 60 and 120 kg ha^{-1} rates) on: (i) rice grain production, (ii) the cover crop yield with N content, (iii) the "apparent" N contribution to a succeeding rice crop, and (iv) soil fertility status. The experimental design was a split-split-plot randomized complete block with four replications. In 1996 and 1997, with no fertilizer N, rice grain yield was lower in Triticale cover than in Fallow and in hairy vetch cover. Nitrogen fertilization always increased grain yield of rice following Fallow or Triticale. In contrast, the yield following hairy vetch did not change with N fertilization, except in 1997. Compared with fallow system, hairy vetch system increased N rice uptake by an average of 9 kg ha^{-1} in 1997 and 15 kg ha^{-1} in 1998, respectively, where no N fertilizer was applied; on the contrary a variable N immobilization resulted with triticale (from 3 to 12 kg ha^{-1}). N fertilization always increased the N rice uptakes. Compared with the initial soil values: a) the organic C and N concentration increased in the hairy vetch system, b) the extractable P was on average less in 1998 than in 1995, c) the K^+ concentration resulted greater in the superficial soil layer of the Fallow and Triticale system, and where the above ground straw was incorporated in the soil.
Keywords: rice, cover crop, rice residues, N fertilizer.

069
SPATIAL VARIABILITY IN A CONTROLLED ENVIRONMENT
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Genetic improvement for tolerance to low temperature during the critical microspore stage of rice (Oryza sativa L.) is essential with management practices only able to offer limited protection. To date, screening for low temperature tolerance has been conducted in glasshouse facilities using fixed lines and varieties with the aim of identifying parents for the rice improvement program. The next step is establishing an efficient screen for segregating populations. Such screening requires plants exposure to low temperatures during the reproductive stage, however detecting the onset of reproductive stage requires destructive sampling. Since plants within each population are genetically unique and cannot be dissected to determine floral intiation, exposure to low temperatures begins after initiation is estimated to occur. Since this results in varying exposure, an intial experiment aimed to identify effect of duration of exposure to low night temperature on spikelet sterility of rice plants. Additional experiments were conducted to measure spatial variation within a controlled - temperature glasshouse. The effects of location within the glasshouse and pot location within growing tubs were investigated. We identified variation associated with duration of exposure and spatial effects, highlighting the need for rigorous experimental design when screening segregating populations for low temperature tolerance in a controlled environment.

077
PLANT P CONTENTS AT PANICLE INITIATION STAGE IN RICE AS FUNCTION OF SOIL P AVAILABILITY
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Plant P levels at panicle initiation stage in rice are associated to optimum yields. However the relationship of this parameter with soil P availability, assessed by different methods has not been studied. With this aim the relationship between both parameters was studied in 10 field trials. P added levels were 0, 30, 60 and 90 kg P_2O_5 ha^{-1}. P availability at sowing was estimated by Bray 1, 1% citric acid, Mehlich 3, Olsen and 0.2M ammonium oxalate methods, as well as by Bray 1 method after 3 and 7 days of anaerobic incubation periods. Total P content in plant at panicle initiation stage (PPP) was measured as well as the rice grain yield at harvest. The PPP without P application was in average 0.24±0.05 %, while for the fertilized treatments 0.26±0.03 %. There was a good relationship between the P extracted by the different methods and the PPP of the treatment without P fertilizer: Bray 1 (R^2=0.537), citric acid (R^2=0.472) and Mehlich 3 (R^2=0.417). For these methods the soil P critical levels were 5, 4 and 6 mg P kg^{-1} respectively, corresponding to an average PPP of 0.26%. Without P application there was a trend to increase yields as a function of the increase in PPP, while a wider variation was observed in the yields of the fertilized treatments. With P application a clear relationship between PPP and rice yield was not found.
Keywords: panicle initiation P content, methods of P availability

077
CONTENIDOS DE FÓSFORO AL ESTADO DE PRIMORDIO EN PLANTAS DE ARROZ EN FUNCIÓN DE SU DISPONIBILIDAD EN EL SUELO
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Existen estimaciones de los niveles críticos de P en planta a primordio para óptimos rendimientos. Sin embargo no se ha estudiado su relación con la disponibilidad del nutriente en el suelo evaluada por diferentes métodos. Con el objetivo de estudiar las relaciones entre ambos parámetros, se evaluaron 10 ensayos de respuesta al agregado de P en arroz. Los niveles de P agregado fueron 0, 30, 60 y 90 kg P2O5 ha-1. Se estimó el P disponible a la siembra por Bray 1, ácido cítrico al 1%, Mehlich 3, Olsen, Bray 1 post incubación anaerobia de 3 y 7 días, y oxalato de amonio 0.2M. Se determinó el porcentaje de P de planta entera a primordio (PPP), y rendimiento de grano a cosecha. El PPP sin fertilización fue de 0.24±0.05%, en tanto que para los tratamientos fertilizados fue de 0.26±0.03%. Las relaciones entre el P extractado por los métodos y el PPP de los tratamientos sin fertilización mostró buenos ajustes para Bray 1 (R2=0.537), cítrico (R2=0.472) y Mehlich 3 (R2=0.417), siendo los niveles críticos 5, 4 y 6 mg P kg-1 de suelo para los tres métodos, respectivamente. Dichos valores se corresponden con PPP promedio de 0.26%. En los tratamientos testigo hubo una tendencia al aumento en el rendimiento en función del PPP, en tanto que para los tratamientos fertilizados, se observó mayor variación en los rendimientos, la cual no estuvo asociada con el PPP.
Palabras clave: P en primordio, métodos de P disponible

080
OPTIMUM TIMING FOR INITIAL FLOODING IN RICE
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Flooding is an important component of yield and cost of production in rice. In Corrientes, it is very common to establish initial flooding 20-25 days after emergency or later. In soils susceptible to straighthead, the necessity of draining the soil, made the moment of initial flooding to be more important. The objective of this study was to determine the better moment for initial flooding. A three-year experiment was conducted at the Corrientes Experiment Station-INTA. Four flooding timing were studied: 10, 17, 24 y 31 days after emergency (DDE) with 4 Varieties (Taim, CT 6919-INTA, IRGA-417 and Agrisul). Crop practices were the conventional for the area. A completely randomized block design with 4 replications was used in a split plot. Flooding time was the main plot, and variety the sub-plot. Weed control was adjusted by necessity. Rice yield decreased significantly (670 Kg/Ha) in the later flooding treatment (31 DDE), due to a decrease in number of panicles/m^2. Grains/panicle and grain weight were not affected. Days to flowering increased 2,5 days by every week that flooding was delayed. Lodging and milling quality were not affected by flooding treatments. Differences among varieties were not detected. Delaying flooding increased considerably weed problems and consequently weed control costs. Partial Cost and Treatment Net Profit (BNT) were determined. The BNT decreased considerably when timing for initial flooding was delayed.
Index words: Oryza sativa, rice, flooding, irrigation, water management, cultivar response.

080
MOMENTO OPTIMO DE INICIO DEL RIEGO EN ARROZ
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El riego es un componente importante del rendimiento y costo de producción del arroz. En Corrientes, es común iniciar el riego después de los 20-25 días de emergencia. En suelos vaneadores, la necesidad de desecamiento, hace que el inicio de inundación adquiera mayor relevancia. Con el objetivo de determinar el mejor momento de inicio de riego, se condujo un ensayo en la E.E.A. Corrientes-INTA durante 3 años. Se estudiaron 4 Momentos de inicio de riego: 10, 17, 24 y 31 días después de la emergencia (DDE) en 4 Variedades (Taim, CT 6919-INTA, IRGA-417 y Agrisul). Las prácticas de manejo fueron las convencionales para la zona. El diseño fue bloques completos al azar con 4 repeticiones en parcelas divididas. Parcela principal fue Momento de riego y variedad la sub-parcela. El control de malezas se ajustó según necesidad.
El rendimiento disminuyó significativamente (670 Kg/Ha) en el tratamiento de riego más tardío (31 DDE), debido a la disminución del número de panojas/m2. Granos/panoja y peso de granos no fueron afectados. El ciclo a floración se alargó 2,5 días por cada semana que se demoró el riego. La calidad industrial y el vuelco no fueron afectados por los tratamientos. No hubieron diferencias entre variedades. La demora en el inicio de riego incrementó el enmalezamiento y los costos de control. Se determinó el Costo Parcial y Beneficio Neto por Tratamiento que disminuyó considerablemente al retrazarse el inicio de riego.

081
ANALYSIS AD MODELLING OF WATER AND NEAR WATER TEMPERATURES IN RICE FIELDS
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The knowledge of meteorological conditions of flooded rice canopy is important for better modelling the crop behaviour in mid latitudes, where water thermal effect is crucial to mitigate the effects of both daily thermal excursions and cold arctic air outbreaks in spring and early summer.
A micrometeorological model able to estimate Water and Near Water Temperatures (WNWT) in rice fields from data gauged by standard meteorological stations could significantly improve the accuracy and realism of rice crop simulation models and consequently the skill of the models used by European Union for analysis and forecast of rice yield.
Two WNWT micrometeorological models, adopting two different strategies, were developed and compared: i) an empirical one which estimates WNWT on the basis of the air temperatures of five previous days and ii) a mechanistic one founded on the resolution of the energy balance equation adopting as storage term the heat accumulation into the water.
Calibration and validation of the two WNWT models were initially carried out with data sets of water and air temperatures available only for two levels (water bottom and air at 1.80 m). Therefore from the beginning of the rice season 2002, a specific monitoring activity was started by setting i) an automatic floating station measuring temperature into the water (bottom and surface), into the canopy and above it and ii) an automatic system for the continuous water level measurement.
Results obtained with the two WNWT models are presented and discussed.
Keywords: Paddy rice field, temperature profile, model

083

A SIMULATION MODEL AND AN AGRO-ECOLOGICAL INDICATOR TO ASSESS RICE YIELD LOSSES

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In several regions of northern Italy, increasing urban areas dimension leads to conflicts for water use between countryside and city, particularly where rice is traditionally cultivated in flooded conditions. Sometimes, regional Irrigation Boards are not able to assure sufficient amounts of water for rice paddies determining decreases in yields. These losses have been so far estimated by agronomist and/or economist in a traditional way.
New tools have been developed to support this assessment: simulation models and agro-ecological indicators. In this work, the simulation model CropSyst and the indicator Yield Gap have been used to quantify rice yield losses occurred in 2001 in rice farms of southern Milan (Italy) due to insufficient water availability.
The Yield Gap indicator evaluates the impact of sub-optimized management or particular socio-economical conditions on yield, comparing actual and potential productions. CropSyst model has been used in order to simulate potential yields and water balances. Crop parameters have been set up by using published values calibrated and validated for similar cultivars. For the simulations, agrotechniques have been indicated by farmers, weather data have been collected near the farms and hydraulic soil properties have been obtained by regional soil maps. Declared yield have been also compared with the ones published on the 2001 Ente Risi annual report.
Observed production data agreed with simulated ones and average yield loss resulted around 35%. The study allowed to develop a new integrated methodology aiming at estimating the economical damage due to insufficient water availability.
Keywords: Agro-ecological indicator, simulation model, rice, yield losses

086

O PLANTIO DIRETO E SEUS EFEITOS SOBRE A FERTILIDADE DE UM PLANOSSOLO E O RENDIMENTO DE GRÃOS DE ARROZ IRRIGADO

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O plantio direto (PD), no tempo, tem contribuído para a melhoria da capacidade produtiva dos solos de áreas altas. Em solos de várzea estas informações não são disponíveis. Este trabalho objetivou avaliar os efeitos do PD de arroz irrigado, cultivar BRS Taim, sobre o comportamento da fertilidade de um Planossolo e o rendimento de grãos. O experimento, conduzido por três anos consecutivos, foi delineado em blocos casualisados, com quatro repetições. Os sistemas de manejo testados foram: PD de arroz sob leguminosas, PD de arroz sob gramíneas, PD de arroz sob consorciação, PD de arroz sob nabo forrageiro, cultivo mínimo (CM) e sistema convencional (SC). A fertilidade do solo foi avaliada, na camada de 0 a 20 cm, antes da implantação do experimento e, após o seu encerramento, em três profundidades (0-5; 5-10 e 10-20 cm). O sistema PD manifestou uma tendência, após três anos, de acidificação do solo, comparativamente ao SC. Os menores teores de Al, no solo, foram observados no SC, indicando um efeito sinérgico do calcário com o revolvimento do solo. Ocorreram concentrações dos atributos químicos, com exceção do Na e do Al, na camada mais superficial do solo, sendo mais acentuada a do P, particularmente no PD. Os teores finais de Ca+Mg, CTC, P e $C_{orgânico}$ do solo manifestaram uma tendência de acréscimo até a camada de 5 a 10 cm, em relação aos respectivos teores médios iniciais, independente de manejo, enquanto que os menores teores de K, foram verificados no CM, e apresentaram um acentuado decréscimo, a partir dos 5 cm de profundidade, em relação aos teores iniciais; independente do sistema de manejo. A produtividade de grãos do arroz não foi influenciada pelo manejo do solo, pelo tempo de cultivo e pelas alterações observadas nos atributos químicos do solo.
Palavras chaves: manejo do solo, sistema convencional, cultivo mínimo.

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EFFECTS OF NO-TILLAGE SYSTEM ON PLANOSOIL FERTILITY AND IRRIGATED RICE PRODUCTION

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It is well know the positive side effect of no-tillage system to enhance the highland soil capacity of production. However, such information does not exist to lowlands. This research aimed to evaluate the effects of no-tillage system on Planosoil fertility and irrigated rice production (cv. Taim). A three years long experiment was carried out with four randomised replications. Variables were: no-tillage-irrigated rice under leguminous, no-tillage-irrigated rice under grass, no-tillage-irrigated rice under consortium, no-tillage-irrigated rice under wild radish, minimum tillage and conventional tillage. Soil fertility was evaluated, before set up the experiment, on a layer of 0 to 20 cm, and at the end of the experiment, on three layers (0-5; 5-10 e 10-20cm). No-tillage system shows a tendency, after three years, to promote soil acidulation, when compared to conventional system. A synergism between lime and ploughing can be indicated by the lowest value of Al found on conventional system. Concentration of chemical attribute, but not Na and Al, were found on soil surface. P was the most concentrated one with its largest values at no-tillage system. Ca+Mg, CTC, P and $C_{organic}$ tendency of concentration was found on soil layer of 5 to 10cm, compared to their initial values, independent of soil management. The lowest value of K was found at conventional tillage, getting worse after 5cm deep. Rice production got no influence of management, time and chemical attributes.
Key words: soil management, conventional system, minimum tillage.

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RICE VARIETIES RESPONSE TO PLANTING DATE IN CORRIENTES

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Planting date is one of the most important tools that farmer have for influencing his crop. In Corrientes, planting date go from September to the end of December, and sometimes also to January. There are not good information about the impact of planting date on the growth and yield of rice crop. The objective of this 5-years study was to determine the response of varieties being planted in Corrientes to planting date. Trials were conducted at the Corrientes Experiment Station-INTA. Eleven varieties (Taim, Agrisul, Cypress, CT 6919-INTA, IR 1529-INTA, Paso-144, Epagri-106, Epagri-108, IRGA-417, RP2 y Supremo-1), were planted in 4 or 5 planting dates (September, October, November, December and January) along 5 years. A completely randomized block design with 4 replications was used every year. Cultural practices were the conventional for the area. For the analysis, emergency date was taken into account rather than planting date. In general, rice yield shown a quadratic response, with yields improving for the emergences of October in relation to the September ones. From there, yields decreased significantly as the planting date was farther than the ideal one. Response curves were determined for each variety studied. Cypress was the most insensible variety to planting date. Also the response of yield components, growing parameters and milling quality was determined for the varieties used.
Index words: Oryza sativa, rice, planting date, cultivar response.

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RESPUESTA DE VARIEDADES DE ARROZ A LA EPOCA DE SIEMBRA EN CORRIENTES

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La fecha de siembra es una de las principales armas que posee el productor para influir sobre el cultivo. En Corrientes, la siembra se extiende desde Septiembre hasta fines de Diciembre, e incluso Enero, sin que este bien determinada la influencia de esta variable en el resultado final de la explotación. Con el objetivo de determinar la respuesta de las variedades en cultivo a la época de siembra, se estudió su respuesta en la E.E.A. Corrientes-INTA. Se evaluaron 4-5 Épocas de siembra (Septiembre, Octubre, Noviembre, Diciembre, Enero) utilizando 11 Variedades (Taim, Agrisul, Ciprés, CT 6919-INTA, IR 1529-INTA, Paso-144, Epagri-106, Epagri-108, IRGA-417, RP2 y Supremo-1), durante 5 campañas. El diseño fue bloques completos al azar con 4 repeticiones en cada año. Las prácticas de manejo fueron las convencionales para la zona. Para los análisis se tuvieron en cuenta las fechas de emergencia mas que de siembra.

El rendimiento mostró en general una respuesta cuadrática, con los rendimientos mejorando en las emergencias de Octubre respecto a las de Septiembre, para a partir de allí caer significativamente con mayor intensidad al alejarse de la época de siembra ideal. Se determinaron curvas de respuesta para cada una de las variedades estudiadas. Ciprés se mostró como la variedad mas insensible a la época de siembra. También se determinó la respuesta de los componentes de rendimiento, parámetros de crecimiento y calidad industrial para las variedades utilizadas.

Palabras claves: Oryza sativa, arroz, época de siembra, respuesta varietal.

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ADAPTABILIDADE DE GENÓTIPOS DE ARROZ IRRIGADO CULTIVADOS NO SISTEMA PRÉ-GERMINADO SOB LÂMINA DE ÁGUA CONSTANTE

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No sistema pré-germinado de cultivo do arroz irrigado, adota-se usualmente o manejo de retirada da água da lavoura, aproximadamente aos três dias após a semeadura, objetivando melhor estabelecimento das plântulas. No entanto, esta prática acarreta perda de água e nutrientes, além da reinfestação com plantas daninhas. Neste sentido, a permanência de água na lavoura, posiciona-se como uma proposta de manejo capaz de minimizar estes problemas. Com isso, conduziu-se um experimento no ano agrícola de 2000/01 e outro em 2001/02, objetivando avaliar a adaptação de genótipos de arroz irrigado, quando submetidos ao cultivo em lâmina constante, especialmente quanto ao acamamento de plantas, aspecto considerado limitante neste manejo de irrigação. Os experimentos foram instalados em área de várzea, em um PLANOSSOLO, e os tratamentos foram compostos por oito e 12 genótipos, respectivamente, nos anos agrícolas 2000/01e 2001/02. No primeiro ano, a produtividade média situou-se em 7279 kg.ha^{-1}, com o genótipo IRGA 1572 obtendo 8297 kg.ha^{-1}, sendo o mais produtivo em valores absolutos. A percentagem de acamamento situou-se entre 0 a 60% e na maioria dos tratamentos observou-se de 1 a 20%. Todos os genótipos exibiram acamamento de plantas, exceto El paso L 144. Na safra 2001/02, a produtividade média foi de 8492 kg.ha^{-1}, com o genótipo BRS-PELOTA atingindo a maior produtividade (9282 kg ha^{-1}). Não foi verificado acamamento em nenhum genótipo. Constata-se que a produtividade dos genótipos é elevada neste manejo de irrigação, mas o acamamento de plantas pode ser limitante, dependendo do ano e do genótipo utilizado.

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DESEMPENHO DE CULTIVARES DE ARROZ (*Oryza sativa* L.) IRRIGADO EM DIFERENTES SISTEMAS DE ESTABELECIMENTO DA CULTURA.

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O cultivo do arroz irrigado pode ser realizado sob diferentes sistemas de estabelecimento. Além da flexibilidade, alguns desses sistemas proporcionam aumento de produtividade, redução de custos e a melhoria na qualidade do produto. No entanto, estas alternativas devem ser avaliadas também quanto às exigências e potencialidades de cada sistema, sendo a escolha da cultivar uma prática decisiva neste contexto. Nesse sentido, conduziu-se um estudo objetivando-se avaliar o desempenho agronômico de cultivares de arroz irrigado em diferentes sistemas de estabelecimento da cultura. O experimento foi conduzido na área experimental da UFSM, Santa Maria (RS), Brazil, em PLANOSSOLO HIDROMÓRFICO Eutrófico arênico, textura média. O delineamento foi de blocos ao acaso, em parcelas sub-subdivididas, com quatro repetições. As parcelas corresponderam às estações de crescimento (1999/2000, 2000/01 e 2001/02); nas subparcelas, foram alocados os sistemas de cultivo (convencional, cultivo mínimo, pré-germinado, mix de pré-germinado e transplante das mudas); e nas sub-subparcelas, as cultivares (*IRGA 420*, *EL PASO 144*, *BRS TAIM* e *EPAGRI 108*). Os resultados mostraram que o rendimento de grãos varia com a estação de crescimento; e dentre os sistemas de cultivo, o pré-germinado, transplante de mudas e o sistema convencional proporcionaram maior produtividade. Nas três estações de crescimento, *EL PASO 144* demonstrou melhor adaptação e estabilidade produtiva, seguido de *EPAGRI 108*. Os resultados mostraram a viabilidade técnica de outros sistemas de estabelecimento do arroz irrigado com alta produtividade de grãos, desde que o manejo do solo, água e da cultura sejam adequados e as condições ambientais sejam favoráveis ao desenvolvimento do arroz.

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EFEITO DO VIGOR NA TRANSFERÊNCIA DE BIOMASSA EM SEMENTES DE ARROZ IRRIGADO.

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RESUMO- O presente trabalho foi conduzido com o objetivo de avaliar o efeito do vigor das sementes sobre a transferência de biomassa armazenada nas sementes, para novos tecidos em formação, bem como as possíveis diferenças na alocação em partes aéreas e radiculares. Utilizou-se três lotes de sementes de alto vigor e três lotes de sementes de baixo vigor das cultivares de arroz irrigado El Paso 144 e IRGA 417. As sementes foram pré-germinadas em temperatura de 25°C e após semeadas em papel germitest, sendo mantidas em germinador sob a mesma temperatura. Aos 3, 5, 7 e 14 dias após a semeadura determinou-se o comprimento da parte aérea e do sistema radical. Após, separou-se parte aérea, raízes e sementes que foram acondicionadas separadamente e secas em estufa para a determinação da matéria seca de cada componente. Conhecendo-se o peso da matéria seca inicial das sementes de cada lote, determinou-se a porcentagem de biomassa transferida para os novos tecidos formados, e a proporção dessa alocação nas partes aéreas e raízes. Os resultados obtidos permitiram concluir que ocorreu interação entre os cultivares e os níveis de vigor, ao longo do período avaliado. Entretanto, de maneira geral, as sementes de alto vigor transferiram maior quantidade de matéria seca para os tecidos em desenvolvimento que as sementes de menor vigor. Embora tenha ocorrido maior alocação de matéria seca para as partes aéreas, as plântulas apresentaram, em geral, maior comprimento de raízes.

Palavras-chave: vigor, transferência de biomassa , sementes, arroz irrigado.

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THE EFFECT OF LEVEL AND TIME OF NITROGEN FERTILIZER APPLICATION AND CUTTING HEIGHT ON YIELD AND YIELD COMPONENT OF RICE RATOONING

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In order to study the effect of level and time of nitrogen fertilizer application and cutting height on yield and yield component of rice ratooning (Tarom genotype, a traditional cultivar in Mazandaran Province, Iran) an experiment was conducted at Rice Research Institute of Iran, Deputy of Mazandaran, Amol. The experiment was conducted in a factorial design based on randomized completely block design with 3 replications. The nitrogen fertilizer level in 4 levels (0, 11.5, 23 and 34.5 kg N per heatare), Time of nitrogen fertilizer application in 2 levels (immediately and one month after main crop harvest) and cutting height in 3 levels (0, 20 and 40 cm) were the treatments. The results showed that different levels of N fertilizer did not significantly affect ratoon yield, harvest index, total tiller number, spikelets per panicle, filled spikelet percentage and 1000-grain weight but N applied immediately after main crop harvest significantly affect ratoon yield and spikelets per panicle. Cutting height has a significant effect on ratoon yield, spikelets per panicle and filled spikelets percentage. Ratoon yield and spikelets per panicle was significantly higher when the main crop was cut at 40 cm above ground.
Keywords: Rice, Ratoon, Yield, Nitrogen and Cutting height.

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COMPARISON OF DIRECT SEEDING (UPLAND) AND TRANSPLANTING METHOD IN RICE CULTIVATION: CASE STUDY, AMOL, MAZANDARAN PROVINCE, IRAN.

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In order to increase water use efficiency, decrease production cost and omit of some hard operation in rice cultivation (that was seen in usual transplanting method) an experiment was carried out at Rice Research Institute of Iran, Deputy of Mazandaran, Amol. The experiment was conducted in a split-plot design based on randomized completely design with 3 replications. The first irrigation after sowing with 4 levels (30,37,42 days after sowing and control as transplanting) that considered as the main plots and four genotypes of rice (Tarom, Nemat, Dasht and 7165 Line) constituted the subplots. Soil moisture in sowing time was 70 percent and dry seeds that didn't germinated seeded as drilling method with 25-cm distance between each row. Results showed that yield in irrigation treatments have significant difference so that irrigation 42 days after sowing and control (transplanting and permanent irrigation) have the highest yield (7738 kg per hectare) and the lowest yield, respectively. This advantage was related to more tiller number and seed number per panicle in irrigation 42 days after sowing. Also, yield among genotypes were significant difference so that Nemat and Tarom genotypes have the highest and lowest yield, respectively. However, 1000-grain weight, harvest index, fertile and unfertile seed have not significant differences among different irrigation treatments.
Keywords: Rice, Direct Seeding, Upland, Irrigation and Transplanting.

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THE EFFECT OF TRANSPLANTING DATE, NITROGEN FERTILIZER AND PLANT DENSITY ON YIELD AND YIELD COMPONENT OF THREE PROMISE LINES OF RICE (*ORYZA SATIVA* L.)

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In order to study the effect of transplanting date, nitrogen fertilizer and plant density on yield and yield components of rice genotypes an experiment was carried out at Rice Research Station at Tonekabon (Mazandaran Province, Iran) in 2000. The experiment was conducted in a split split-plot design based on randomized completely block design with 3 replications. The transplanting dates were considered as the main plots. Nitrogen fertilizer and plant density constituted the subplot and sub- subplots, respectively. The results showed that transplanting dates have a significant effect on yield, plant height, panicle length, 1000-grain weight and number of unfertile seed. The highest and lowest yields were observed for transplanting date of May 15 and June 14, respectively. Nitrogen fertilizer and plant density have a significant effect on Tiller number, unfertile seed and yield. The highest and lowest yields were observed for 250 kg and 150 kg urea per hectare and 30*10 cm and 25*25 cm, respectively. Generally, with delay in transplanting date, lower amount of nitrogen fertilizer and higher plant density grain yield decreased in all the promise lines of rice.
Keywords: Rice, Transplanting Date, Nitrogen, Density, Yield.

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CORN HYBRIDS YIELD ESTABILITY OF CORN HYBRIDS ON RIO GRANDE DO SUL STATE, (BRAZIL), IN RICEPRODUCTION SOILS

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The agricultural crop diversificationdiversification's experiences in in lowlands areas (rice soils) on the Rio Grande do Sul state (RS) lowlands aims to qualify the productive system historically based on the rice/cattle-raising binomial. Corn production technology in these areas, comprehends not only crop and environmental management, but also the correct cultivar variety use. Corn hybrids grain yield is influenced by environmental factors, which can interact with plant genotype. A study was carried out with the objective of identify stable and/or responsive corn hybrids to grain yield in RS hidromorfic soils. It was used yield data (t/ha) of a group of corn trials developed in fifteen environments in the agricultural period from 1995/96 to 2000/01. Stability was analyzed by an unbalanced discontinuous bi-segmented model. Each hybrid was classified based on: 1. The comparison of its yield average with the average of all hybrids; 2. As a function of parameters from discontinuous bi-segmented equation (β_1 and β_2) and; 3. As a function of its adjustment quality (R^2). AG 6018, P 30F33, P 30K75, DKB 215 and DKB 344 hybrids were recommended for intermediate environments; AGN 2012, AGN 3150, BRS 3060, and P30R07 hybrids, for higher-than intermediate environments, and AG 5011, G800 and P 3063 hybrids for all environments, indicating that these are responsive hybrids.
Key words: Zea mays L., cultivarvarieties, genotype x environment, grain yield, yield stability, lowland areas.

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ESTABILIDADE DE RENDIMENTO DE HÍBRIDOS DE MILHO EM SOLOS DE ARROZ DO RIO GRANDE DO SUL, BRAZIL
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Experiências de diversificação na produção de grãos, em solos de arroz (várzeas) do Rio Grande do Sul (RS), Brazil, têm mostrado resultados positivos para a sustentabilidade do sistema produtivo, alicerçado, historicamente, no binômio pecuária de corte-arroz. A tecnologia de produção do milho nessas áreas envolve, além do manejo da cultura e do ambiente (solo e água), a utilização de cultivares adequadas. A produtividade do milho é influenciada pelas características peculiares dos solos hidromórficos, podendo haver interação entre genótipos e ambiente. Este estudo objetivou identificar híbridos de milho estáveis e/ou responsivos em rendimento de grãos, em diferentes ambientes de solos hidromórficos. Foram utilizados os resultados de ensaios de híbridos de milho, conduzidos em 15 ambientes, no período agrícola de 1995/96 até 2000/01. Foi utilizada a análise de estabilidade pelo modelo bisegmentado descontínuo desbalanceado. A classificação dos híbridos deu-se pela comparação de sua média com a média geral; em função dos parâmetros da equação bisegmentada descontínua (β_1 and β_2); e, em função da qualidade do ajustamento (R^2). Classificaram-se os híbridos AG 6018, P 30F33, P 30K75, DKB 215 e DKB 344, como recomendados para ambientes médios; AGN 2012, AGN 3150, BRS 3060 e P 30R07, apenas para ambientes acima da média e AG 5011, G 800, P 3021 e P3063, para qualquer ambiente, sendo considerados do tipo ideal ou responsivos.
Palavras-chave: *Zea mays* L., cultivar, genótipo x ambiente, produção de grãos, estabilidade de rendimento, terras baixas.

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maNage rice – CROP-MANAGEMENT SOFTWARE FOR THE AUSTRALIAN RICE INDUSTRY
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maNage rice is an interactive software package used by about 600 of the 2200 Australian ricegrowers and their advisers. Its main function is to indicate the optimum rate of topdressed N fertilizer, based on predicted yield response in relation to cold-damage, flood-water depth at the microspore stage, cultivar and sowing date. It also calculates riskiness of yield response to N in relation to cold damage, profitability in relation to grain price and fertilizer cost, and the probability of achieving a known return. Since 2001 three new functions have been added, based on automatic downloads of daily temperature, evapotranspiration (ET) and rainfall http://www.clw.csiro.au/services/weather): (1) Predictions of the stages of panicle initiation, microspore, flowering and physiological maturity, based on cultivar, sowing date, photoperiod and downloaded temperature. (2) A water-use calculator based on ET, rainfall, percolation below the root-zone and crop duration. The calculator uses downloaded ET from sowing to the current date (as shown on the computer clock) and then long-term average ET from that date until maturity. This information assists ricegrowers in planning future irrigation needs. (3) Prediction of optimum harvest date, based on rate of grain-drying, percent whole grain and soil dry enough for harvesting. The rate of grain drying is estimated from an initial measurement of grain moisture, daily ET (downloaded or long-term average), and soil moisture status. Percent whole grain is estimated from the moisture content and rate of drying. The soil moisture is estimated from the date of drainage and daily ET.

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PREDICTING NITROGEN MINERALIZATION OF RICE SOILS WITH NIR
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Nitrogen fertilizer applied at sowing is twice as efficient as topdressed N for rice in the Australian riverina. Despite this advantage, only two-thirds of the N fertilizer is applied at sowing because there is no soil test to predict the optimum amount and there is a yield penalty from cold damage and lodging of overfertilized crops. A rapid test to predict N mineralization in flooded soil could improve N-use efficiency. A preliminary study using 22 soils showed that near infrared reflectance (NIR) spectra were correlated (r=0.85) with N-mineralization in anaerobic conditions (40°C for 21 days) and with plant N uptake in a controlled environment (r=0.87). However neither anaerobic incubation nor NIR was closely correlated with N uptake by rice growing in the field in different seasons. A calibration of NIR spectra with anaerobic N-mineralisation was developed (r=0.66) using 807 soils. Predicted mineralisation was then tested using a set of 63 independent soils. The standard error of prediction was 27 mg N/kg for a range of data from 20 to 220 mg N/kg, implying that the method is capable of separating soils into 4 mineralization classes. Many Australian ricegrowers can distinguish soil-N supply with this level of accuracy, based on intuition and knowledge of field history, so the NIR test alone provides little progress. There are indications that variation in soil properties not detected by NIR may contribute to the low accuracy, so there may be scope for future improvements in predicting N mineralisation.

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IMPROVEMENT OF BINASHAIL RICE LODGING CONTROL THROUGH EFFICIENT FERTILIZER MANAGEMENT
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Lodging is a major threat to cultivate temperate rice in Bangladesh. Field experiment was conducted at Ishurdi Substation of Bangladesh Institute of Nuclear Agriculture, Bangladesh to investigate the fertilizer management to overcome this lodging tendency of Binashail rice. There were seven treatments such as T1=control i.e. 39-18-15, T2=47-20-23, T3=47-28-23, T2=63-20-23, T5=47-38-23, T6=63-38-23 and T7=63-38-23 N-P-K as urea-triple super phosphate-muriate of potash. The experiment was set in RCBD with three replications having plot size 4x5 m^2. Results showed that T3 treatment produced the highest grain and straw yield (4.82 and 6.75 t/ha) over other treatments. The highest plant height, effective tiller per hill, panicle length, grain per panicle, effective grain per panicle, 1000 seed wt., nitrogen uptake, phosphorus uptake and B:C ratio were observed 105.0 cm, 9.73, 22.36, 122.73, 102.73, 18.17g, 85.63 kg/ha, 45.24 kg/ha and 1.92, respectively in T3 treatment and tiller per hill 10.93 (T6 and T7). Nitrogen balance sheet observed slightly decreased the nitrogen content in soil. From this results it revealed that optimum nitrogenous fertilizer in combination with phosphorus and potassium could serve as potential amendments to protect the lodging and yield of Binashail rice and also favourably influenced by the use of fertilizer at optimum level.
Keywords: Binashail rice, Lodging, Fertilizer management

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EVALUATION OF SOIL P AVAILABILITY METHODS IN IRRIGATED RICE CROPS OF URUGUAY
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Generally soil P availability methods present low prediction capacity in irrigated rice crops. In order to compare the behavior of classical and alternative methodologies, the response to P addition was evaluated in 40 field trials. The soils differed in their chemical characteristics (iron oxides, organic C, and clay content) and in P availability. P added levels were 0, 30, 60 and 90 kg P_2O_5 ha^{-1}. P availability was estimated by Bray 1, 1% citric acid, Mehlich 3, Olsen and 0.2M ammonium oxalate methods, as well as by Bray 1 method after 3 and 7 days of anaerobic incubation periods. The plant parameter evaluated was rice grain yield. The response index used was relative yield, calculated as the relationship between the treatment without P addition and the average of the two highest yielding treatments. There was a high correlation among the amounts of P extracted by the different methods. For the soils of the east and north-east region of the country, with rice yields greater than 6000 kg ha^{-1}, the 1 % citric acid extraction presented the highest relationship with the response index (R^2=0.626), followed by Mehlich 3 (R^2=0.432) and Bray 1 (R^2=0.314). For these methods the soil P critical levels were 7, 6 and 7 mg P kg^{-1} respectively. The other methodologies tested showed lower relationships with relative yield. On Basaltic soils no relationships were found between P extracted by the different methods and relative yield.
Keywords: methods of P availability, irrigated rice, P critical levels

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EVALUACIÓN DE MÉTODOS PARA ESTIMAR LA DISPONIBILIDAD DE P DEL SUELO EN CULTIVO DE ARROZ IRRIGADO EN URUGUAY
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Los métodos utilizados para estimar la disponibilidad de P en arroz irrigado generalmente presentan escaso poder predictivo. Con el objetivo de comparar el comportamiento de metodologías clásicas y alternativas, se evaluaron 40 ensayos de campo de respuesta a P en suelos variables en sus características químicas (contenidos de óxidos de hierro, carbono orgánico y arcilla), y disponibilidad de P. Los niveles de P agregado fueron 0, 30, 60 y 90 kg P_2O_5 ha^{-1}. Se estimó el P disponible por los extractantes Bray 1, ácido cítrico al 1%, Mehlich 3, Olsen, Bray 1 post incubación anaerobia de 3 y 7 días, y oxalato de amonio 0.2M. En planta se determinó el rendimiento de arroz en grano. El índice de respuesta usado fue el rendimiento relativo del testigo respecto al promedio de los dos tratamientos de mayor rendimiento. Las cantidades de P extraídas por los diferentes métodos estuvieron altamente correlacionadas entre si. Para los suelos de la zona este-noreste del país, con rendimientos de arroz mayores a los 6000 kg ha^{-1}, el P extraído por el ácido cítrico al 1% guardó mayor relación con el índice de respuesta utilizado. No pondría nada o pondría esto = respecto al (R^2=0.626), seguido por Mehlich 3 (R^2=0.432) y Bray 1 (R^2=0.314). Los niveles críticos de P en el suelo fueron de 7, 6 y 7 mg P kg^{-1} de suelo, respectivamente. Las restantes metodologías mostraron menores relaciones con el rendimiento relativo del testigo. En suelos del norte sobre basalto ninguno de los métodos evaluados mostró buen poder predictivo de la disponibilidad de P.
Palabras clave: métodos P disponible, arroz irrigado, niveles críticos de P

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P AVAILABILITY METHODS AND THEIR RELATIONSHIP WITH CHEMICAL CHARACTERISTICS IN RICE SOILS
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P availability in irrigated rice soils have particularities associated with the dynamics of iron compounds. In order to evaluate the soil P availability estimated by different methods, and their relationship with some soil characteristics, 41 soil samples were taken from fields which differed in their chemical characteristics and residual P content. P availability was estimated by Bray 1, 1% citric acid, Mehlich 3, Olsen, and 0.2M ammonium oxalate methods, as well as by Bray 1 method after 3 and 7 days of anaerobic incubation periods. The amount of iron extracted by sodium dithionite (Fe_d) and 0.2M ammonium oxalate (Fe_o), organic carbon (OC) and clay content (CC) were determined. High correlations were observed between the amounts of P determined by the different methods. Bray 1, citric acid, Mehlich 3 and Olsen methods extracted similar quantities of P, whereas P extracted after 3 and 7 days anaerobic incubation periods were higher. Citric acid and Mehlich 3 gave a better estimation of the soil residual P from previous P applications. The P released from the anaerobic incubation was positively correlated with the iron activity index (Fe_o/Fe_d). Ammonium oxalate method extracted the highest amounts of P that were significantly correlated to OC, Fe_o/Fe_d and CC. The Bray 1, 1% citric acid, Mehlich 3 and Olsen methods did not show significant correlations with OC, Fe_o/Fe_d and CC; however citric acid presented a weak relationship with Fe_o/Fe_d ($P<0.073$).
Key words: methods of P availability, flooded soils, iron oxides, organic carbon

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MÉTODOS PARA ESTIMAR LA DISPONIBILIDAD DE P Y SU RELACIÓN CON CARACTERÍSTICAS QUÍMICAS DE SUELOS DEL CULTIVO DE ARROZ
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La disponibilidad de P en suelos inundados presenta particularidades asociadas a la dinámica de las formas de hierro. Con el objetivo de evaluar la estimación realizada por diferentes métodos de análisis de P disponible, y su relación con características de suelo, se muestrearon 41 suelos arroceros con diferentes características químicas e historia de fertilización fosfatada. Se realizó la estimación de P disponible por los métodos Bray 1, ácido cítrico al 1%, Mehlich 3, Olsen, oxalato de amonio 0.2M, y Bray 1 post incubación anaerobia de 3 y 7 días. Se determinó el hierro extraído por ditionito de sodio (Fe_d) y oxalato de amonio 0,2M (Fe_o), carbono orgánico (Corg) y contenido de arcilla (Ac). Se observaron altas correlaciones entre las cantidades de P extraídas por los diferentes métodos. Los métodos Bray 1, ácido cítrico, Mehlich 3 y Olsen extractaron cantidades similares de P, mientras que las extracciones por Bray 1 post incubación anaerobia de 3 y 7 días dieron resultados mayores. Los métodos cítrico y Mehlich 3 estimaron mejor la residualidad del P de aplicaciones anteriores. El P liberado durante la incubación anaerobia se correlacionó positivamente con el Índice de Actividad de Fe (Fe_o/Fe_d). El oxalato de amonio fue el método que extrajo las cantidades más elevadas de P, las cuales se correlacionaron significativamente con Corg, Fe_o/Fe_d, y Ac. Los métodos Bray 1, cítrico, Mehlich 3 y Olsen no mostraron relaciones significativas con Corg, Fe_o/Fe_d, y Ac, aunque cítrico presentó cierto grado de relación con el parámetro Fe_o/Fe_d ($P<0.073$).
Palabras clave: métodos de P disponible, suelos inundados, óxidos de hierro, carbono orgánico

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USE OF THE RICE GROWTH STAGING SYSTEM TO UNDERSTAND TIMING OF SILICA UPTAKE AND OTHER PHENOMOMEN
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The rice growth staging system has been developed to allow better communication about rice (Counce, Keisling and Mitchell. 2000. Crop Science 40:436-443). The basis of the system is the presence of objective morphological markers for determining the stage of development for a rice plant. Since silica deposition is important to both disease and insect resistance, we sought to better understand the stage of development for silica deposition. Seedling development consists of four growth stages: unimbibed seed (S0), radicle and coleoptile emergence (S1,S2), and prophyll emergence from the coleoptile (S3). Vegetative development consists of stages V1, V2...VN; N being equal to the final number of leaves with collars on the main stem. Reproductive development consists of 10 growth stages based on discrete morphological criteria: panicle initiation (R0), panicle branch differentiation (R1), flag leaf collar formation (R2), panicle exertion (R3), anthesis (R4), grain length and width expansion (R5), grain depth expansion (R6), yellow grain (R7), brown grain (R8), and all grains which reached R5 have reached R8 (R9). Growth stages R4-R8 are indicated when one grain on a main stem panicle has reached the indicator grain stage (that is for a plant with only one grain at anthesis (R4) and all other grains earlier, the growth stage would be R4). Individual panicles were harvested at various growth stages, and the individual grains were divided into their indicator grain classes R3-R8. We measured silica contents of rice seeds over a range of rice growth stages and found silica deposition to be occurring primarily between R3 and R4 and between R6 and R7 growth stages. Silica was deposited in the hull of rice grains during growth stages R3, R4 and R6 and R7. The rice growth staging system can be used to experimentally elucidate these and other topics of rice research.

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PLATAFORMA DE COLHEITA E COLHEITA MANUAL COM TRILHA MECÂNICA SOBRE QUALIDADE DE SEMENTES ARROZ
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Durante a colheita do arroz irrigado ocorrem perdas e danos físicos e fisiológicos às sementes. No final da década de oitenta, surgiram as plataformas recolhedoras que retiram ou arrancam o grão ao invés de cortar a panícula, porém pouco se conhece a respeito dos danos físicos e fisiológicos que este sistema de plataforma pode causar às sementes. Este trabalho teve por objetivo avaliar os danos mecânicos causados às sementes de cultivares de arroz BR-IRGA 409 e BR-IRGA 410, por três formas de colheita: (a) colheita manual e trilha mecânica; (b) colheita com plataforma de corte; (c) colheita com plataforma recolhedora. Quando a colheita for mecânica, realizou-se a coleta das amostras diretamente do graneleiro. O delineamento experimental foi blocos ao acaso, com seis repeticões. Os resultados demonstraram que as sementes de arroz irrigado dos cultivares estudados apresentaram diferenças significativas e suas qualidades físicas e fisiológicas, quando colhidas com plataforma de corte e com plataforma recolhedora. Estes dois métodos de colheita, porém, apresentaram danos significativamente maiores quando comparados à colheita manual e trilha mecânica.
Palavras-chave: colheita mecânica, plataforma de corte, plataforma recolhedora.

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HARVEST HEADER AND MANUAL HARVEST WITH MECHANICAL STRIP ON RICE SEEDS QUALITY
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During irrigated rice harvesting occur losses and physical and phisiological seed demage. Late 80, appeared the stripper headers that strip the grain, instead of cutting the spike. However, little is know about physical and physiological seed damage by harvest header. The objective of this work was to evaluate the mechanical demage caused to BR-IRGA 409 and BR-Irga 410 rice cultivars by three harvesting methods: (a) manual harvesting and mechanical strip; (b) cutterbar harvesting and; (c) stripper header harvesting. Samples were collected directly in the grain tank when the harvest was mechanical. The experimental design was randomized blocks whit six replications. Results demonstrated that rice seeds of the studied variety didn't showed significant differences in physical and physiological in seed quality when harvested by cutterbar or striper header. These two harvesting forms, howevwe, showed significantly seed damages when compared to manual harvesting and mechanical stip.
Key words: hervest, vutterbar header, stripper header.

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FATTENING LAMBS ON SUMMER SOIL TILLAGE IN RICE-LIVESTOCK SYSTEMS
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The effect of lamb stocking rate (SR) grazing summer soil tillage before rice introduction was evaluated on animal production and rice yield. This study was carried out at the Rice - Livestock Production Research Unit - INIA Treinta y Tres (Uruguay). The summer soil tillage was done 8 months before rice sowing. The swards used were dominated by regenerated ryegrass, natural grasses and weeds. The SR evaluated were 6, 12 and 18 lambs/ha, using continuous grazing, from June to October 2000. Initial liveweight of the lambs was 30,6 kg, and the average daily gain was 97, 57 and 8 g., for 6, 12 and 18 lambs/ha, respectively. All the lambs in the lowest SR achieved the requirements of the local lamb heavy market. Lamb carcass weight (cold) and fatness (GR point) were maximum with 6 lambs/ha, with values of 17,7 kg and 12,0 mm, respectively. The best combination between animal production/ha and product quality was achieved at the lower SR. Rice yield was not affected by the different SR applied. Fattening lambs on summer soil tillage in rice - livestock production systems is a complementary productive alternative in those systems, resulting in better farm incomes with low investment and fast capital recovery.

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ENGORDE DE CORDEROS SOBRE LABOREOS DE VERANO EN SISTEMAS DE ARROZ - GANADERÍA

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En la Unidad de Producción Arroz - Ganadería de INIA Treinta y Tres (Uruguay) se realizó un estudio que evaluó el efecto de diferentes dotaciones de corderos en laboreos de verano previo a la siembra del arroz sobre productividad animal y en el rendimiento posterior del cultivo. El laboreo de verano se realizó con 8 meses de anticipación a la siembra del arroz. Los componentes de la pastura fueron raigrás regenerado, gramíneas naturales y malezas. Se evaluaron 6, 12 y 18 corderos/ha en pastoreo continuo entre los meses de junio y octubre de 2000. El peso inicial de los corderos fue 30,6 kg. La ganancia de peso de los corderos fue de 97, 57 y 8 g/a/día para las cargas de 6, 12 y 18 corderos/ha, respectivamente. Todos los animales del tratamiento de 6 corderos/ha cumplieron con los estándares de calidad de la industria. Los pesos de canales fría y grados de terminación (punto GR) fueron máximos en el tratamiento de 6 corderos/ha, con valores de 17,7 kg y 12,0 mm, respectivamente. La combinación de producción por ha y calidad de producto obtenido se logró en la dotación de 6 corderos/ha. El rendimiento del cultivo de arroz no fue afectado por las dotaciones evaluadas. El engorde de corderos sobre laboreos de verano en sistemas de arroz - ganadería es una alternativa de producción que logra una complementación entre rubros, permite la diversificación productiva y mejora los ingresos de dichas empresas, siendo de baja inversión y rápida recuperación del capital invertido.

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STRAIGHTHEAD DAMAGE IN RICE SEED AND ITS DETECTION BY TETRAZOLIUM TEST

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Straighthead is a physiological disorder associated with soil conditions, that causes yield reduction and seed quality deterioration in rice. Control of the disease is obtained by draining fields. Two different experiments were set during the 93/94 season to study straighthead effect on rice seeds, and to check if this type of seed damage could be detected by the tetrazolium test. In a pot experiment five varieties were grown in soil mixtures with increasing percentage of a straighthead inducing soil, trying to obtain a range of disease severity. Another experiment was conducted taking seed samples from two water management trials: a) Time of flooding - 15, 30, 45, 60, and 75 days after emergence; b) Flooding/drainage - Drainage intervals of 15, 25, and 35 days before heading. Standard germination and Tetrazolium (TZ) test were performed with seeds from pot and field experiments. In the TZ test, embryo classification was done into the common viable and non-viable categories, and three other types of embryo abnormalities, not usually classified for rice seed. These other categories were: Poorly differentiated embryo (PDE), Non differentiated embryo (NDE), and Seeds without embryo (SWE). The addition of them was considered Total straighthead damage (STR). An independent susceptibility to yield and seed viability was seen among the cultivars evaluated. A consistent relationship between the degree of seed deterioration by straighthead, and the STR symptoms in the TZ test was found. The possibility to detect straighthead deteriorated seed lots by TZ test was demonstrated, and the inclusion of these "straighthead embryo symptoms" into the ISTA Tetrazolium Rules for rice is suggested.

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DAÑOS EN SEMILLA DE ARROZ CAUSADOS POR ESPIGA ERECTA Y SU DETECCIÓN MEDIANTE EL ANÁLISIS DE TETRAZOLIO

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Espiga erecta o "straighthead" es un desorden fisiológico asociado a condiciones de suelo, que causa reducción de rendimiento y problemas de calidad de semilla en el arroz. El control de esta enfermedad se obtiene mediante el drenaje temporario del cultivo. Dos experimentos diferentes fueron instalados en la zafra 1993/1994 para estudiar el efecto de espiga erecta en semilla de arroz y para evaluar si los daños de esta enfermedad podían ser detectados por el análisis de Tetrazolio. En un experimento en macetas cinco variedades de arroz fueron cultivadas con una mezcla de suelos, con proporciones crecientes de un suelo inductor de daños de espiga erecta. El objetivo de esta variación de suelos era obtener un rango de severidad de la enfermedad. Otro experimento fue conducido tomando muestras de semilla de dos experimentos de manejo de riego de arroz: a) Ensyo sobre momento de inundación – 15, 30, 45, 60 y 75 días después de la emergencia; b) Ensayo de inundación y drenaje – intervalos de drenaje de 15, 25 y 35 días realizados antes de la floración. Se realizaron análisis estándar de germinación y análisis de viabilidad por Tetrazolio (TZ) a las semillas obtenidas del ensayo macetero y de los ensayos de campo. En el TZ la clasificación de embriones se hizo sobre la base del estándar de categorías de semillas viables y no viables y se incluyeron otros tres tipos de anormalidades del embrión no definidas en los manuales para semilla de arroz. Estas categorías fueron: embriones poco diferenciados (PDE), embriones no diferenciados (NDE) y semillas sin embrión (SWE). La suma de estas tres categorías se consideró como daño total por espiga erecta (STR). Los resultados muestran una susceptibilidad independiente a daños en rendimiento o en calidad de semilla entre las variedades evaluadas. Se encontró una relación consistente entre el grado de deterioro de la semilla de arroz por espiga erecta y el porcentaje de embriones con síntomas STR en el análisis TZ. La posibilidad de detectar los daños causados por espiga erecta en la semilla mediante el análisis de TZ fue demostrada y la inclusión de esas categorías de daño de embriones por espiga erecta en las reglas de Análisis de Tetrazolio de ISTA es sugerida.

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TECHNOLOGY FOR RICE CROP SEEDING WITH MINIMUM OR NO-TILLAGE FOR EASTERN URUGUAY

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The paper summarizes recommendations derived from research conducted since 1992, with no-tillage seeding in spring, on soils prepared 8 to 9 months earlier. Under these conditions, there was a need of higher Nitrogen (N) fertilization and of early flush irrigation of the field than with conventional tillage, to assure crop establishment. Good *Echinochloa sp.* control was obtained with tank mixes, or sequences, of Glyphosate with pre-emergent herbicides, when soil coverage by existing vegetation was lower than 60%. Rice crop establishment and grain yield were affected by seeding of Ryegrass (*Lolium multiflorum L.*) in the previous fall-winter. In order to control this pasture for early rice planting, in cool springs, Glyphosate dose must be higher than 2 l/ha, and the period between final grazing and herbicide application does not affect rice yields. Anticipation of Glyphosate application, with reference to rice seeding, is beneficial for early N nutrition and rice yield. Lower root and foliage development observed under no-tillage was not improved with N application in different stages. Indica varieties had better relative behavior than Tropical Japonica ones under this system. Soil compaction caused by lamb grazing (6 to 18 animals/ha) did not affect rice yield.

Keywords: Rice, Ryegrass (Lolium multiflorum L.), Herbicide management, Glyphosate, No-tillage, Nitrogen fertilization, Irrigation management

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TECNOLOGÍA PARA LA SIEMBRA DEL CULTIVO DE ARROZ CON REDUCCIÓN O ELIMINACIÓN DEL LABOREO PARA LA ZONA ESTE DEL URUGUAY
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Se realizan una serie de recomendaciones derivadas de la investigación efectuadas a partir del año 1992 con siembra bajo cero laboreo en primavera sobre suelos preparados con 8 a 9 meses de anticipación. Se ha encontrado mayor necesidad, referido al laboreo convencional, de la aplicación de nitrógeno (N) así como también de realizar tempranamente un baño en años con déficit hídrico para asegurar la implantación. Se determinó un buen control de *Echinochloa sp.* con la aplicación de mezclas de glifosato con preemergentes sobre tapices previos con cobertura vegetal no superior al 60% del área. Se encontró que la siembra previa de raigrás (*Lolium multiflorum L.*) incidió negativamente en la implantación y los rendimientos de grano. Para el control de esta pastura, se verificó que en siembras tempranas del arroz en primaveras frías la dosis de glifosato debe ser mayor a 2 l/ha mientras que el momento de retiro del ganado no afecta los rendimientos del cultivo. La anticipación de la aplicación del glifosato con respecto a la siembra del arroz ha sido beneficiosa en la nutrición nitrogenada temprana y rendimiento final del arroz. El menor desarrollo radicular y foliar de las plantas bajo cero laboreo no fue superado por la aplicación de N en distintos momentos. Las variedades de tipo tropical tuvieron mejor performance relativa en este tipo de siembra. La compactación provocada por corderos (entre 6 y 18 animales/ha) no afectó el rendimiento final del arroz.
Palabras claves: Arroz, Raigrás (*Lolium multiflorum L.*), Manejo de herbicidas, Glifosato, Cero Laboreo, Fertilización nitrogenada, Manejo del riego

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EFFECTS OF RYEGRASS (*Lolium multiflorum L.*) MANAGEMENT IN THE ESTABLISHMENT AND YIELD OF RICE SEEDED WITH NO-TILLAGE IN EASTERN URUGUAY
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In Eastern Uruguay, soil use is shared by rice crop and livestock. It is possible to improve the winter utilization of soil by livestock with the use of Ryegrass (*Lolium Multiflorum L.*). In recent years, soil tillage for rice has been reduced or eliminated, creating a need for information for soil and pasture management under this system. Two experiments were set in INIA Treinta y Tres (Lat. 33º S) to determine Ryegrass incidence, as well as different variables of pasture management, in rice establishment and yield. In the first one, three Ryegrass seeding rates (0, 20 and 40 kg/ha) were combined with two cutting heights (5 and 10 cm, simulating animal grazing), to evaluate rice establishment, grain yield and its components, from 1995 to 1998. There were negative effects of Ryegrass in two of the three years, and its effects were reduced by intensive cutting (5 cm). The second experiment evaluated the effect of period between cutting and Glyphosate application times (24-28 days vs. 12-14 days) interacting with three doses of Glyphosate (2, 4 and 6 l/ha) in two seeding times (October and November). In this experiment, dose of Glyphosate interacted with time of seeding, and the 2 l/ha dose had a poor control in the first seeding time and a good one in the second seeding. The length of period between cutting and application had no effect on rice yield.
Keywords: Rice, Ryegrass (*Lolium multiflorum L.*), Glyphosate management, No-tillage

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EFECTOS DEL MANEJO DEL TAPIZ PREVIO DE RAIGRÁS (*Lolium multiflorum L.*) EN LA IMPLANTACIÓN Y RENDIMIENTO DE ARROZ SEMBRADO CON CERO LABOREO PARA LA ZONA ESTE DEL URUGUAY
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En la zona Este del Uruguay, el cultivo de arroz comparte con la ganadería el uso del suelo siendo posible un mayor aprovechamiento invernal de los mismos con raigrás (*Lolium multiflorum L.*). También se ha reducido o eliminado el laboreo existiendo poca información referente al manejo de las pasturas previas al arroz bajo estas condiciones de siembra. Se instalaron dos experimentos en el Este del Uruguay (Paso de la Laguna) (Lat. 33° S) con el objetivo de conocer la incidencia del raigrás previo al cultivo así como también los efectos de distintas variables de manejo del mismo en la implantación y rendimiento. En el primero de ellos se combinaron tres densidades de siembra del raigrás (0, 20 y 40 kg/ha) con dos alturas de corte (5 y 10 cm simulando el pastoreo animal) evaluándose la implantación del arroz, su rendimiento en grano y componentes, en los años 1995/96, 1996/97 y 1997/98. Se encontraron efectos negativos de la pastura en dos de los tres años siendo atenuada tal incidencia con un corte bajo de la misma. En el segundo experimento se estudiaron los efectos del período corte de la pastura – aplicación del glifosato interaccionando con tres dosis del herbicida (2,4 y 6 lt/ha) en dos épocas de siembra del arroz (Octubre y Noviembre) en el año 1996/97. Se determinó interacción entre dosis de glifosato y época de siembra en donde la dosis de 2 lt/ha realizó un mal control en la primera época y buena en la segunda. En cambio, el período corte – aplicación del glifosato no tuvo mayor incidencia en el rendimiento del cultivo.
Palabras claves: Arroz, Raigrás (*Lolium multiflorum L.*), Manejo de herbicidas, Glifosato, Cero Laboreo

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EFFECT OF ANTICIPATED GLYPHOSATE APPLICATION FOR NO-TILLAGE SEEDING OF RICE IN EASTERN URUGUAY
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Rice crop seeded with no-tillage has higher management demands for stand establishment compared with conventional tillage. Considering that initial Nitrogen (N) availability and presence of vegetal residues could interfere with early rice establishment, anticipated Glyphosate application, for no-tillage seeding, may improve both factors. With the objective to verify this hypothesis, an anticipated Glyphosate application was compared with one prior to seeding (late treatment), in two locations of Eastern Uruguay (Paso de la Laguna and Arrozal 33) in 2001/02. The anticipated treatment consisted of two Glyphosate applications (45 days before and at planting) in Paso de la Laguna, while there was only one (32 days before planting) in Arrozal 33. Late treatment in Paso de la Laguna was applied 15 days before planting and, in Arrozal 33, the day before seeding. Dry matter production and N uptake were evaluated at tillering stage and grain yield at maturity. Anticipated Glyphosate application improved N uptake at tillering stage (36%) (P=0.002) and yield (21%) (P=0.000) in Paso de la Laguna, while in Arrozal 33, it only improved yield 7% (P= 0.09). Therefore, anticipated Glyphosate application is favorable to early N nutrition and yield of the crop, provided that weeds are controlled and do not interfere with initial N availability.
Keywords: Rice, No-tillage, Glyphosate management

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EFECTOS DE LA ANTICIPACIÓN DE LA APLICACIÓN DEL GLIFOSATO PARA LA SIEMBRA DE ARROZ CON CERO LABOREO EN LA ZONA ESTE DEL URUGUAY
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Se han determinado mayores exigencias en el manejo para la implantación del cultivo de arroz sembrado con cero laboreo que las correspondientes a la siembra convencional. Posiblemente, la disponibilidad de nitrógeno (N) y la presencia de restos vegetales pueden interferir en la misma. La aplicación anticipada del glifosato puede mejorar la incidencia de estas dos variables para la siembra con cero laboreo. Con tal motivo se comparó una aplicación anticipada de glifosato contra otra realizada poco antes de la siembra en dos localidades del Este del Uruguay (Paso de la Laguna y Arrozal 33) en el año 2001/02. En Paso de la Laguna, en el tratamiento anticipado se realizaron dos aplicaciones de herbicida (45 días antes y el mismo día de la siembra) mientras que en Arrozal 33 se efectuó una (32 días antes). El tratamiento tardío en Paso de la Laguna se efectuó a los 15 días antes de la siembra y en Arrozal 33 el día anterior a la misma. Se evaluó la cantidad de materia seca y de N absorbido al estado de macollaje así como el rendimiento encontrándose diferencias en estas variables a favor de la anticipación de la aplicación del glifosato para Paso de la Laguna (36% en el consumo de N, P=0.002 y 21%, P=0.000, en el rendimiento) mientras que en Arrozal 33 solo hubo diferencias en el mismo sentido en un 7% en el rendimiento (P= 0.09). Por lo tanto la aplicación anticipada del herbicida es ventajosa en la nutrición temprana del cultivo debiendo controlarse las malezas para que no interfieran en la disponibilidad inicial de N.
Palabras claves: Arroz, Cero Laboreo, Manejo de Herbicidas, Glifosato

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DRY MATTER PRODUCTION AND DISTRIBUTION AFTER FLOWERING OF THREE RICE CULTIVARS IN DIFFERENT GROWING SEASONS AND PLANTING DATES.
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The evolution of dry matter distribution between leaves, stem plus sheath and panicles for the two more cultivated rice varieties (El Paso 144 and INIA Tacuarí) and a more recent one (INIA Zapata) are presented for two planting dates and growing seasons. Although is known that after flowering the dry matter from reserves accumulated in tillers, sheaths and leaves, as well as from photosynthesis, are reallocated in the panicles, with some genetic differences among varieties; it is important to know the variation of the accumulation of dry matter among the different components within and between years. The major objectives of this study were to measure the dry weight production, between successive moments, of the different components observing the variability between planting dates of a given growing season. The evolution of the weight of each component (panicles, stems plus sheaths and leaves) were measured every ten days after 100% flowering for the 2000/01 and 2001/02 growing seasons. These two growing seasons were not affected by low temperature conditions. The results of a combine analysis and correlations with climatic data in these two growing season is presented.
Key words: Rice, dry matter production and distribution, climate.

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PRODUCCIÓN Y DISTRIBUCIÓN DE LA MATERIA SECA LUEGO DE LA FLORACIÓN PARA TRES VARIEDADES DE ARROZ EN DIFERENTES ZAFRAS Y EPOCAS DE SIEMBRA
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Se presenta la evolución de la distribución de la materia seca entre hojas, tallo más vaina y panojas para las dos variedades de mayor área de siembra en el país (El Paso 144 e INIA Tacuarí) y una de reciente liberación (INIA Zapata) en dos épocas de siembra durante dos años. Si bien es conocido que luego de la floración la materia seca proveniente de las reservas en tallo, vaina y hojas así como de la fotosíntesis se acumula en la panoja, habiendo variaciones de origen genético, también es importante conocer la variación que existe para los componentes entre y dentro de años. Los objetivos principales del trabajo fueron medir la producción entre los distintos momentos sucesivos de la materia seca entre los componentes observando las variaciones entre dos épocas de siembra dentro de un mismo año. La evolución en peso de cada componente se registró cada diez días luego del 100% de floración en cinco momentos en los años 2000/01 y 2001/02. Se presentan resultados de un análisis combinado y las correlaciones con parámetros del clima en los dos años sin limitaciones por bajas temperaturas para el cultivo.
Palabras claves: Arroz, Producción de materia seca, Clima

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GRAIN FILLING CHARACTERISTICS OF FOUR RICE CULTIVARS IN DIFFERENT GROWING SEASONS AND PLANTING DATES
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The knowledge of when a cultivar achieves its physiological maturity and its grain filling strategies under different growing conditions are two important aspects for determining its cycle and harvest time. With this goal, grain filling evolution, rate and duration were determined for El Paso 144, INIA Tacuarí, INIA Caraguatá and INIA Zapata in two planting dates during several growing seasons. The correlation among 1000 kernel weight, grain filling rate and duration, and panicle size and with climatic data of the first month of grain filling, when the filling rate was higher, were studied. Polynomial equations, mainly of the third order, fitted well the evolution of grain filling of the different cultivars and growing seasons. A rapid phase of grain filling was observed during the first 30 to 35 days after 50% heading. This phase was followed by a slower filling phase until physiological maturity was reached. The different cultivars differed in their grain filling durations (from 50% heading to physiological maturity), measured as degree day with base temperature of 50 F. El Paso 144 showed the shortest average grain filling duration, INIA Caraguatá and INIA Zapata intermediate and INIA Tacuarí the longest one. Within the most common cultivar used by growers, INIA Tacuarí, a Japanese type cultivar, registered a more stable grain filling duration among years than EL Paso 144, a Tropical type cultivar, evaluated in the same number of experiments.
Key words: Rice, 1000 kernel weight, grain filling, grain filling rate, grain filling duration, climate.

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CARACTERISTICAS DEL LLENADO DE GRANO PARA CUATRO VARIEDADES DE ARROZ EN DIFERENTES ZAFRAS Y EPOCAS DE SIEMBRA
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La determinación del momento de madurez fisiológica y la evolución del llenado de grano de una variedad en diferentes condiciones climáticas es importante para el conocimiento de la duración del ciclo y la decisión de la época de cosecha. Con tal motivo, se determinó la evolución, la tasa y la duración de llenado del grano para las variedades El Paso 144, INIA Tacuarí, INIA Caraguatá e INIA Zapata en dos épocas de siembra durante diferentes años. El peso de mil granos, la tasa y la duración del llenado de las variedades se correlacionaron con datos climáticos del primer mes de llenado cuando éste fue más intenso. Se encontró un buen ajuste de la evolución del peso de grano con las ecuaciones polinomiales principalmente de tercer grado para las distintas variedades. En general se observó una fase rápida de llenado dentro de los 30 – 35 días post – 50% floración y luego una tasa más lenta hasta la madurez fisiológica. También, se encontraron diferencias entre la duración del llenado de grano (50% de floración – madurez fisiológica) medido en suma térmica (base 10°C), para las distintas variedades. El Paso 144 presentó la menor duración promedio en acumulación térmica, INIA Caraguatá e INIA Zapata intermedio e INIA Tacuarí la mayor. Dentro de las variedades más usadas en el país, INIA Tacuarí, de tipo japónica, evaluada en el mismo número de ensayos que El Paso 144, de tipo tropical, fue más estable entre años en la duración del llenado.
Palabras claves: Arroz, Peso de mil granos, Llenado de grano, Tasa de llenado de grano, Duración de llenado de grano, Clima

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RICE IN RUSSIA: HISTORY AND PERSPECTIVE
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Rice is a stable food crop of irrigated agriculture. In Russian Federation it is grown to produce valuable diet grain. To date, rice production in Russia is not above 900,000 t, thus the population need in this important food product is not fully satisfied.
Russian rice growers face the task of increasing production of this crop. Growth of rice yields and grain quality improvement are closely connected to creation of new varieties and optimization of agricultural technology.
Rice in Russia is grown in the Far East (Primorye) and southern parts of the country: Astrakhan, Rostov, Krasnodar and Stavropol areas, republics of Northern Caucasus: Adygeya, Dagestan, Calmykia and Chechen. Krasnodar territory (Kuban) is the main rice growing area of Russia. Annual rice production is 70% total rough rice production of the country.
Rice growing started in the European part of Russia in the 30-ies first in Kuban, then spread to other areas. In the years that followed rice production changed a lot. Huge rice irrigation systems of engineering type have been constructed. Mechanised technologies of rice growing have been developed and introduced. Local high yielding rice varieties have been released. Huge water reservoirs were constructed. Water-extracting stations allow providing water for irrigation of the whole system and powerful pumps can remove water from rice fields in time.
By the end of 60-ies Kuban had a powerful complex for rice production with total irrigated area of 220,000 ha. It became possible to grow rice on 130,000 - 150,000 ha with average yield of 4.0-4.5 t/ha. Rice production in Kuban reached two-thirds of total rice production of Russia. It became possible to supply population of the country with locally produced rice.
By that time research institutions of the area - All Russia (earlier All-Union) Research Institute of rice (VNIIR), Kuban State Agricultural University and others have released high yielding varieties, worked out and introduced highly mechanised farming methods of rice growing and harvesting.
Among the limiting factors of rice production in Russia are diseases and pests. Thus breeding programmes are aimed at creation of yield yielding varieties with good grain quality and resistance to pests and diseases.
Key words: Rice, varieties, technology, Russia.

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BASE TEMPERATURE DETERMINATION AND VALIDATION FOR THE CALCULATION OF DEGREE-DAYS
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The objectives of this study were to determine the base temperature for the calculation of degree-days accumulation in different cultivars (Japonica and Indica) and validate this technology in order to see its potential use as a planning tool for management decisions. The validation of these results was carried out on rice farmers' fields.
Different methods were used for the determination of the base temperature (T_b). The different methods used agreed in the determination of the T_b for the different cultivars. The degree-days accumulations differ depending on the stage of the crop and cultivar. The accumulation between planting and flowering depends mainly on the genetic characteristic of the cultivar. El Paso 144, an Indica cultivar, was the one that presented the highest accumulation in this phase reflecting that is a long cycle cultivar. Conversely, INIA Tacuari, a short cycle cultivar, presented the lowest accumulation in this phase. The best fit of the different models using the experimental data was obtained using a T_b of 7°C.
Degree-days accumulation using a T_b= 7 and T_b = 10 (most commonly used in the literature) were used at the farmer fields to compare with the experimental results. Both base temperatures (7&10 °C) give very good adjustment to the experimental data and were in most of the fields similar to the average values observed in the experimental data. More important, in those fields were the Degree-days accumulation were quite different from the experimental data, farmers were able to detect the management reasons (herbicide, irrigation, etc) that cause this departures. This indicates the potential use of this tool by farmers to check the normal development of their crops.
Key-words: Degree Days, Base Temperature.

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DETERMINACIÓN DE LA TEMPERATURA BASE Y VALIDACIÓN PARA EL CÁLCULO DE GRADOS-DÍA
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Los objetivos de este estudio fueron determinar la temperatura base para el cálculo de la acumulación de grados-día en diferentes cultivares (japónica e índica) y validar esta tecnologia para demostrar su uso potencial como herramienta de planeamiento para el manejo de decisiones. La validación de estos resultados fue llevado a cabo en chacras comerciales. Diferentes métodos fueron utilizados para la determinación de la temperatura base (T_b). Todos los métodos dieron resultados similares en los diferentes cultivares. La diferencia en acumulación de grados-día depende de la etapa fenológica del cultivo y del cultivar. La acumulación entre siembra y floración depende principalmente de las características genéticas del cultivar. El Paso 144, un cultivar índico presento la mayor acumulación en esta fase debido a que es un cultivar de ciclo largo. Contrariamente, INIA Tacuarí, un cultivar de ciclo corto presento la menor acumulación en esta fase. El mejor ajuste de los diferentes modelos fue obtenido usando una T_b = 7 y T_b = 10°C (mas comunmente usada en la literatura) fueron usadas en chacras comerciales para comparar con los resultados experimentales. Ambas temperaturas base (7 y 10°C) se ajustaron muy bien con los datos experimentales dando en muchos casos valores similares al promedio. En los casos donde los grados-dís fueron diferentes, se pudo detectar a que se debían a diferencias en manejo (herbicida, riego, etc). Esto demuestra el potencial uso de esta herramienta para su utilización en la detección de problemas y planificación de estrategias de manejo en los cultivos comerciales.
Palabras claves: Grados-día, Temperatura base

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MONITORING WEED RESISTANCE TO HERBICIDES IN PADDY RICE IN SANTA CATARINA, SOUTHERN BRAZIL

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Paddy rice is a very important cash crop in Santa Catarina, where are cropped 130 thousand hectares of water-seeded rice. The major weed species are barnyardgrass and junglerice (*Echinochloa* spp), red rice (*Oryza* spp), arrowhead (*Sagittaria montevidensis*), ducksalad (*Heteranthera reniformis*), *Ludwigia* spp, fringrush (*Fimbristylis miliacea*), and smallflower umbrella sedge (*Cyperus difformis*). The major herbicides used by the growers are ALS inhibitors (sulfonylureas, pyrimidunyloxybenzoic) and quinclorac. ALS inhibitor herbicides and quinclorac were first labelled for rice weed control in 1991. One of the most common herbicide treatment used by farmers has been quinclorac combined with one of the sulfonylureas herbicide. In 1996/97 season growers started facing problems controlling arrowhead and the first case of rice weed resistance was confirmed in Santa Catarina. Arrowhead resistance to sulfonylureas (azimsulfuron, ethoxysulfuron, metsulfuron, pyrazosulfuron), sulfamoylurea (cyclosulfamuron) or pyrimidunyloxybenzoic (bispyribac-sodium) has spread out to 30-40% of the planted area. In 1999, it was detected barnyardgrass resistant to quinclorac in two sites. Monitoring studies carried out in 2000, confirmed the occurrence *C. difformis* (five sites) and *F. miliacea* (two sites) resistant to sulfonylureas herbicides. Results of the control studies showed that bentazon applied at early growth stage (4 - 8 leaf stage) was the only herbicide labelled for paddy rice in Brazil that controlled all arrowhead resistant ecotypes. Propanil, fenoxaprop and bispiribac-sodium provide good control of the resistant barnyardgrass. *C. difformis* and *F. miliacea* resistant to sulfonylureas can be controlled with bentazon or bispyribac-sodium at the label rates.

Key words: herbicide resistance, *Sagittaria montevidensis*, *Echinochloa* spp, *Cyperus difformis*, *Fimbristylis miliacea*.

046

SCHOENOPLECTUS MUCRONATUS (L.) PALLA AND CYPERUS DIFFORMIS L. ACCESSIONS RESISTANT TO ALS-INHIBITORS IN ITALIAN RICE FIELDS

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Sulfonylureas and other ALS-inhibitor herbicides have been used in Italian paddy fields for more than 10 years. Since 1995, lack of control has been reported for Alisma plantago-aquatica L. and Schoenoplectus mucronatus (L.) Palla. Starting from 1999, insufficient efficacy of ALS-inhibitors herbicides have been reported also against Cyperus difformis L.
A dose-response study has been carried out in the greenhouse to estimate the sensitivity of different S. mucronatus and C. difformis accessions to two bensulfuron-methyl and cinosulfuron.
Two S. mucronatus (RS1 and RS2) and one C. difformis (RC1)accessions that escaped field treatments were sprayed either with bensulfuron-methyl or cinosulfuron at 8 doses, from 0 to 4x the recommended field rate (100 g a.i.ha-1 and 80 g a.i.ha-1 for bensulfuron and cinosulfuron, respectively). Two additional accessions were also included as sensitive references (SS and SC, for S. mucronatus and C. difformis, respectively). Seeds of both species were placed on 36 cm2 pots filled with commercial potting substrate. Prior to seeding, S. mucronatus seeds were scarified with sulphuric acid for 5'. Treatments were applied at 4-leaf stage. Aboveground fresh weight per pot was determined 15-20 days after spraying.
In S. mucronatus, the rate determining 50% of growth reduction (GR50) referred to bensulfuron-methyl and cinosulfuron was more than 1,000 and 100 times higher, respectively, than that of SS, both in RS1 and RS2. In C. difformis, the GR50 of RC1 referred to bensulfuron-methyl was higher than 4x. In the case of cinosulfuron, GR50 of RC1 was more than 700 times higher than that of SC.
The accessions of both species show a variable degree of resistance both to bensulfuron-methyl and cinosulfuron, which are widely used in Italian rice fields. Further investigations are needed to understand the mechanism of resistance.

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ECHINOCHLOA CLASSIFICATION BY MOLECULAR MARKERS

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This work is part of a study carried out by several research units with the aim of classifying *Echinochloa* species present in Italian rice fields on the basis of morphological and genetic traits and herbicide sensitivity.
The genus *Echinochloa* includes troublesome weeds growing in rice fields. This genus includes about 50 species widely spread in tropical and temperate regions. *Echinochloa* ssp. have a great morphological variability and different responses to herbicides; this leads to different taxonomic classifications, in fact different authors proposed different species based on morphological characters considered. Otherwise a correct classification is important to act a strategy for *Echinochloa* management.
To contribute to *Echinochloa* classification molecular markers were employed to assess genetic relationship among 80 *Echinochloa* biotypes, collected in 40 different areas of Nothern Italy.
Seven primer combinations were used for AFLP (Amplified Fragments Length Polymorphism) analysis and they produced a total of 214 bands, 154 of which were polymorphic, (polymorphism percentage=72%, PIC=0.34).
The AFLP data were elaborated using the statistical analysis software NTSYS-pc 2.02 and an UPGMA-dendrogram was produced. It split the ecotypes into clusters on the base of their genetic relationship. The classification obtained from molecular data will be compared to the morphological classification in order to get the distinctive traits of each species. The future work will include the SSR, another class of molecular markers recently isolated also in *Echinochloa*. They represent a powerful tool to study genetic variation within the *Echinochloa* genus.
Keywords: AFLP; SSR; molecular markers; *Echinochloa*; classification.
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DOSE-RESPONSE ASSAYS WITH RICE HERBICIDES TO SCREEN ECHINOCHLOA WITHIN-POPULATION VARIABILITY

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This work is part of a study carried out by several research units with the aim of classifying Echinochloa specie present in Italian rice fields on the basis of morphological and genetic traits and herbicide sensitivity.
Echinochloa species are the main weeds infesting Italian rice fields. These plants show a high variability in morphological and competition-related traits, such as size, tillering ability and germination behaviour. This variability makes field identification of different species difficult and uncertain. Recent studies have pointed-out the presence in Italy of Echinochloa populations showing different sensitivity to propanil. In our study, the within-population variability of sensitivity to propanil and other rice herbicides in Echinochloa has been investigated with greenhouse experiments. Whole-plant bioassays were carried out starting from seeds of 38 accessions collected in paddy fields during summer 2001. The seeds were scarified with sulphuric acid for 30' and then directly placed on 36 cm2 pots filled with commercial potting substrate. The seedlings were sprayed at 3-4 leaf stage at four rates (0, 0.5x, 1x, and 2x recommended field rate) of either azimsulfuron, bensulfuron-methyl, bispyribac-sodium, cyhalofop-butyl, molinate, propanil or quinclorac. Aboveground fresh weight per pot was determined 7 or 15 days after spraying, according to the herbicide. The accessions showed a high variability of response to the tested herbicides, especially for azimsulfuron, bispyribac-sodium and molinate.
The treatment with bensulfuron-methyl, bispyribac-sodium and molinate at 2x resulted in less than 50% fresh weight reduction in about 10% of the tested accessions.
A lower amount of sensitivity variability was found with propanil and quinclorac. About 6 accessions showed hormetic response at 0.5x in bensulfuron-methyl, bispyribac-sodium, molinate, and quinclorac.
These results are in keeping with the variability found on both morphological and molecular traits of Italian Echinochloa populations.

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PENOXSULAM, A NEW BROADSPECTRUM HERBICIDE FOR WEED CONTROL IN TEMPERATE RICE.

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Penoxsulam (DE-638, XDE-638, DASH-001, DASH-1100), ISO proposed common name, is a new selective herbicide for weed control in dry-seeded, water-seeded and transplanted rice that has residual activity. Penoxsulam is a member of the triazolopyrimidine sulfonamide class of chemistry with ALS (acetolactate synthase) inhibition mode of action. Penoxsulam is a systemic xylem and phloem mobile herbicide that is absorbed via leaves, stems and roots. The compound is translocated in plants to meristematic tissues. Differential selectivity in rice is due to faster metabolism of the parent compound to inactive metabolites as compared to sensitive weeds. Penoxsulam is safe to fish, bees and non-target arthropods.

Small plot field research trials have been conducted from 1998 to 2002 in the major temperate rice growing areas around the world. Typical ground application equipment included knapsack, compressed gas backpack, 5L Handy type and various granule applicators. Spray volumes varied from 100 to 1,000 l/ha (ground) and 30 to 120 l/ha (air). Penoxsulam formulations to be commercialized include SC, OD and granules. Penoxsulam is a broadspectrum herbicide that controls many annual and perennial *Echinochloa* spp (ECHCG, ECHCO, ECHOR, ECHPH, ECHCV and ECHPO). Major broadleaf and sedge weeds controlled include AESVI, ALTPH, ALSPA, ALSPO, AMMCO, BIDTR, COMDI, CYPDI, CYPIR, CYPSE, ECLAL, ELOKU, HETLI, LIDPY, MOOKO, MOOVA, MOOVP, ROTIN, SAGCA, SAGTR, SAGPY, SCPJU, SCPMA, SCPMU, SEBEX and SPHZE. Penoxsulam has been shown to control many sulfonylurea resistant weeds and propanil, quinclorac and ACCase resistant *Echinochloa* spp. Penoxsulam use rates will vary from 20 to 48 gr ai/ha. Penoxsulam will be used primarily as a postemergence application but can be used preemergence or applied directly into flooded rice fields for weed control, depending on the country and current cultural practices. Where penoxsulam will be commercialized it has demonstrated rice safety equal to or greater than commercial products with no negative effect on yield or seed quality. Key attributes of penoxsulam include wide window of application, good rice selectivity to indica and japonica rice, broadspectrum weed control, residual weed control, no rotational crop issues, water management and formulation flexibility to meet grower needs.

Palabras Claves / Key Words: Echinochloa, barnyardgrass, junglerice, watergrass, residuality, broadleaf weeds, sedge weeds, aquatic weeds.

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MORPHOLOGICAL TRAITS RELATED TO ECHINOCHLOA spp. INFESTING ITALIAN RICE FIELDS

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This work is part of a study carried out by several research units with the aim of classifying *Echinochloa* species present in Italian rice fields on the basis of morphological and genetic traits and herbicide sensitivity. The genus *Echinochloa* comprises about 50 species, which include subspecies and varieties, widely spread in tropical and temperate regions.

The presence of numerous intergrading polymorphic complexes within *Echinochloa* genus usually makes the field identification difficult and uncertain. For this reason different taxonomic classifications have been proposed. The aim of this first study was to determine how morphological or morphometric traits can contribute to *Echinochloa* identification in Italian rice field conditions, and to compare these data with molecular analysis. Eighty biotypes were collected in 40 different rice fields of Po Valley (Northern Italy). Mature seeds of these biotypes were grown in greenhouse and 30 plants from each were transplanted in the field at three to four leaf stage for morphological description. Plant height, growth habit (prostrateness), color of the basal part of the stem, color of the collar region, presence or absence of hairs in sheaths and awns in the spikelets, type of inflorescence and spikelets color at maturity were evaluated for each biotypes. Length and width of the spikelets and length of the lower glume were also determined. Results obtained by cluster analysis showed that main parameters useful to identify *E. crus-galli* species were color of the basal part of the stem and spikelet length. According to morphological characters our populations were classified into five different taxa.

Key words: *Echinochloa* spp., morphological traits, biotypes.

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WEED CONTROL IN RICE WITH METAM-SODIO

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Metam-sodio is a fungicide used for geosterilization, which show a certain herbicidal properties. Field experiment was conducted in 2000 at Copiano (Pavia, Italy) to determine the effects of three rates of Metam-sodio (300, 450 and 600 kg ha^{-1}) and three planting time (5, 12 and 18 days after chemical treatments) on weed rice control. Test design was a split-plot with four replications. The mainplot size was 13, 5 by 15 m and the subplot size was 13, 5 by 5 m. The chemical treatments were carried out in pre-sown. Two days after chemical treatments all field plots were flooded 10 cm deep. An early variety of rice (Loto) was sown at 150 kg ha^{-1}. Weed control was visually evaluated as a percent of cover ground by all weeds and by each weed at three, four and five weeks after herbicide applications. Observations were made also on rice selectivity, and on rice grain yield. Metam-sodio did not injure the rice plants. Metam-sodio at 450 kg ha^{-1} controlled 100 %, 97% and 92% of red rice at the first, second and third observations, respectively. Good results gave also Metam-sodio at 300 and 600 kg ha^{-1}, which controlled 94 - 82 % of red rice during the season. *Echinochloa crus-galli* was controlled better at the higher rate of Metam-sodio than at 300 kg ha^{-1}, particularly in the early part of the season. Metam-sodio performed poorly against *Heteranthera reniformis, Bulboschoenus maritimus* and *Lindernia* spp. The best rice grain yield was obtained with all rates of Metam-sodio when the rice was sown 5 days after treatments.

Keywords: weed control, rice, metam-sodio.

065

IDENTIFICATION AND CHARACTERIZATION OF SOMATIC RED RICE (*ORYZA SATIVA VAR. SYLVATICA*) CHROMOSOMES USING COMPUTERIZED CHROMOSOMAL (C.H.I.A.-XL) IMAGING

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Aim of this work is to list the characteristics of red rice chromosomes in order to define any differences from the karyotype of the Loto (*Oryza sativa sub. japonica*) cultivar used as reference. The study and identification of rice chromosomes involves many factors. It was therefore necessary to adopt a methodical approach to obtain good preparations using prometaphase chromosomes, and a computerized methodology to analyse chromosomal imaging (C.H.I.A.-XL). The individual chromosomes were analysed according to the following parameters: length differences, centromere position, correlation between chromosomal types and chromatin density distribution. The results obtained are the first characterization of diploid genotypes of rice. No difference was found between the karyotype of the Loto (2n=24) cultivar and the "Kashihikari" haploid described by *Fukui and Iijima 1992.*

The analysis of red rice (2n=24) karyotype, shed light on the presence of chromosomal as well as genomic mutations. Early results obtained using a detailed chromosome analysis showed various translocations involving a chromosome of the first pair and other elements of the set: a 5th, a 7th, a 9th, or a 12th.

Genomic mutations show the existence of heteroploid cells with 23 (2n-1) and 25 (2n+1) chromosomes. In the prometaphase analysed up to now, the chromosomes involved in heteroploidy are the 2nd, 5th, 9th, and the 12th.

Keywords: red rice, somatic chromosomes, identification, characterization, computerized chromosomal imaging.

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CONTROL OF BLACKBERRY ON RICE CHANNEL BANKS
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Blackberry (*Rubus fruticosus*) is an aggressive perennial weed, which often invades irrigation channel banks. Trials were conducted in 2000-2001 in a rice field area of North Italy, near Milano, to evaluate the effects of glyphosate, glyphosate with different surfactants, triclopyr, picloram, different mixtures of glyphosate plus triclopyr, and fluroxypyr plus triclopyr, on blackberry control on rice channel banks. The treatments were carried out on August 3, 2001 and July 2, 2002. A randomized block design with 4 replications was used. The bank area of each plot was 12 X 2m. Sprays were applied with a backpack sprayer equipped with two flat-fan nozzles delivering 500 L ha^{-1} at 200 k Pa. Observations were made to determine the percentage of ground cover by blackberry, percentage of blackberry control and percentage of new sprouts from each weed plant. At first, the best blackberry control was obtained with fluroxypyr plus triclopyr at 120+360, and 160+480 g a.i. ha^{-1}, with different surfactants. However their percentage of control decreased from the first (September 10, 2001) till the fourth observation (July 2, 2002) when the best performance was obtained with glyphosate+APG surfactant at 2160 g a.i. ha^{-1}, which controlled 96% of blackberry. The percentage of blackberry new sprouts per plant was reduced by all treatments, with the exception of heavy grazing. This last treatment performed well against the new sprouts grew from underground buds.
Keywords: weed control, blackberry, rice channel.

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ABILITY OF RICE CULTIVARS TO SUPPRESS *Echinochloa phyllopogon* (Stapf) Koss.
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Enhancing cultivar weed suppressiveness can reduce weed control costs, environmental concerns and delay the development of herbicide resistance. The aim of this research was to identify plant characteristics associated with the ability of rice to suppress weeds. In 2000 and 2001, a pot experiment was conducted with seven rice cultivars grown weed-free or in competition with watergrass (WG). The experimental design was a randomized complete-block design with 5 replications. Data was subjected to ANOVA, correlation and path analysis. Cultivars differed in relative percent yield loss (YL=100-(yield in competition/weed-free yield x 100)), in their watergrass suppressiveness, and in the extent of suppression throughout the season. YL per unit WG biomass (WGb) at either 12 days after seeding (DAS), 36 DAS, heading or final harvest was similar among cultivars. WGb 36DAS was correlated with YL, and the ability of rice to suppress early weed growth was associated with plant height and leaf weight ratio at 36 DAS, but not with plant height at 12 DAS (path coefficients,β, to WGb 36 DAS were -0.33**, -0.21*, and 0.30**, respectively). WGb at harvest was not correlated with WGb 36 DAS, thus, certain cultivars were more suppressive of late rather than early WG growth and viceversa. Cultivar performance under competition depended on weed suppressiveness rather than on the magnitude of yield losses per unit of competitive weed biomass. Keywords: competitive cultivars, weed suppression, weed tolerance, *Echinochloa phyllopogon*, rice.

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CHARACTERIZATION OF HYBRID POPULATIONS FROM RICE CROSSED WITH AWNED AND AWNLESS RED RICE
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Red rice (Oryza sativa L.) is a major weed of rice (Oryza sativa L.) in the southern U.S. and it intercrosses at low rates with the rice cultivars produced in this region. Knowledge of the plant phenotypes produced from such crosses may help farmers to accurately identify and manage crosses derived from specific red rice ecotypes and rice, including herbicide-resistant cultivars. F1 hybrids were produced by hand-pollinating male-sterile Kaybonnet and Cypress (southern long grain tropical japonica cultivars) with two awned and two awnless U.S. red rice types. Parental, F1, and F2 (>150) plants from these crosses were grown in the field under flooded conditions in 2002 at Stuttgart, AR. Phenotypic characteristics including tillering, tiller angle, leaf pubescence, culm and leaf color, plant height, days to flowering, awn length, hull color, and bran color were determined. F1 plants produced pubescent leaves and red bran color, confirming that these were dominant traits. The awned red rice crosses resulted in F1 plants with reddish-purple culms (not expressed in any of the parents) and flowering dates similar to both parents. Crosses with awnless Stuttgart strawhull red rice resulted in F1 plants with green culms and flowering dates later than either parent. Many F2 plants produced few or no seed, apparently because of sterility or because maturity was delayed to the point that heading and/or seed fill did not occur. F2 segregation ratios for phenotypic traits are being determined. Implications for identification and management of hybrid populations will be discussed.

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RED RICE SEEDS VIABILITY IN SOIL
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The objetive of this work was to study the viability of red rice seeds in the soil,during a four years period. The work was conduced at the EMBRAPA Temperate Climate, from april 1994 to april 1998. Two thousands, non-dormant seeds, of red rice were mixed into a seived soil taken from a rice cropped field, fitted to plastic meshed bags (12 X10 cm) and stored in 12 cm deep soil trenches. At three months intervals one of these plastic bag was open and the seeds washed and separated into viable and non-viable seeds. From the viable seeds two repetition of 100 seeds were taken from the germination test, without treatament overcoming the dormancy.The seeds which did not germinate were submited to the tetrazolium test for verification of viability. The results allowed to conclude: there was a redutcion of 98,8% in the amount of viable red rice seeds stored in the soil; the red rice seed acquired secundary dormancy three months after the begin of the soil storage; the perecentage of dormant red rice seed stayed constant during the period of this study; the secundary dormancy of the red rice seeds is rapidly overcomed after the treatament for overcoming was applied.
Key words: rice, dormancy, germinability.

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VIABILIDADE DE SEMENTES DE ARROZ-VERMELHO NO SOLO
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O objetivo deste trabalho foi estudar a viabilidade de sementes de arroz-vermelho no solo, durante um período de quatro anos. O trabalho foi realizado na EMBRAPA Clima Temperado, no período de abril de 1994 a abril de 1998. Duas mil sementes de arroz-vermelho, sem dormência, foram misturadas, com solo próprio para de cultivo de arroz, acondicionadas em sacos de tela plástica (12x10cm) e colocadas em trincheiras com 12cm de profundidade. A cada três meses, foi retirado um saco cujas sementes foram lavadas e separadas em sementes aparentemente viáveis e sementes não viáveis. Das viáveis, foram retiradas duas repetições de cem para o teste de germinação, sem tratamento para superação de dormência. As que não germinaram e apresentavam característica de sementes dormentes foram, novamente, colocadas a germinar porém, com tratamento para superação da dormência . As sementes que não germinaram foram submetidas ao teste de tetrazólio para verificação de viabilidade. A análise dos resultados permitiram concluir, em relação ao ecótipo estudado, que: sementes de arroz-vermelho, acondicionadas no solo, apresentaram uma redução de 98,8% na quantidade de sementes viáveis; três meses após serem acondicionadas no solo, entraram em dormência secundária ; a percentagem de sementes dormentes permaneceu praticamente, constante, durante o período estudado.
Palavras chaves: arroz ; dormência; germinabilidade.

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TRATEGIES TO REDUCE SOIL STOCK OF RED-RICE
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Rio Grande do Sul State produces approximately 5,0 tons per year. It represents more than 48% of total Brazilian rice production. Red-rice can cause economic losses up to 100 million US dollar and is considered one of the most important problems of rice crop. New technologies to reduce Red-rice problem can increase rice production of Rio Grande do Sul State up to one million tons. Increase or maintenance of Red-rice soil stock is consequence of contaminated rice seed (with Red-rice) and natural degraining and dormancy of Red-rice. The main objective of this research, carried out at Embrapa Temperate Climate Research Centre, was evaluate the influence of soil management and crop rotation on Red-rice soil stock. The most effective reduction of Red-rice soil stock are to bring flooding forward on pre-germinated system, not ploughing after harvesting (it is necessary to wait five months) and crop rotation during 03 to 04 years period (soybean, corn, sorghum and cultivated pasture)
Key words: Oryza sativa L., Red-rice, management, control.

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ESTRATÉGIAS DE MANEJO PARA REDUÇÃO DO BANCO DE SEMENTES DE ARROZ VERMELHO NO SOLO
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A cultura do arroz irrigado no Rio Grande do Sul ocupa cerca de 980 mil hectares, e contribui com 48% da produção nacional representando cerca de 5 milhões de toneladas. Entre os problemas das lavouras orizícolas do RS destaca-se a presença do arroz- vermelho que causa prejuízos anuais na ordem de U$ 100 milhões. A geração de tecnologias visando a recuperação e melhoria produtiva dos solos infestados, contribui para minimizar os problemas hoje enfrentados no sistema produtivo da cultura do arroz irrigado, podendo elevar anualmente a produção em 1 milhão de toneladas de grãos de arroz no RS. O aumento ou manutenção do banco de sementes de arroz-vermelho no solo deve-se ao uso de sementes contaminadas, este pertencer a mesma espécie do arroz comercial, ao degrane natural e a dormência das sementes no solo. Este trabalho objetivou analisar os resultados obtidos em várias pesquisas, realizadas pela Embrapa Clima Temperado, as quais avaliaram o comportamento da semente de arroz-vermelho submetidas a diferentes manejos de solo e planta, afim de definir recomendações práticas que proporcionem a significativa redução do banco de sementes de arroz-vermelho do solo. Concluiu-se que as seguintes práticas são efetivas para a redução deste banco: antecipação da inundação do solo no sistema de cultivo de arroz pré-germinado; não preparar o solo logo após a colheita do arroz (aguardar cerca de 05 meses); adoção de pousio em áreas infestadas por um período de 03 a 04 anos e uso de rotação de culturas (soja, milho, sorgo e pastagens).
Palavras-chave: Oryza sativa L., arroz-vermelho, manejo, medidas de controle.

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DISTRIBUTION OF THE *ECHINOCHLOA* ECOTYPES RESISTANT TO HERBICIDE QUINCLORAC AT RIO GRANDE DO SUL STATE.
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Abstract: The *Echinochloa* species resistant to quinclorac are highly distributed over all rice-cultivated areas of Rio Grande do Sul, Brazil. Was conducted a research at Embrapa Clima Temperado, Pelotas RS, to determinate the geographic distribution of the problem. The experiment was installed at greenhouse in the randomized blocks layout, with 3 treatments and 4 replications. 15 ecotypes were collected from many counties do determine the resistance problem distribution. The experiment was composed by three herbicide levels: zero, 375, and 750g/ha of quinclorac + assist at 0,5% v/v applied over the 15 ecotypes at the 3-4 leaves stage. The evolution was monitorated for 30 days, when the susceptible and resistant ecotypes were defined. The resistant seeds were from the following counties: Arroio Grande, Bagé, Camaquã, Capivari, Dom Pedrito, Jaguarão, Mostardas, Pelotas, Rio Grande, Santa Vitória do Palmar, São Gabriel, São José do Norte, and Viamão.
Keywords: Resistance, distribution, *Echinochloa*.

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DISTRIBUIÇÃO DE CAPIM-ARROZ RESISTENTE AO HERBICIDA QUINCLORAC NO RIO GRANDE DO SUL.

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Resumo: O problema do capim-arroz resistente ao herbicida quinclorac vem se distribuindo rapidamente por todas as regiões arrozeiras do Rio Grande do Sul. Com o objetivo de determinar a distribuição geográfica do problema dentro do estado, conduziu-se um estudo em casa-de-vegetação, com delineamento de blocos casualizados e 4 repetições, na Embrapa Clima Temperado, Pelotas, RS. Coletaram-se 15 ecótipos de várias cidades do Rio Grande do Sul, para avaliação da presença de resistência para posterior mapeamento. O experimento constou de 3 tratamentos: zero, 375 e 750g/ha de quinclorac, mais assist 0,5% v/v sobre os 15 ecótipos. A aplicação ocorreu quando o capim-arroz estava no estágio de 3-4 folhas. Durante 30 dias monitorou-se a evolução dos tratamentos, até a completa definição dos ecótipos resistentes e suscetíveis. Observou-se que os lotes que apresentaram resistência eram originários de Arroio Grande, Bagé, Camaquã, Capivari, Dom Pedrito, Jaguarão, Mostardas, Pelotas, Rio Grande, Santa Vitória do Palmar, São Gabriel, São José do Norte e Viamão.

Palavras chave: resistência, distribuição, capim-arroz.

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DETERMINATION OF A LABORATORY METODOLOGY TO IDENTIFY *ECHINOCHLOA* SEEDS RESISTANT TO QUINCLORAC

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The quinclorac-based herbicide Facet stills in continuous use for several years in rice-cultivated areas at Rio Grande do Sul, Brazil. The preference for this product is due to a effectiveness in *Echinochloa* species control and to a great selectivity to rice plants. Not much time ago have been appeared some complaints for lacks in control. The possibility of resistance was performed just recently, and from 1998 on, some studies have been conducted to investigate the hipotesis. Considering that the resistance phenomenon is now spreading by many localities, and that the greenhouse tests takes a long time do define a result, was seen that a quick test in laboratory was needed to identify *Echinochloa*-resistant seeds. A preliminary test was conducted at Weeds Laboratory in Embrapa Clima Temperado, RS, Brazil, with three replications and completely randomized layout. The objective of this work was to determinate the effective doses over a susceptible ecotype for GR50 determination and response curve drawing. 5g of Facet DF was dissolved in 1000ml of destilated water. After, this solution was addicted to different treatments at 0,1%, 0,5%, 1,0, 5,0%, and 10%. The gerbox papers stayed submersed in this solutions for 24 hours and taken into the gerboxes, and a susceptible ecotype, named ETB-00, was sowed over. After 10 days the avaliation was performed. The results showed that almost total control was achieved already from the lower dose, drawing the response curve to GR50 determination.

Keywords: resistance, barnyardgrass, quick test, flooded rice.

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DETERMINAÇÃO DE METODOLOGIA DE LABORATÓRIO PARA IDENTIFICAÇÃO DE SEMENTES DE CAPIM-ARROZ RESISTENTE AO QUINCLORAC

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O uso continuado do herbicida quinclorac nas lavouras de arroz do Rio Grande do Sul. Sua preferência por parte do produtor deve-se à efetividade no controle de capim-arroz (*Echinochloa* sp.), e também à alta seletividade ao arroz. Há alguns anos surgiram queixas sobre falhas de controle. A hipótese de que isso se devia ao fenômeno de resistência da planta daninha ao herbicida foi levantada somente em 1998, com alguns estudos sendo desenvolvidos a partir de então. Considerando-se que o fenômeno da resistência está se espalhando muito rápido pelas lavouras do RS, e que os testes "padrão" em casa de vegetação geralmente são demorados, surgiu a necessidade da criação de um "teste rápido", realizado a nível de laboratório, para a identificação de sementes de ecótipos de capim-arroz resistentes ao quinclorac. Um teste preliminar foi conduzido no laboratório de Plantas Daninhas da Embrapa Clima Temperado, com delineamento experimental completamente casualizado e 3 repetições. O objetivo deste teste preliminar foi determinar a GR50 de um ecótipo suscetível para posterior comparação de ecótipos. Utilizaram-se caixas GerBox e um germinador. Inicialmente diluiu-se 5g de Facet DF em 1000ml de água destilada, utilizando-se a seguir as seguintes concentrações desta solução: 0,1%, 0,5%, 1,0%, 5,0%, e 10%. Emergiu-se os papéis gerbox nas soluções por 24 horas, após foram colocados dentro das caixas e um ecótipo suscetível, denominado ETB-00 foi semeado. Após dez dias realizou-se a avaliação. Os resultados evidenciaram que, em laboratório, obteve-se controle muito eficiente sobre o ecótipo suscetível já com a menor dose, sendo a partir daí desenhada a curva de resposta ao herbicida.

Palavras-chave: resistência, capim-arroz, teste rápido, arroz irrigado.

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ECHINOCLHOA SP CONTROL WITH HERBICIDE TANK MIXES UNDER TWO TIMES OF FLOODING.

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In Uruguay rice farmers plant the crop on a drained soil surface. According to rainfall, irrigation flushing is required to prevent water stress, before establishing the permanent flood 40-50 days after planting. They control weeds (mainly *Echinochloa crus-galli*) applying early postemergence treatments before flooding. Clomazone, quinclorac, propanil, clefoxidim and bispiribac have demonstrated good weed control efficacy. An experiment was drill seeded in 2000-01 and 2001-02 growing seasons to evaluate weed control of different herbicide tank mixes under two flooding times (15 days of difference between them). Effects of the following tank mixes: setoxidim+clomazone, propanil+clomazone, clefoxidim+quinclorac, quinclorac+clomazone, bispiribac+clomazone, with a check without chemical treatment, were compared to. Addition of coadyuvants were also evaluated in some of them. Number and growth development stage of weeds at the time of application, weed control readings at 60 days after treatment applications and previous harvest, and rice grain yield, were recorded. Differential effects on weed control produced by time of flooding were found. According to that, weed control performance of some herbicides tank mixes decreased when time of flooding was delayed, while other ones showed excellent control in any situation. Coadyuvants in some cases improved the control when the delayed flooding time was used.

Key words: Echinochloa sp, barnyardgrass, bispiribac, clefoxidim, clomazone, propanil, quinclorac, setoxidim, flooding time

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ECONTROL DE *ECHINOCHLOA SP* CON DIFERENTES MEZCLAS DE HERBICIDAS EN EL TANQUE SEGÚN DOS ÉPOCAS DE INUNDACIÓN

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En Uruguay se siembra el arroz en un suelo drenado, inundándose el cultivo aproximadamente 40-50 días pos-siembra. Dependiendo de la ocurrencia de lluvias, previamente se da un baño, con posterior retiro del agua. El control de malezas (principalmente *Echinochloa crus-galli*) se realiza con aplicaciones en postemergencia temprana previo a la inundación. Clomazone, quinclorac, propanil, clefoxidim y bispiribac han demostrado buen control de la maleza. En los años 2000-01 y 2001-02 se instaló un experimento para evaluar el control de distintas mezclas de tanque de estos herbicidas, según dos épocas de inundación del cultivo (15 días de diferencia entre ellas). Se compararon los efectos de las siguientes mezclas: setoxidim+clomazone, propanil+clomazone, clefoxidim+quinclorac, quinclorac+clomazone, bispiribac+clomazone, junto a un testigo sin control químico. En algunas de ellas, también se evaluó el agregado de coadyuvantes. Se registró el número y estado de malezas al momento de aplicación de los tratamientos, control sesenta días después de realizadas las aplicaciones y previo a la cosecha y rendimiento de arroz. Se pudo apreciar efectos diferentes del riego en los controles obtenidos. Algunos tratamientos fueron afectados en su performance final cuando se retrasó la inundación del cultivo, mientras que otros mostraron excelente control en ambas situaciones. También se detectaron el algunos casos, impactos distintos con el agregado de coadyuvantes, resultando su presencia más favorable cuando se inundó más tarde.

Palabras clave: Echinochloa sp, control capín, bispiribac, clefoxidim, clomazone, propanil, quinclorac, setoxidim, época de inundación

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INIA TACUARÍ (*Oryza sativa* L.) SUSCEPTIBILITY TO MALEIC HYDRAZIDE AND GLYPHOSATE APPLIED OVER-THE-TOP AT GRAIN FILLING STAGE ON RICE YIELD AND GRAIN MILLING QUALITY

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When maleic hydrazide or glyphosate are applied over-the-top to the rice crop to suppress viable seeds of red rice, it is necessary to sow an early maturity variety without sensitivity to the photoperiod. Then, an early time of seeding determines a window large enough on flowering between INIA Tacuarí and red rice that allows the secure use of both products at the filling grain stage of the variety. An experiment from 1999 to 2001 was conducted to study three times of application of maleic hydrazide (1.96, 2.45, and 2.94 kg a.i./ha) and glyphosate (0.48, 1.44, and 2.4 kg a.i./ha) plus a check without application over INIA Tacuarí on grain yield and grain milling quality. The time of application was defined by the green grain percentage. At the time of application 1, the lowest yield was obtained; being that significant different than those of times 2 and 3 in 2000. Maleic hydrazide produced significant greater yield than glyphosate, appearing an interaction between product and time of application in 2001. In 2000, maleic hydrazide did not affect head yield at any time of application, instead, glyphosate showed a significant reduction on head yield at the times 1 and 2. Maleic hydrazide or glyphosate applied over-the-top is recommended with a green grain percentage of INIA Tacuarí below 40 or 20%, respectively.

Key words: *Oryza sativa*, rice yield, grain milling quality, maleic hydrazide, glyphosate

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SUSCEPTIBILIDAD DE INIA TACUARÍ (*Oryza sativa* L.) A LA APLICACIÓN DE HIDRACIDA MALEICA Y GLIFOSATO DURANTE EL LLENADO DE LOS GRANOS EN EL RENDIMIENTO Y CALIDAD INDUSTRIAL

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La aplicación de hidracida maleica o glifosato sobre el arroz cultivado para suprimir la semillazón del arroz rojo hace necesario la siembra de una variedad de ciclo corto y sin sensibilidad al fotoperíodo como INIA Tacuarí. De manera tal, una siembra temprana origina una ventana en días entre la floración de INIA Tacuarí y del arroz rojo suficientemente larga, que permite el uso seguro de ambos productos en el estado de llenado de los granos de la variedad. Entre 1999 y 2001, se condujo un experimento para estudiar tres momentos de aplicación de hidracida maleica (1,96; 2,45 y 2,94 kg i.a./ha) y glifosato (0,48; 1,44 y 2,4 kg i.a./ha) junto a un testigo sin aplicación sobre INIA Tacuarí en el rendimiento en grano y su calidad industrial. El momento de aplicación se definió por el porcentaje de granos verdes. Se observó que el momento de aplicación 1 presentó los menores rendimientos en grano, siendo éste significativamente inferior a los momentos 2 y 3 en el año 2000. Hidracida maleica fue superior significativamente al glifosato en rendimiento, presentándose una interacción entre producto y momento de aplicación en el año 2001. En el 2000, se apreció que hidracida maleica no afectó el porcentaje de entero en los distintos momentos de aplicación, mientras que el glifosato lo redujo significativamente en los momentos 1 y 2. Se recomienda la aplicación de hidracida maleica o glifosato cuando INIA Tacuarí no supere el 40 o el 20% de granos verdes, respectivamente.

Palabras claves: *Oryza sativa*, arroz, rendimiento en grano, calidad industrial, hidracida maleica, glifosato

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SEED VIABILITY SUPPRESSION OF RED RICE (*Oryza* sp.) BY MALEIC HYDRAZIDE AND GLYPHOSATE APPLIED OVER-THE-TOP

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Rice fields of Uruguay present red rice (RR) infestation characterized by a low population in terms of number of individuals, sometimes showing up as aggregated plants (patches) or as dispersed plants. A reasonable approach, taking into account the longevity and the high dormancy of RR seed in the soil, it is to stop the RR plants producing new seeds by using chemicals as. In 1998 and 1999, an experiment was conducted to study the application of maleic hydrazide (1.96, 2.45, y 2.94 kg a.i./ha) and glyphosate (0.48, 1.44, and 2.4 kg a.i./ha) at different times of RR panicles development plus a check without application. At the time of application 1, between 50 to 70% of RR panicles were at the end of flowering (dry stamens at the base of the panicle), and the times 2 and 3 presented a greater proportion of panicles at the filling stage. Either maleic hydrazide or glyphosate promoted that a greater proportion of RR seeds were not viable at the time of application 1, decreasing when the treatments were delayed. At any time of application, it was observed the lack of response to the increase of the maleic hydrazide rate on seed viability suppression. However, glyphosate promoted a positive response when its rates were increased at the times of application 1 and 2.

Key words: *Oryza* sp., red rice, suppression of seed viability, maleic hydrazide, glyphosate

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SUPRESIÓN DE LA SEMILLAZÓN DEL ARROZ ROJO (*Oryza* sp.) POR LA APLICACIÓN DE HIDRACIDA MALEICA Y GLIFOSATO

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La infestación de arroz rojo (AR) en los campos arroceros del Uruguay se presenta en general como una población baja en número de individuos, estando muchas veces agrupadas (manchones) y otras dispersa. Se considera que dada la longevidad y elevada dormancia de la semilla de AR en el suelo, una aproximación razonable es evitar que las plantas de AR generen semillas nuevas por medios químicos. Se realizó un experimento en los años 1998 y 1999 en el cual se estudió la aplicación de hidracida maleica (1,96; 2,45 y 2,94 kg i.a./ha) y glifosato (0,48; 1,44 y 2,4 kg i.a./ha) en distintos momentos del desarrollo de las panojas de AR más un testigo sin aplicación. El momento 1 correspondió a la existencia de 50 a 70% de las panojas del AR que habían finalizado la floración (estambres secos en la base de la panoja), y los momentos 2 y 3 presentaban una proporción creciente de las panojas llenando las semillas. Se observó que tanto hidracida maleica como glifosato aplicados en el momento 1 provocaron que una mayor proporción de las semillas de AR fueran inviables, disminuyendo la misma cuando se atrasaban los tratamientos. No se apreció respuesta al aumento de las dosis para hidracida maleica en la supresión de la semillazón en ningún momento de aplicación, mientras que glifosato promovió una respuesta positiva al aumentar las dosis en los momentos 1 y 2.

Palabras claves: *Oryza* sp., arroz rojo, supresión de la semillazón, hidracida maleica, glifosato

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ARROZ (*Oryza sativa* L.) SEMBRADO EN AGUA Y CONVENCIONAL CON MOLINATE PARA EL CONTROL DEL ARROZ ROJO(*Oryza* sp.)

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El arroz rojo (AR) es una maleza genética y fisiológicamente muy similar al arroz cultivado, de manera que su control en el mismo necesita integrar distintas prácticas de manejo. En 1999 y 2000, se condujo un experimento para estudiar la eficacia de la siembra en agua y la siembra convencional usando distintas dosis de molinate (0; 3,08; 4,48; 5,88 y 7,28 kg i.a./ha) en el control del AR. Se evaluaron la inundación continua y la inundación con un período breve de drenaje (3 a 5 días después de la siembra seguido por reinundación) para el primer método de siembra, correspondiéndole inundación temprana y tardía al segundo. Se sembraron INIA Tacuarí y El Paso 144 en ensayos individuales por método de siembra. La siembra en agua, en tres ensayos de cuatro logró controles entre 55 a 90% sobre el testigo. Sin embargo, la siembra convencional de El Paso 144 con una infestación de AR media a alta obtuvo un 79% de control, mientras que en los restantes ensayos con poblaciones de AR más altas, los controles fueron pobres. Cuando existió control del AR, las dosis de 4,48 y 5,88 kg/ha de molinate presiembra incorporado en el suelo mostraron un buen comportamiento en la siembra en agua y 5,88 kg/ha en la siembra convencional. La siembra en agua no eliminó al AR aunque mostró claramente un control superior que la siembra convencional.

Palabras claves: *Oryza* sp., control del arroz rojo, arroz, siembra en agua, siembra convencional, manejo de la inundación, molinate

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RED RICE CONTROL (*Oryza* sp.) UNDER WATER- AND DRY-SEEDED RICE (*Oryza oryza* L.) CULTURE USING MOLINATE

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Red rice (RR) is a weed that is genetic and physiologically similar to rice, consequently its control in a rice crop needs to integrate some management practices. In 1999 and 2000, an experiment was conducted to study water-seeded and dry-seeded rice culture efficacy to control RR using molinate at different rates (0, 3.08, 4.48, 5.88 and 7.28 kg a.i./ha). Continuous flooding and pinpoint flooding with a short period of drainage (from 3 to 5 days after seeding followed by slow reflooding) for the first seeding method, and an early and late flooding for the second method. INIA Tacuarí and El Paso 144 were seeded in individual trials for seeding methods. Three of four trials had from 55 to 90% of control over the check under water-seeding culture. However, 79% of control was just obtained when El Paso 144 was dry-seeded in an intermediate to high RR infestation, while in the rest of the trials the control was poor due to higher RR populations. When the control of RR was obtained, molinate rates of 4.48 and 5.88 kg a.i./ha pre seeding soil-incorporated showed good performance under water-seeded method, and 5.88 kg/ha under dry-seeded method. Water-seeded rice did not eliminate RR but had a clearly higher control than dry-seeded culture.

Key words: *Oryza* sp., red rice control, water-seeded rice, dry-seeded rice, water management, molinate

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STUDY ON THE PRIMARY INOCULUM OF *Magnaporthe grisea* IN A RICE FIRST PLANTING FIELD.

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Blast caused by *Magnaporthe grisea* is the most important disease of rice in many regions of the world. Air-borne conidia, infected seeds and diseased weeds are among the most important means of fungal dissemination to new regions. The objective of this work was to determine the primary inoculum for the occurrence of blast epidemics in a rice field with the following characteristics: high percentage of neck blast, planted in small area and never with rice before, isolated from other rice fields, nearby weeds with blast symptoms, and seeds were not certified or treated with fungicides. Preliminary results showed that *M. grisea* survived for a period shorter than 5 months on seeds and among weed isolates collected from many locations, *Bromus catharticus, Penisetum purpureum, Eleusine indica,* and *Cenchrus echinatus* caused disease symptoms on Japanese rice differentials. Genomic DNA digested with *Eco*RI, hybridized with MGR583 and *Pot2* revealed that DNA fingerprints of those weed isolates were different from rice isolates demonstrating they were not opportunistic-rice isolates. As the isolate from *E. indica* was collected from the field of interest, these results strongly suggest that *M. grisea* from this weed was the primary source for the rice blast epidemics in this field.

Key woords: *Pyricularia grisea*, seeds, DNA fingerprinting

047

WHITE TIP SYMPTOMS IN ITALIAN RICE VARIETIES

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Rice plants infested by the seed-borne nematode *Aphelenchoides besseyi* Christie, the causal organism of white tip disease, exhibit different symptoms. Since this disease is new for Italy, in a six year trial symptoms were studied naturally infesting plants of almost all the Italian rice varieties. Experimental field was dry-seeded and subsequently flooded, being this cultural system the most favourable to *Aphelenchoides besseyi* proliferation. Since *Aphelenchoides besseyi* can be transmitted in flood water in lowland rice, the source of infestation was seed very infested of a highly susceptible variety. A six-rows, 1 m x 1 m plot was drilled for each tested variety. Rows of the infested variety (I) and the tested (T) one were sowed in the following sequence I - T - I - I - T - I. It seems possible to rank Italian rice varieties in 3 groups on the basis of the different leaf symptoms: 1. typical whitening of leaf tip, 2. chlorotic streaks or stripes on leaves observed with back light, 3. no leaf symptoms in stunted plants with panicle partially emerged and reduced in size. In addition to the mentioned leaf symptoms, according to the group plants, expresses also other typical symptoms such as shortening of flag leaf - which twists at the apical portion and hinders the emergence of panicle, reduction of the panicle length and the grain number, spikelets with distorted glumes and deformed kernels, production of tillers from the uppers nodes, etc. Furthermore symptomless but infested plants were also found.

Keywords: Aphelenchoides besseyi Christie, rice, Italian varieties, symptoms.

049

POTENTIAL CHEMICAL AND BIOLOGICAL AGENTS FOR THE CONTROL OF AGGREGATE SHEATH SPOT AND SHEATH SPOT OF RICE IN SOUTH EASTERN AUSTRALIA.

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Aggregate sheath spot, caused by Rhizoctonia oryzae-sativae (Sawada) Mordue and sheath spot caused by R. oryzae Ryker and Gooch, have recently been reported on cultivated rice in south eastern Australia. No fungicide is currently registered or used on rice crop in Australia. This paper describes the screening techniques used in our study to evaluate the effect of potential biological control agents and the effect of fungicides on both pathogens. Eight isolates of Trichoderma harzianum, one isolate of T. viride and one isolate of Talaromyces flavus and six fungicides (propiconazole, azoxystrobin, pyraclostrobin, kresoxim-methyl, metalaxyl-M and tolclofos-methyl) were tested in-vitro against R. oryzae-sativae and R. oryzae. Two isolates of T. harzianum reduced the growth of both pathogens by more than 99%. When used at the rate of 10ìg/mL, propiconazole, pyraclostrobin and tolclofos-methyl showed a good activity against both R. oryzae-sativae and R. oryzae. The growth of R. oryzae-sativae was reduced by 94% with pyraclostrobin, 86% with propiconazole and 66% with tolclofos-methyl. The growth of R. oryzae was reduced by 89% with pyraclostrobin, 98% with propiconazole and by 100% with tolclofos-methyl. This study showed that several chemical and biological control agents may have the potential to control aggregate sheath spot and sheath spot of rice in Australia. Further research is needed to investigate these promising potential control agents at the field level.

Keywords: biological control, fungicides, rice diseases.

074

WHITE TIP DISEASE IN ITALIAN RICE

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Aphelenchoides besseyi Christie is a seed-borne plant-parasitic nematode and is the causal organism of the "white tip" disease of rice. It has been reported from most of the rice growing countries and recently it was found in Italian rice field and seed, even if quarantine has been applied to prevent the nematode introduction in European Union. In the last years all seed lots produced in Italy have been tested for detecting Aphelenchoides besseyi. Data are reported concerning the population density of nematode in the seed lots officially inspected for certification in the last 6 years. At the same time experimental research started - to implement information coming from other rice growing countries - on distribution, possible survival in the field, yield loss, economic damage threshold and control by chemicals. Moreover a reliable and efficient method for detecting Aphelenchoides besseyi in seed was prepared on the basis of these reported in literature. Results obtained confirm information gathered in other countries. Briefly, seed transmission is the principal dispersal way for Aphelenchoides besseyi in Italy. Hot water treatment is confirmed to be the most appropriate control method, unfortunately it cannot be applied to large amount of seeds. Data are reported concerning the relation between seed infestation and crop performance in trials where 2 varieties, 2 cultural systems (flooded or dry-seeded crop) and 4 infestation levels were compared: 30 viable nematodes per 100 seeds is the tolerance limit density beneath which there is no significant damage on flooded rice crop.

Keywords: Aphelenchoides besseyi Christie, rice seed, yield loss, detecting method.

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RICE DIESEASES IN THE REPUBLIC OF MACEDONIA

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Research carried on to date by the author concerning rice parasites indicates that fungi are the dominant causers of pathologycal changes observed in plants in the field.
Materials derived from diseased plants were used to isolate pure cultures of fungi, whose pathogenicity was proved by artificial inoculations of the soil, young seedlings, and adult plants at the haeding stage which were grown in the greenhouse.
On the basis of the growing, phytopathological and morphological characteristics of the parasites examined, it was found that the isolates obtained by the author from rice plants belong to the following species of parasitic fungi:
Blast Pyricularia oryzae Cav.
Brown spot is caused by Cochliobolus myabeanus (Ito & Kuribayshi) Drechs. Ex Dastur, Syns. Helminthosporium oryzae (Breda de Haan) and Drechslera oryzae (Breda de Haan) Subramanian and Jain.
Stem Rot is caused by Sclerotium oryzae Catt. (sclerotial state) Nakatae sigmoidea Hara (syn. Helminthosporium sigmoideum Cav.) (conidial state of S. oryzae) Magnaporthe salvinii Catt. Krause & Webster (perithecial state of S. oryzae) Cercospora oryzae Miyake Entyloma oryzae Syd. & P. Syd. syn. Entyloma lineatum (Cooke) Davis Rhizoctonia solani Kühn. And Kernel smut is caused by Tilletia barclayana (Bref.) Sacc. & Syd.

089

OUTBREAK OF RICE GRAIN DISCOLORATION IN ITALY

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In tropical countries rice grain discoloration is a serious diseases caused by fungal pathogens like *Cochliobolus miyabeanus, Magnaporthe grisea* and *Sarocladium* spp., and by numerous pathogenic and saprophytic bacteria. In contrast, in Italy rice grain discoloration was reported occasionally, and as a consequence of severe epidemics of brown spot and blast. However, the disease incidence and severity has recently increased, in spite of improved fungal disease epidemics control. The failure of fungicides to reduce grain discoloration suggests that fungi may not be the primary causal agents, leaving several open questions concerning the etiology of grain discoloration and factors influencing its epidemics. The aims of this research were to investigate I) the incidence of grain discoloration for the most widespread rice varieties, II) to search for a positive correlation between grain discoloration and fungal disease incidence and severity, date of sowing and fungicide treatments. Rice samples with more than 4% discoloured grains were collected all over rice-cultivated area to estimate varieties sensitivity. Field trials were carried out in Rosasco (Pavia province) on cv Selenio (subsp. Japonica) for two years. Fiftythree percent of rice samples (*N*=32), were of cv Selenio, which resulted the most sensitive variety with an average disease severity of 9.3%, followed by cv Loto and cv Balilla with 9.1% and 5.8%, respectively. Percentage of discoloured grains on cv Selenio decreased delaying the date of sowing, but was not correlated to *C. miyabeanus* incidence and severity, nitrogen fertilization level and fungicide treatments. We are currently studying the microflora associated to rice spikelets in order to identify the casual agent of the disease. This knowledge is critical to propose appropriate disease management strategies.
Keywords: glume discoloration, rice, *Cochliobolus miyabeanus*

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MONITORING FUNGI ON RICE SEED OF SEVERAL ITALIAN VARIATIES.

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Many fungi can be present on rice seed and some can cause problems both to plant growth and to production quality. A survey was conducted in Italy to list the fungi present on seed with and without hulls. The fungi greatly differ in distribution among varieties and in abundance on seeds. Some of them seem to be linked to the spot on white rice and could be the cause of quality decreasing in Italy. A total of 51 italian rice varieties were investigated. The number of observed fungus taxa was 62 and 51 for paddy and husked rice seed, respectively.
Key words: rice seed fungi, rice
Power Point Presentation
Se permite publicar este abstract en el libro de resumenes

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RELATIONSHIP BETWEEN VIRULENCE AND LINEAGE CHARACTERIZATION OF Pyricularia grisea IN THE STATE OF RIO GRANDE DO SUL, BRAZIL

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Selection for rice blast resistance is a major problem of any rice breeding program due to the variability of the fungi Pyricularia grisea. This diversity has been characterized by DNA molecular markers that allow the identification of groups of isolates, so called lineages, genetically related to each other. One challenging question is to investigate whether the isolates from the same lineage show the same virulence spectrum. Then, isolates of P. grisea from the State of Rio Grande do Sul were used in this work with the objective to verify their molecular and virulence pattern. Fifty and one monosporic isolates were obtained from samples collected in 12 counties and used to inoculate 6 near isogenic lines (NILs) with known resistance genes. Phenotypic reaction was determined based on a disease scale that ranges from 1-3 for resistant response with increasing hypersensitive reaction and from 4-9 for increasing degree of susceptibility. DNA of each isolate was extracted from mycelia grown in liquid media and used in PCR reactions with primers based on the repetitive sequence Pot-2. The frequency of virulent isolates is higher in the NIL that contains the Pi-1 gene and lower in the NIL containing the Pi-2 gene. The compatible reaction on the NIL that carries Pi- 2 is very weak, exhibiting, in general, a type 4 reaction. The statistical analysis indicates the presence of 6 lineages. No obvious relationship between phenotypic virulence and lineage determination has been found.
Key words: Near isogenic lines, rice blast, variability.

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FUNGI ASSOCIATED TO IRRIGATED RICE SEEDS CROP IN RIO GRANDE DO SUL
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Aiming the estabilishment of the brazilian sanitary patterns for rice seeds making a complementary survey on fungi associated with irrigated rice in Rio Grande do Sul was carried out during the crops of 1993 to 1998. It were used 350 seed sample, for 10 different cultivars, of the basic, certified or fiscalized. Groups four hundred seeds were withdrown from each sample in the Laboratory of Phytopatology, Embrapa Clima Temperado. The following percentages of fungi contamination were found: Pyricularia oryzae, 0,04%; Bipolares oryzae, 2,6%; Curvularia lunata, 4,9%; Nigrospora oryzae, 16,3%; Alternaria sp., 6,3%; Fusarium sp, 1,8%; Phoma sp., 11,1%; Cladosporium sp., 11,6%; Epicocum sp., 1,5%; Aspergillus sp., 7,6%; Penicillium sp., 34,4%; Gerlachia oryzae, 18,0%; Alternaria padwickii, 8,4%; others, 5,1%.
Key words: cultivars, diseases, sanity, seeds.

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FUNGOS ASSOCIADOS A SEMENTES DE ARROZ IRRIGADO NO RIO GRANDE DO SUL
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Visando subsidiar o estabelecimento de padrões sanitários Brazileiros para sementes de arroz foi realizado um levantamento complementar dos fungos associados as sementes de arroz irrigado no Rio Grande do Sul durante as safras de 1993 a 1998. Foram utilizadas 350 amostras de sementes de 10 cultivares diferentes de arroz irrigado das classes básica, certificada e fiscalizada. De cada amostra foram retiradas 400 sementes para realização de testes de sanidade, pelo método do "Blotter test, no Laboratório de Fitopatologia da EMBRAPA Clima Temperado. Encontraram-se os seguintes percentuais de fungos associados com sementes *: Pyricularia oryzae, 0,04%; Bipolares oryzae, 2,6%; Curvularia lunata, 4,9%; Nigrospora oryzae, 16,3%; Alternaria sp. 6,3%; Fusarium sp., 1,8%; Phoma sp., 11,1%; cladosporium., 11,6%; Epicocum sp., 1,5%; Aspergillus sp., 7,6%; Penicillum sp., 34,4%; Gerlachia oryzae, 18,0%; Alternaria padwickii, 8,4%; outros, 5,1%.*
Palavras Chaves: cultivares, doenças, sanidade, sementes.

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REPORT OF BACTERIA AND OTHER PATHOGENS IN THE CULTURE OF RICE IN URUGUAY. PART I: BACTERIA
VERDIER, E.; DÍAZ, L.; FERNANDEZ, J.; FISCHER, G.; Dirección General de Servicios Agrícolas, MGAP, Montevideo, Uruguay.

The new alternatives of incorporated managing into the culture(culturing) of the rice, they have generated changes in the dynamics of the diseases. One of the problems that it has increased is the spotted one with grains. The aim is to determine and to quantify bacteria, fungi and nematodos in the culture of rice, for area of production, in them you will cultivate relevant with 400 samples of seed and 94 of field. In the analyses of the samples of seed and plant, the test was used for determination of bacteria of blotter, means of culture, biochemical reactions, inoculation in plants and DAS-ELISA.

The results of bacteria per year. In seed: *Pseudomonas syringae:* 2% y 6%; *P. avenae:* 48% y 45%; *P. glumae:* 14% y 20%; *Erwinia herbicola:* 32% y 12%. In plant: *P. syringae:* 2% y 29%; *P. avenae:* 6% y 4%; *P. glumae:* 4% y 13%; *P. fuscovaginae*: 9% y 4%; *Erwinia herbicola:* 11% y 10%.

The results for zone of production and per year they are the following ones: North: P. avenae: 52 % and 68 %; P. glumae: 14 % and 21 %; E. herbicola: 24 % and 16 %; Center - North: 58 % and 47 %; 4 % and 18 %; 38 % and 29 %; East: 46 % and 52 %; 15 % and 20 %; 32 % and 12 %, respectively. Conclusions: The major proportion of the spotted one of present grain in the culture, is caused by all five pathogenic bacterial identified ones; principally P. avenae; E. hebicola and P. glumae.

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RELEVAMIENTO DE BACTERIAS Y OTROS PATOGENOS EN EL CULTIVO DE ARROZ EN URUGUAY. PARTE I: BACTERIAS
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Las nuevas alternativas de manejo incorporadas al cultivo del arroz, han generado cambios en la dinámica de las enfermedades. Uno de los problemas que ha aumentado es el manchado de granos. El objetivo es determinar y cuantificar bacterias, hongos y nematodos en el cultivo de arroz, por área de producción, en los cultivares mas relevantes con 400 muestras de semilla y 94 de campo. En los análisis de las muestras de semilla y planta, se utilizó para determinación de bacterias el test de blotter, medios de cultivo, reacciones bioquímicas, inoculación en plantas y DAS-ELISA.

Los resultados de bacterias por año. En semilla: *Pseudomonas syringae:* 2% y 6%; *P. avenae:* 48% y 45%; *P. glumae:* 14% y 20%; *Erwinia herbicola:* 32% y 12%. Y en planta: *P. syringae:* 2% y 29%; *P. avenae:* 6% y 4%; *P. glumae:* 4% y 13%; *P. fuscovaginae*: 9% y 4%; *Erwinia herbicola:* 11% y 10%.

Los resultados por zona de producción y por año son los siguientes: Norte: P. *avenae*: 52% y 68%; P. *glumae*: 14% y 21%; E. *herbicola*: 24% y 16%; Centro-Norte: 58% y 47%; 4% y 18%; 38% y 29%; Este: 46% y 52%; 15% y 20%; 32% y 12%, respectivamente.

Conclusiones: La mayor proporción del manchado de grano presente en el cultivo, es causado por los cinco patógenos bacterianos identificados; principalmente *P. avenae; E. hebicola* y *P. glumae.*

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RICE CROP SURVEY OF BACTERIA AND OTHER PHYTOPATOGENS IN URUGUAY. PART II: FUNGI.

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Present rice crop agronomy has changed pest dynamics and increased grain discoloration problems. The purpose of this work was to quantify bacteria, fungi and nematodes by area of production at the most significant rice cultivars during 2000 and 2001 seasons in 400 seed samples and 94 field plant samples. For fungi detection, seed blotter test on aleatory selected seed and discolorated seed, and wash/centrifugation method were used. For plants samples, observation of symptoms and signs and isolation on culture media. In the cultivars El Paso 144 and INIA Tacuarí (84% of seed samples) the fungal total mean incidence on aleatory selected seed were 21,2 and 22,2%. *Alternaria alternata* (4,2%), *Phoma sorghina* (3,1%), *Curvularia* spp, (3%), *Penicillium* spp. and *Aspergillus* spp (2,5%), prevailed. In discolorated seed prevailed no fungal causes with 49,3 % of mean incidence for EP 144 and 52,1 % for INIA Tacuarí. For EP 144 fungal seed discoloration was 21,4%, and for INIA Tacuari 21,1 %. *Alternaria alternata* (5,1%) *Phoma sorghina* (3,9%) and *Curvularia* spp, (2,7%) prevailed as field fungi. *Penicillium* spp. (2,4%) and *Aspergillus* spp. (2,2%) prevailed as storage moulds. *Tilletia barclayana* was detected on 77 % of samples with a mean of 7.931 teliospores per gram of seed. On plants prevailed panicle discoloration with 27% of *Phoma sorghina*. *Bipolaris oryzae* (24%), *Rhizoctonia* spp. (20%) and *Phoma sorghina* (12%) prevailed on foliage.

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RELEVAMIENTO DE BACTERIAS Y OTROS PATOGENOS EN EL CULTIVO DE ARROZ EN URUGUAY. PARTE II: HONGOS.

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El manejo actual del cultivo de arroz, ha incrementado la problemática del manchado de granos y modificado la dinámica de plagas. El objetivo del trabajo fue cuantificar bacterias, hongos y nematodos, por área de producción, en los cultivares más relevantes, durante las zafras 2000 y 2001, en 400 muestras de semilla y 94 de plantas. Para hongos, se usó la técnica de blotter para semilla al azar y manchada, y lavado - centrifugación. Para plantas se observaron síntomas y signos y se aisló en medio de cultivo. En los cultivares El Paso 144 e INIA Tacuarí (84 % de las muestras de semilla) la incidencia media total de fungosis en semilla al azar fue 21,3 y 22,2 %, respectivamente. Predominaron *Alternaria alternata* (4,2%), *Phoma sorghina* (3,1%), *Curvularia* spp, (3%), *Penicillium* spp. y *Aspergillus* spp (2,5%). En semilla manchada dominaron causales no fungosas, con incidencia media de 49,3 % para El Paso 144 y 52,1 % para INIA Tacuarí. La semilla manchada por hongos fue 21,4 % para EP 144, y 21,1 % para INIA Tacuarí. Entre los hongos causantes de manchado en el cultivo, predominaron *Alternaria alternata* (5,1%) *Phoma sorghina* (3,9%) y *Curvularia* spp, (2,7%),. Como causantes de manchado en almacenaje, prevalecieron *Penicillium* spp. (2,4%) y *Aspergillus* spp (2,2%). *Tilletia barclayana* se detectó en el 77 % de las muestras, con una media de 7.931 teliosporas/g de semilla. En plantas predominó el manchado de panoja, destacándose *Phoma sorghina* con 27%. En follaje dominaron *Bipolaris oryzae* (24%), *Rhizoctonia* spp. (20%) y *Phoma sorghina* (12%).

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REPORT OF BACTERIA AND OTHERS PATHOGENS IN THE CULTURE OF RICE IN URUGUAY. PART III: NEMATODOS.

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The new alternatives of managing incorporated into the culture of the rice have generated changes in the dynamics of the diseases. One of the problems that it has increased is the spotted one with grains. The aim of this work was to determine and to quantify bacteria, fungi and nematodos in the culture of rice, for area of production, in the more relevant cultivars, with 400 samples of seed and 94 of field samples. In seed the technology of soaking was used. In plants Fenwick, soaking and centrifugación were used. Was observed a whole of 23 affected samples (11,5 %), without detection of nematodos of economic importance for the culture. *Aphelenchoides* sp. 3 %; *Mononchus* sp. 0,5 %; *Nothotylenchus* sp. 0,5 %; *Psilenchus* sp. 1 %; Rhabditida 6 %; *Tylenchus* sp. 0,5 %, were detected. In the samples of soil and plant, only 4 % of the same ones were free of nematodos. They were not detected nematodos of economic importance. Detected genres were: *Aphelenchoides* sp. 0,52 %; *Aphelenchus* sp. 8,69 %; Criconemoides sp. 8,69 %; *Helicotylenchus* sp. 32,61 %; *Hoplolaimus* sp. 2,17 %; *Nothotylenchus* sp. 13,04 %; *Psilenchus* sp. 8,69 %; Rhabditida 71,74 %; *Rotylenchus* sp. 4,35 %; *Tylenchus* sp. 69,56 %.

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RELEVAMIENTO DE BACTERIAS Y OTROS PATOGENOS EN EL CULTIVO DE ARROZ EN URUGUAY. PARTE III: NEMATODOS.

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Las nuevas alternativas de manejo incorporadas al cultivo del arroz, han generado cambios en la dinámica de las enfermedades. Uno de los problemas que ha aumentado es el manchado de granos. El objetivo de este trabajo fue determinar y cuantificar bacterias, hongos y nematodos en el cultivo de arroz, por área de producción, en los cultivares mas relevantes, con 400 muestras de semilla y 94 de campo. En semilla se utilizó la técnica de remojo-licuado-centrifugación. En plantas se usó Fenwick, remojo y centrifugación. Se observaron un total de 23 muestras afectadas (11,5%), sin detección de nematodos de importancia económica para el cultivo. Se detectaron *Aphelenchoides* sp. 3%; *Mononchus* sp. 0,5%; *Nothotylenchus* sp. 0,5%; *Psilenchus* sp. 1%; *Rhabditida* 6%; *Tylenchus* sp. 0,5%. En las muestras de suelo y planta, solamente un 4% de las mismas estaban libres de nematodos. No se detectaron nematodos de importancia económica. Los géneros detectados fueron: *Aphelenchoides* sp. 0,52%; *Aphelenchus* sp. 8,69%; *Criconemoides* sp. 8,69%; *Helicotylenchus* sp. 32,61%; *Hoplolaimus* sp. 2,17%; *Nothotylenchus* sp. 13,04%; *Psilenchus* sp. 8,69%; *Rhabditida* 71,74%; *Rotylenchus* sp. 4,35%; *Tylenchus* sp. 69,56%.

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MOLECULAR STRATEGIES FOR CHARACTERIZATION OF FUNGAL ISOLATES FROM URUGUAYAN RICE FIELDS

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Sustainability of the rice production, which has expanded both the area and the productivity per hectare in the last years, is one of the most important bases of the Uruguayan rice industry. However, with the increase of the rice frequency in the agricultural-pastures rotations, some emergent diseases have been identified as the main risks for crop intensification. Fungal samples corresponding to *Rhizoctonia* and *Sclerotium* species associated with the culm and sheath complex of diseases, often inaccurately identified using morphological characters, were collected during 2000 and 2001 crop seasons from rice plants and soil in different rice fields throughout the range of rice crops in Uruguay. Fungal DNA samples were analyzed either by PCR amplification using combinations of ITS primers and species-specific primers (GMROS-2 and GMROS-6 for *R. oryzae-sativae*, GMRS-3 and GMRS-4 for *R. solani*, and GMRO-3 for *R. oryzae*), based on Johanson et al (1998). The combination GMRS-4/ ITS1 was also included to compare amplified sequences from *Sclerotium* isolates. On the other hand, a basic step in breeding for blast durable resistance is the identification of population structure for the pathogen *Pyricularia grisea*. Isolates were obtained from lesions present on field-infected plants of different cultivars grown commercially in Uruguay and on experimental nurseries. Samples were collected during crop seasons from 1995 to 2001, both from infected leaves and neck-infected panicles. AFLPs markers were used to assess genomic diversity among *P. grisea* isolates. Isolates collected from different cultivars and different rice fields will be compared with isolates used for screening and selection of breeding lines with improved resistance under artificial inoculation. Using different strategies for characterization of representative samples of fungal isolates, combining anonymous marker loci (such as AFLPs) and DNA variation within fungal genomic sequences, is currently being applied to assess population structure of fungal isolates from Uruguayan rice fields.

Keywords: molecular, characterization, fingerprinting, AFLPs, ITS, Pyricularia, Rhizoctonia

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EVOLUCIÓN Y PREDICCIÓN DE GRADO DE SEVERIDAD DE PODREDUMBRE DEL TALLO Y MANCHA AGREGADA DE LAS VAINAS, MEDIANTE LA DETECCIÓN TEMPRANA DE SÍNTOMAS, EN TRES CULTIVARES

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Resultados anteriores de la investigación mostraron que es posible lograr buenos controles de Podredumbre del tallo y Mancha agregada de las vainas, provocadas por los hongos patógenos *Sclerotium oryzae y Rhizoctonia oryzae sativae*, mediante aplicaciones de fungicidas al inicio de floración. Se planteó el estudio de la evolución de las enfermedades del tallo en los cultivares más sembrados en Uruguay, el daño causado por las mismas en rendimiento en grano y calidad y la predicción de niveles de infección al final del ciclo basada en la detección temprana de síntomas, para establecer un umbral que justifique el control químico. Durante tres zafras (1994-1996), fueron instalados en Paso de la Laguna, Treinta y Tres, 15 ensayos con los cultivares Bluebelle, INIA Tacuarí y El Paso 144. En los mismos se realizó inoculación artificial de *Sclerotium oryzae y Rhizoctonia oryzae sativae* en dosis crecientes, incluyéndose un testigo con infección natural protegido con fungicida aplicado en floración y un testigo con infección natural sin fungicida. Los resultados de Mancha agregada de las vainas muestran que la severidad alcanzada por las parcelas inoculadas superan al testigo protegido en 46,6% para INIA Tacuarí, 27,2% para Bluebelle y 20,9% para El Paso 144. Eso implicó reducción del rendimiento en grano, de 12,0%, para INIA Tacuarí, 6,6% para Bluebelle y no significativa para El Paso 144. La misma comparación referida a la severidad de Podredumbre del tallo mostró valores de 23,5%, 37,0% y 23,6% respectivamente. Las correspondientes pérdidas de rendimiento en las parcelas inoculadas fueron 5,3% para INIA Tacuarí, 19,4% para Bluebelle y 5,7% para El Paso 144. Para ambas enfermedades, no hubieron diferencias en grado de severidad ni rendimiento entre los distintos niveles de inoculación. En los tres cultivares la evolución del Indice de grado de severidad (Ou, 1986), creció a partir de la mitad de floración, con una evolución más rápida a partir de la etapa de doblado de la panoja en las dos enfermedades. No se logró establecer un umbral de infección, ya que en principio de floración los porcentajes de severidad alcanzados fueron muy bajos (0,5%).

Palabras clave: *Rhizoctonia oryzae sativae, Sclerotium oryzae*, control, inoculación, fungicida.

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STEM ROT AND AGGREGATE SHEATH SPOT EVOLUTION IN RICE AND DEGREE OF SEVERITY PREDICTION, THROUGH EARLY SYMPTOM DETECTION IN THREE CULTIVARS

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According with previous research results, it is possible to get good chemical controls of Stem rot and Aggregate sheath spot of rice, with fungicide applications in early flowering stage. The study of the development of that stem diseases in the three more used cultivars in Uruguay and yield and quality losses evaluation, was planned. The main objective was the prediction of final levels of infection based in the early symptom detection in order to establish a threshold to apply chemical control, During three growing seasons (1994-1996), fifteen experiments with the cultivars Bluebelle, INIA Tacuarí and El Paso 144 were installed in the experimental field of Paso de la Laguna, Treinta y Tres. Artificial inoculation with *Sclerotium oryzae* and *Rhizoctonia oryzae sativae* in increasing rates was made. A protected check with fungicide application in flowering stage and a check with natural infection without fungicide, was included. The results of Aggregate sheath spot showed that the disease severity reached at harvest time is higher in the inoculated plots than in the protected check in 46,6% for INIA Tacuarí, 27,2% for Bluebelle and 20,9% for El Paso 144. Those results generated a yield decrease of 12,0%, in INIA Tacuarí, 6,6% in Bluebelle and no differences for El Paso 144. The same comparation referred to the severity of Stem rot showed increments of 23.5%, 37.0% y 23.6% respectively. The corresponding yield losses were 5,3% for INIA Tacuarí, 19,4% for Bluebelle and 5,7% for El Paso 144. For both diseases, there were no differences among different levels of inoculation referred to disease severity and yield. The evolution of the Degree of severity index (Ou, 1986), of the studied diseases, developed after the middle of the flowering stage, with a higher increment at the end of that period and in the filling grain stage, for the three cultivars. The establishment of a threshold of infection was not possible because at the early flowering stage in Uruguayan climate conditions the disease severity levels were very low (0.5% or less).

Key-worlds: Rhizoctonia oryzae sativae, Sclerotium oryzae, chemical control, inoculation, fungicide.

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STUDIES OF *Sclerotium oryzae* AND *Rhizoctonia oryzae sativae* POPULATIONS IN THE SOIL, AND ITS RELATIONSHIP WITH THE RICE STEM DISEASES, IN URUGUAY

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Stem rot and Aggregate sheath spot caused by the pathogen fungi *Sclerotium oryzae* and *Rhizoctonia oryzae sativae,* developed into a major rice diseases in Uruguay during the last two decades. The study was conducted at INIA Treinta y Tres (33º Lat. S, 54º Long. W), from 1999 to 2002, to know the behavior of both fungi populations in the soil under different soil management and cultivars and their relationship with the diseases in the next crop. The pathogen density was determined through the soil sampling, in twelve selected sites. Each sample consisted of twenty cores of 3.0 cm in diameter and 12.0 cm in depth. In the sites, a stem disease severity index (Ou, 1986) present in the following crop was estimated. The sites selected were different in: crop frequencies (high and low), soil management (no tillage or conventional tillage) and cultivar planted (El Paso 144 and INIA Tacuarí). Soil inoculum density, (Number of sclerotium per g. of soil), increased in the sites with high crop frequency during the three growing seasons for *Sclerotium oryzae* ($p<0.0001$) and only in the last period for *Rhizoctonia oryzae sativae* ($p=0.0001$). The *Rhizoctonia* population density was higher in the sites with conventional tillage than in the sites with no tillage, during the growing season 2000-2001 ($p=0.0001$) and more studies are necessary to confirm that result. The inoculum density was not affected by the cultivar planted, and changes were not detected between years for both pathogens. The pathogen density and the calculated disease severity Index of the next crop were positively associated for both fungi. In some situations, that correlation was not consistent through the years among different sites, due to different management practices.

Key-worlds: Sclerotium oryzae, Rhizoctonia oryzae sativae, population, density, soil fungi

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ESTUDIO DE LAS POBLACIONES DE *Sclerotium oryzae* Y *Rhizoctonia oryzae sativae* EN EL SUELO Y SU RELACIÓN CON LAS ENFERMEDADES DEL TALLO DEL ARROZ EN URUGUAY

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Podredumbre del tallo y Mancha agregada de las vainas, enfermedades del arroz causadas por los hongos patógenos *Sclerotium oryzae* y *Rhizoctonia oryzae sativae* han incrementado su importancia en Uruguay, durante las dos últimas décadas. El presente estudio fue conducido en INIA Treinta y Tres (Lat. 33º S, Long. 54º O), entre 1999 y 2002, para conocer el comportamiento de las respectivas poblaciones de hongos en suelos con diferentes manejos y dos cultivares y establecer su relación con las enfermedades causadas en el cultivo. La densidad de los patógenos fue determinada mediante muestreos de suelo en doce sitios. Cada muestra consistió de 20 perforaciones de 12.0 cm de profundidad y 3.0 cm de diámetro. En los sitios, se estimó un índice de severidad de las enfermedades provocadas (Ou, 1986), presentes en el cultivo siguiente. Los sitios estudiados fueron diferentes en: frecuencia de uso (alta o baja), tipo de laboreo (convencional o cero) y cultivar (El Paso 144 o INIA Tacuarí). La densidad de inóculo en suelo (No. de esclerocios por gramo de suelo) fue mayor en los sitios con alta frecuencia de uso, durante los tres años para *Sclerotium oryzae* (p=0.0001) y sólo en la última zafra para *Rhizoctonia oryzae sativae* (p=0.0001). La densidad de la población de *Rhizoctonia* fue mayor en los sitios con laboreo convencional, que en los de cero laboreo, durante la zafra 2000-2001 (p=0.0001); se necesitan más estudios para confirmar este resultado. La densidad de inóculo no fue afectada por el cultivar sembrado ni en años consecutivos en el mismo sitio, en ambos patógenos. Dicho parámetro y el índice de severidad en el cultivo siguiente, se asociaron positivamente para ambas enfermedades. Dicha correlación no fue consistente a lo largo de los años entre distintos sitios debido a diferentes prácticas de manejo en los mismos.

Palabras clave: Rhizoctonia oryzae sativae, Sclerotium oryzae, población, densidad, hongos del suelo

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DEVELOPMENT OF A REFINED UNDERSTANDING OF RICE WATER WEEVIL BIOLOGY TO OPTIMIZE MANAGEMENT EFFICACY

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The Rice Water Weevil, Lissorhoptrus oryzophilus, is the most important Arthropod pest of rice in California. Insecticidal control is an important means of managing this insect pest and one insecticide, carbofuran, was exclusively used for this control for 30+ years. In 1999, two new insecticides (diflubenzuron and lambda-cyhalothrin) were registered in California rice for this pest and the use of carbofuran was phased-out. These materials are both applied after flooding and rice seeding and provide rice water weevil (RWW) control by disrupting the lifecycle of this pest. This differed considerably from carbofuran which was applied in a preventative manner, i.e., pre-flood. These new products have a short residual in the water, therefore, timing of application is critical. An application made before the time of significant adult infestation, will likely dissipate before the RWW population has developed. If the application is made too late, then viable RWW eggs are already present in the rice plants and the damaging larval population will result since these products have no direct activity on RWW larvae. Optimal efficacy with these post-flood materials requires a more thorough understanding of RWW biology, such as RWW flight timing, ovipositional timing, field infestation patterns, and other aspects of the biology and several studies were conducted to aid in determining treatment timing. In addition, questions arose on determining the need for treatment in a given field and the need for a second application in situations with an extended RWW flight. Specific studies were conducted to address these questions and to develop recommendations.

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STRATEGY DEVELOPMENT FOR RICE DAMAGE CAUSED BY BALCKBIRD (Agelaius ruficapillus)

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Rice area increase in Uruguay caused a population growth of blackbird (BB), legally declared as pest. Crop losses minimization was studied on following steps: I) Diagnose: 1) 121 bird species sharing the rice ecosystem were identified. BB are the most numerous during mature stage and post-harvest
2) feeding habits: rice was found to be its main food item, except during summer when it is completed with arthropods 3) reproduction: its poliginy was confirmed; nesting on rice plants, wild vegetation and eucalyptus; on females development stages (adult and juveniles) were described; on males (adult and juveniles from 0, 1y 2 classes). II) Damage: 8% to 9% Kg/ha average losses from 1994 – 1998 period on eastern rice basin was estimated. III) Conceptual modeling: 3 management measures were determined: a)prevention: rice seed exposure and nest sites should be minimized b) protection: striped aeroaplication of azadiractine and anthraquinone repellents were recommended, defining coverage and application rate c) contention: lethal control for juveniles was tried by distributing toxic bait on fields (CPTH) of 1 : 25 treated grain rate previous to BB reproduction period when food is most scarce. Development of this strategy on a pilot area would be recommended.
Key words: , Agelaius ruficapillus , blackbird, bird damage, aerial application, anthraquinone, azadirachtine, CPTH.

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DESARROLLO DE UNA ESTRATEGIA PARA LA DISMINUCIÓN DEL DAÑO DE PAJAROS NEGROS (Agelaius ruficapillus) EN ARROZ

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El incremento del área arrocera en Uruguay produjo un aumento poblacional del pájaro negro (PN), declarado legalmente plaga nacional. La minimización de perdidas se estudio en las siguientes etapas: I) Diagnóstico: 1) determinadas 121 aves que comparten el agro ecosistema, los PN son los más numerosos durante la maduración y post-cosecha. 2) estudio de alimentación: se concluyo que su alimento anual es el arroz, complementándolo con artrópodos en verano. 3) hábitos reproductivos: confirmada su poliginia; nidificando en plantas de arroz, pajonales, montes naturales y eucaliptos; se determinaron en hembras los estadios de desarrollo (adulto y juvenil) y en machos (adulto, y juveniles clase 0, 1y 2). II) Daño: se estimo un 8% a 9% de pérdidas en Kg./ha, promedio del periodo 1994 – 1998 en la cuenca arrocera del este. III) Modelo conceptual del problema: se hipotetizan tres tipos de medidas: a)prevención: minimizar la exposición del arroz y lugares de nidificación. b) protección: aeroaplicación en franjas con los repelentes azadiractina y anthraquinona definiéndose caudal/ha y cobertura c) control letal: para la disminución de las poblaciones juveniles se distribuyó en el campo cebo toxico (CPTH) a una dosis de 1 grano envenenado cada 25 previo a la reproducción, en momentos de menor disponibilidad de alimentos. Se propondrá el desarrollo de esta estrategia en un área piloto.
Palabras clave: franjeado, caudal, cobertura, pájaro negro, Agelauis ruficapillus, danos, anthraquinona, azadirachtina, CPTH.

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ENTOMOFAUNA DEL CULTIVO DEL ARROZ EN URUGUAY

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Durante las temporadas de cultivos entre los años 2000 a 2002 se realizaron estudios sobre la fauna de artrópodos del cultivo de arroz en el Uruguay. Los objetivos fueron determinar sus componentes fitófagos y entomófagos, realizar una primera aproximación a la importancia económica de los fitófagos y a explicar el funcionamiento de la comunidad de insectos y otros artrópodos en el ecosistema arrocero.
Se relevaron cultivos en todas las regiones arroceras y en cada una de las etapas fenológicas.-
Como resultado se determinó y catalogó por primera vez la fauna del cultivo del arroz para el país. También de que su alta diversidad junto a las particularidades de manejo a que está sujeto, explican la estabilidad y resistencia del sistema a que especies fitófagas pasen a situación de plaga.
Es posible fijar como hipótesis de que el cultivo de arroz en Uruguay posee características que le permiten, si se gestionan correctamente algunos factores como el riego entre otros, evitar las aplicaciones insecticidas. Esto le lleva a poseer ventajas competitivas en un mercado sensible a la inclusión de agrotóxicos en los alimentos y a promover la sustentabilidad del cultivo y de los ecosistemas en que se inserta .

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IDENTIFICATION OF THE BLACKBIRD PROBLEM AND ITS CAUSES IN THE RICE PRODUCTION AREA OF SOUTHERN RIO GRANDE DO SUL

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The Blackbird (*Agelaius ruficapillus*) was a protected animal in Rio Grande do Sul. The bird however is a serious problem on rice producing farms. Its population has risen so drastically that it has become a pest. Control of blackbirds is of utmost priority for the Brazilian rice farmers. However, many control strategies are not legal or have been proved to be ineffective. An efficient, method, acceptable for farmers, environmentalists and nature conservationists, should be found. This paper presents the challenge to manage the 'conflicting objectives and interests' between farmers and environmentalists. The method adopted is a result of long term research, carried out in close co-operation between rice farmers, environmentalists and researchers. It presents an in-depth study of the Blackbird problem and identification of its causes.
(Keywords: *Agelaius ruficapillus*, Blackbird, rice, identification of causes, models)
[1] This paper is part of the author's Ph.D. thesis, undertaken at Wageningen University, in 1999.

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IDENTIFICATION OF THE BLACKBIRD PROBLEM AND ITS CAUSES IN THE RICE PRODUCTION AREA OF SOUTHERN RIO GRANDE DO SUL

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O pássaro-preto foi uma espécie protegida no Rio Grande do Sul. Este pássaro é, no entanto, um problema importante para os orizicultores. Sua população cresceu tanto que tornou-se uma praga. O seu controle passou a ser considerado uma prioridade para os orizicultores. No entanto, muitas estratégias de controle não são legais ou mostraram-se ineficientes. Um método eficiente, aceitável pelos produtores, ambientalistas e conservacionistas precisava ser desenvolvido. Este artigo apresenta o desafio de manejar este conflitante interesse entre agricultores e ambientalistas. O método adotado é resultado de uma pesquisa de longo prazo, conduzida em cooperação com agricultores, ambientalistas e pesquisadores. O artigo apresenta um estudo profundo envolvendo o pássaro-preto e a identificação das causas do problema.
(Palavras chaves: Agelaius ruficapillus, Pássaro-preto, arroz, identificação de causas, modelos)
[1] This paper is part of the author's Ph.D. thesis, undertaken at Wageningen University, in 1999.

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ASSOCIATION AMONG SILICA CONCENTRATION, RICE WATER WEEVIL POPULATION AND DAMAGE, IN IRRIGATED RICE PLANTS

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The rice water weevil (RWW) *Oryzophagus oryzae* (Costa Lima) (Coleoptera: Curculionidae) is a very harmful insect to irrigated rice in South Brazil. Adults and larvae feed in rice leaves and roots, respectively. However, larvae cause the main damage to rice plants. Silica (SiO_2) accumulation in rice plants tissues is injurious to the biology of some insects that feed on rice plants. In this work it was evaluated the effect of silica naturally accumulated in plants of four irrigated rice cultivars (BR Irga 410, BRS Atalanta, BRS Firmeza e Dawn) on RWW population and damage levels. The variables evaluated, were: (1) at 6 days after flooding (DAF), number of adult leaf scars, number of eggs in leaf sheaths and % of silica (by means sulfuric acid method at 72%), in aerial parts of rice plants; (2) at 26 DAF, number and mean weight of larvae, and % of silica, in roots; and (3) grain weight. The cultivars showed differences in relation to silica content. The indexes of leaf scars, oviposition, population and larval weight, were negatively associated to tissue silica contents. Silica did not affect grain weight. Typical effects of antibiosis observed, as larval weight reduction, associated to silica content in rice plant, make it possible to infer that the adequate use of this compound could contribute to minimize the quantity of chemical insecticides applied to insect control.
Key-words: *Oryza sativa*, insecta, curculionidade, nutritional ecology, antibiosis

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ASSOCIAÇÃO ENTRE TEOR DE SÍLICA, POPULACÃO E DANOS DO GORGULHO-AQUÁTICO, EM PLANTAS DE ARROZ IRRIGADO

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O gorgulho-aquático Oryzophagus oryzae (Costa Lima) (Coleoptera: Curculionidae) é um inseto altamente prejudicial ao arroz irrigado no Sul do Brazil. Adultos e larvas alimentam-se respectivamente de folhas e raízes de arroz. As larvas causam, porém, os principais danos. O acúmulo de sílica (SiO_2) em tecidos de plantas de arroz prejudica a biologia de alguns insetos orizívoros. Neste contexto, foi avaliado o efeito da sílica acumulada naturalmente em plantas de quatro cultivares de arroz irrigado (BR Irga 410, BRS Atalanta, BRS Firmeza e Dawn) sobre níveis populacionais e de danos de O. oryzae, registrando as seguintes variáveis: (1) aos 6 dias após a irrigação por inundação (DAI), número de lesões de adultos, nas folhas, e de ovos nas bainhas foliares, e % de sílica (obtida pelo método do ácido sulfúrico a 72%), na parte aérea das plantas; (2) aos 26 DAI, número e peso médio de larvas, e % de sílica, nas raízes; (3) peso de grãos. As cultivares diferiram quanto ao acúmulo de sílica nos tecidos. Os índices, de lesões às folhas, de oviposição, de peso e população larval, foram negativamente correlacionados aos teores de sílica. A sílica afetou o peso de grãos. Efeitos típicos de antibiose detectados, como a redução do peso de larvas, associados ao teor de sílica, permitem inferir que esta substância, se usada adequadamente, pode contribuir para a minimização da quantidade de inseticidas químicos aplicados no controle do inseto.
Palavras-chave: Oryza sativa, insecta, curculionidade, ecologia nutricional, antibiose

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PRELIMINARY STUDIES OF THE ENVIRONMENTAL SOCIOECONOMIC IMPACT OF INSECTS (ORDER ISOPTERA) IN RICE AREAS

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ANTECEDENTS For Altieri sustainable agriculture is: "an agriculture way that tries in the long term to provide maintained yields, by means of the use of technologies and practices of handling that improve the biological efficiency of the system." It tends to reduce the costs to the minimum emphasising interactions and synergies between biological components of agricultural ecosystems, improving the biological, economic efficiency and the protection of the environment.

In the Earth it inhabits a rich selection and varied of alive organisms whose genetic diversity and reciprocal relations constitute the biological diversity of the planet, n atural biological capital that we must conserve aiming at the sustainable use. The United Nations Conference on Environment and Development indicates the increasing international preoccupation on the subject. The study of the biological diversity is one of the objectives of the Convention on Biological Diversity, one of the most important events related to international law, environment and development, ratified by Uruguay on August 8th, 1993 (Law 16.408).

This work is related to a group of social insects: termites (Isoptera) and ants (Hymenoptera) in rice areas.

OBJETIVES

1. Detect and identify termite species and related organisms.
2. Study the interaction between termites and the rice areas..
3. Study and look at the social, economic and environmental impact as a result of these knolls.

MATERIALS AND METHODS. The methodology includes tasks in situ (samplings, interviews to cultivators, photographic documentation) and laboratory (physical and chemical characterization of grounds, entomologic determination of the collected species).

RESULTS. In rice areas with heavy ground lands, low fertility and imperfect drainage (Planosoles Subéutricos and Solod Melánicos, Ground Classification of Uruguay, 1976), identified knolls of variable and showy heights to the stage of rest of the cultive. The investigations allowed to detect the presence of termites and ants of the kind Aparatermes sp. and Camponotus sp. The studies on the relations termites / ants are recent as well as the references of termites in nests of ants.

DISCUSSION AND CONCLUSIONS. These knolls must be eliminated in the working stage, interfere with the cattle and activities of the producer, which implies an additional cost in a culture of relevant economic importance. Solutions are due to obtain that contemplate all the aspects presented here and that are of national interest.

Acknowledgements: Reading and comments of Professor Carlos Carbonell

Key words: Rice, Isoptera, Hymenoptera

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ESTUDIOS PRELIMINARES DEL IMPACTO SOCIOECONÓMICO AMBIENTAL DE INSECTOS (ORDEN ISÓPTERA) EN ÁREAS ARROCERAS

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ANTECEDENTS. Para Altieri agricultura sostenible es: "un modo de agricultura que intenta proporcionar rendimientos sostenidos a largo plazo, mediante el uso de tecnologías y prácticas de manejo que mejoren la eficiencia biológica del sistema." Tiende a reducir al mínimo los insumos enfatizando interacciones y sinergismos entre componentes biológicos de los agroecosistemas, mejorando la eficiencia biológica, económica y la protección del medio ambiente.

En la Tierra habita una selección rica y variada de organismos vivos cuya diversidad genética y relaciones recíprocas constituyen la biodiversidad del plantea, capital biológico natural que debemos conservar apuntando al uso sostenible. La Conferencia de Naciones Unidas sobre Medio Ambiente y Desarrollo indica la creciente preocupación internacional sobre el tema. El Convenio de Diversidad Biológica, uno de los acontecimientos más importantes en derecho internacional, medio ambiente y desarrollo, ratificado por Uruguay el 27/08/93 (Ley 16.408) tiene entre sus cometidos el estudio de la biodiversidad.

El trabajo hace referencia a un grupo de insectos sociales: termites (Orden Isoptera) y hormigas (Orden Hymenoptera) en áreas arroceras.

OBJETIVOS

1. Detectar e identificar las especies de termites y organismos asociados.
2. Estudiar la interacción termites - áreas arroceras.
3. Estudiar y monitorear los impactos socioeconómicos y ambientales como resultado de estos montículos.

MATERIALES Y MÉTODOS. La metodología incluye tareas a campo (muestreos, entrevistas a cultivadores, documentación fotográfica) y laboratorio (caracterización física y química de los suelos, determinación entomológica de las especies colectadas).

RESULTADOS. En terrenos arrozables de suelos pesados, baja fertilidad y drenaje imperfecto (Planosoles Subéutricos y Solod Melánicos, Clasificación de Suelos del Uruguay, 1976), se identificaron montículos de alturas variables y llamativas vinculados a la etapa de descanso del cultivo. Las investigaciones permitieron detectar la presencia de termites y hormigas del género Aparatermes sp. y Camponotus sp. Los estudios sobre las relaciones termites / hormigas son recientes así como las referencias de termites en nidos de hormigas.

DISCUSIÓN Y CONCLUSIONES. Estos montículos deben ser eliminados en la etapa de laboreo, interfieren con la cría del ganado y actividades del productor, lo cual implica un costo adicional en un cultivo de importancia económica relevante. Se deben lograr soluciones que contemplen todos los aspectos aquí presentados y que sean de interés nacional.

Agradecimientos: Lectura crítica del Prof. Carlos Carbonell

Palabras clave: Arroz, Isoptera, Hymenoptera

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SPATIAL NITROGEN MANAGEMENT IN AUSTRALIAN RICE FIELDS
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It is common knowledge that rice yields within land formed paddocks can vary considerably. Australian rice growers are aware of this variation, but many have under estimated the range in yield within a single paddock. The advent of precision agriculture and yield monitors has allowed yield variation to be quantified. In the past, farmers have attempted to even up yields via remedial action over cut areas of teh paddock. This has resulted in additional applications of phosphorus, zinc, nitrogen or manures. Treatment of cut areas has been complicated by the dificulty in locating such areas, the requirment of extra passes with machinery and the varied results obtained. As a result, Australian rice growers have not been able to maximise yields in highly vaiable paddocks using a uniform management strategy.
This paper examines the variable nature of soil nitrogen supply in landformed rice fields and current attempts to manage this variability to better match the nitrogen requirements of the crop. New technologies that allow nitrogen to be applied in zones by ground and airborne equipment are outlined, along with the results of some of the variable rate applications, their sucesses, failures and the lessons learned. The management strategies derived from the trialing of these new technologies will become valuable tools for Australian rice growers in their struggle against increasing input costs and the demands of future environmental regulations.

035
SPATIAL AND TEMPORAL ANALYSIS OF RICE YIELD VARIABILITY IN CALIFORNIA
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Most farmers recognize that spatial variability in yield exists when they harvest. However, this knowledge is generally of an informal, anecdotal nature, which must be made more precise if it is to be used effectively in precision agriculture. Currently, we know little about the spatial structure neither of these yields patterns, nor of the consistency of these patterns from year to year. The consistency of the spatial and temporal structure of crop yield across the field needs to be investigated before implementing any management strategy. The stability of the spatial structure over time will indicate whether the same physical and ecological processes are controlling yield from year to year. In this project we describe yield spatial and temporal structure of two rice fields in California. Yield spatial structure is assumed to consist of a large-scale deterministic structure or trend and a small-scale stochastic structure. Large-scale deterministic structure was determined for each year using median polish. Trend surface spatial behaviors were different each year, indicating a lack of temporal stability in this structure. The small-scale stochastic spatial structure was determined by computing variograms of the yield residuals after subtracting the trends. Variograms showed strong spatial structure of yield residuals. Temporal variability was determined by two different approaches: 1) computing the variance among years; and 2) by using cluster analysis of the standardized trend yield values. Cluster analysis reduced the considerable complexity in a sequence of yields maps of these fields to a few general patterns of among year's variations with a given spatial distribution.
Keywords: Precision Farming, Yield Spatial and Temporal Variability, Variograms, Median Polishing, Cluster Analysis.

036
INTERPRETING YIELD PATTERNS FOR CALIFORNIA RICE PRECISION FARM MANAGEMENT
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The introduction of yield monitors, yield mapping software, global positioning systems, and geographic information systems has made it possible to measure and analyze rice grain yield within a field at a spatial resolution of about 3 to 5 m. The technology can precisely determine low yielding areas, and if the cause of the reduced yield can be identified then corrective action may be possible to bring the low yielding areas up to their yield potential. The objective of this research project is to evaluate recently introduced precision agriculture technology to determine whether it is advantageous for California rice production. This poster describes initial results of this research effort. Yield data from two rice fields are analyzed in conjunction with data from infrared aerial photography and grid based soil sampling. Preliminary results indicate that a program of directed soil sampling based on yield monitor and remote sensing data may provide an inexpensive method for identifying and mapping yield-limiting factors.
-When spatial aspects of yield data were taken into account the field showed two major distinguishable areas of consistent (stable) low or high yields with small patches of variable behavior.
-The cost analysis study showed that the field presented a positive net margin in most of the area, with small islands where the net margin was negative. The develop of cost maps like the one presented in this poster can be of significant importance for the evaluation of the suitability of the adoption of new technologies like Precision Farming.
Keywords: Precision farming, Inter-annual variability, Intra-annual variability, Cost Analysis.

037
AGRONOMIC CHALLENGES OF PRODUCING PREMIUM QUALITY RICE
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Quality is based on a combination of subjective and objective factors. California growers are interested in producing high quality varieties of rice for export and domestic specialty rice markets that have rigorous quality standards. To meet this challenge, the impact of on-farm practices on grain quality must be understood. The objectives were to study the effects of agronomic practices on the physicochemical properties of rice. The paper is a case study highlighting critical on-farm practices required to meet the quality standards for the Japanese market. A series of experiments were conducted. The Japanese variety, Akitakomachi, was grown at N rates ranging from 0 to 100 kg/h applied as a preplant or split application at different growth stages. Productivity and chemical properties related to quality were evaluated. Akitakomachi was harvested at different moisture contents (MC; 20%, 22% and 24%) and dried with combinations of heated and ambient air (24 C, 32 C, and 45 C) to evaluate surface fissuring. Incubation studies to simulate the time from harvester to dryer (1 to 24 hours) were conducted to evaluate off-odor development. The 90 kg/ha treatment applied at preplant produced the highest yields, while the 60 kg/ha as a split application produced the highest taste scores. Yield was highest when tissue N levels were 2.8% at PI. MC above 24% resulted in undesirable protein levels and below produced high rates of fissuring. Periods of longer than 8 hours between harvest and aeration resulted in increased fissuring and off-odors. Results indicate that rice quality is affected by production practices at several points in the growing season. Modifications to conventional practices are needed to produce rice with the desired quality characteristics for the Japanese market.
Keywords: nitrogen, quality, specialty rice

038
PRECISION FARMING FOR SITE-SPECIFIC CROP AND RESOURCE MANAGEMENT
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Site-specific crop management (SSCM) is the management of a crop at a spatial and temporal scale appropriate to that crop's own inherent variability. Precision agriculture has been defined as the application of modern information technologies to achieve SSCM. Concepts of precision agriculture have primarily been developed for application to large-scale production systems characteristic of Europe and North America, and have focused on the spatial dimension. Development of SSCM techniques in tropical regions has focused on the time dimension. Future research should permit these two approaches to be synthesized to a system that uses spatial relationships to optimize the efficiency of collecting information and that optimizes production in each year. An important question is whether concepts of SSCM and precision agriculture can be used to improve farming practices in areas with a lower level of mechanization, and whether methods developed for small farmers to improve the precision with which they manage their crops can provide guidance in the development of SSCM strategies for large fields in high technology systems. The objective of this paper is to consider these questions in the context of rice production. The overriding theme of the paper is that SSCM involves both a spatial and a temporal component, and that the most successful implementation of SSCM will be one that integrates these two components effectively.

039
SPATIAL AND TEMPORAL ANALYSIS OF RICE YIELD VARIABILITY IN CALIFORNIA
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Univ of California Davis, USA

Most farmers recognize that spatial variability in yield exists when they harvest. However, this knowledge is generally of an informal, anecdotal nature, which must be made more precise if it is to be used effectively in precision agriculture. Currently, we know little about the spatial structure neither of these yields patterns, nor of the consistency of these patterns from year to year. The consistency of the spatial and temporal structure of crop yield across the field needs to be investigated before implementing any management strategy. The stability of the spatial structure over time will indicate whether the same physical and ecological processes are controlling yield from year to year. In this project we describe yield spatial and temporal structure of two rice fields in California. Yield spatial structure is assumed to consist of a large-scale deterministic structure or trend and a small-scale stochastic structure. Large-scale deterministic structure was determined for each year using median polish. Trend surface spatial behaviors were different each year, indicating a lack of temporal stability in this structure. The small-scale stochastic spatial structure was determined by computing variograms of the yield residuals after subtracting the trends. Variograms showed strong spatial structure of yield residuals. Temporal variability was determined by two different approaches: 1) computing the variance among years; and 2) by using cluster analysis of the standardized trend yield values. Cluster analysis reduced the considerable complexity in a sequence of yields maps of these fields to a few general patterns of among year's variations with a given spatial distribution.

040
FACTORS UNDERLYING YIELD SPATIOTEMPORAL VARIABILITY IN TWO CALIFORNIA RICE FIELDS
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In this study several approaches were used to determine the factors that cause the spatial and/or temporal variability of two rice fields in California. These approaches include a) classical inferential statistics like Pearson's correlation coefficients and stepwise multiple linear regression, b) non parametric statistics like CART, Mantel and partial Mantel tests and c) geostatistical analysis like variograms and cross-variograms. For Field 1, none of the soil physical or chemical variables that were measured presented a consistent relationship with yield performance in the four years. In Field 2, there were four soil variables consistently related with yield performance from 1998 to 2000. Organic matter was significantly positively correlated with yield, while K, Clay and Soil compaction were significantly negatively correlated with yield performance during these years. Examination of the variograms showed that the range of spatial autocorrelation varied among soil properties and yield in different years. When the partial Mantel test was used to test if the correlations found by the simple Mantel tests are still significant when the spatial correlation is accounted, the results showed that these relationship indeed remain statistically significant when spatial effects were held constant, with the exception of Soil Compaction and Yield in the year 2000. There is no single approach or statistical analysis that is capable to completely explain the causes of yield spatial variability. Each method provides different information, and only by integrating classical inferential statistics, non parametric statistics and geostatistical analyses it is possible to conform a better understanding of causes of yield spatial variability.
Keywords: Precision farming, Spatial analysis, Classification and regression trees, Variograms, Cross-Variograms, Mantel statistics.

044
ESTABLISHING A SYSTEM OF GEOGRAPHICAL INFORMATION WHITH A PROFILE APPLICABLE TO RACE AREAS.
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In the frame of the Proyect of Technological Innovation P.D.T. Nº S/INI/01/044, Conicyt (M.E.C) a methodology for compilation and headling of geographical information is developed.
Its aim is to generate a tool for the groundwork and planning of those agricultural systems which involve resourses geographicaly distributed and which require suitable planning and effective monitoring and control. Starting from the periodic load of information for its analysis in the taking of decisions and based on the technology of the sistems of geographical Information.
The implementation is in the watering system in "India Muerta" administrated by Comisaco S.A. and its coverage is approximately 180.000 Hás. in the province of Rocha.
The differencial contribution with regard to the existing developments in our country, at both state and private level, is in the working scale in the complete level of accuracy in the geographical elements and in the fact that it provides the necessary conditions for the management of the system in real time. This implies to evacuate historical condition of use management and performance for farm, and the needs in the water supply or potential of reload of the system, monitoring of the distribution nets, improvement in the eficiency of the use of the water resourse and other activities.
Technology of GPS, Digital Photogrammetry and software GIS specialized programmed for our clients were used for the development of the system.
The final product is the model of the zone at an adecuated and modernistic scale linked together with the variable time which makes possible to work in past, present or future situations.
Keywords: GIS, GPS, Digital Photogrammetry, Watering Use Administration, Comisaco S.A.

044

IMPLEMENTACIÓN DE UN SISTEMA DE INFORMACIÓN GEOGRÁFICA CON UN PERFIL APLICABLE AL SECTOR ARROCERO.

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En el marco del Proyecto de Innovación Tecnológica PDT Nº S/E/INI/01/044, Conicyt (M.E.C.), se desarrolla una metodología para la recolección y manejo de información geográfica.
Su objeto es generar una herramienta para la gestión y planificación de aquellos sistemas agrícolas que involucren recursos distribuidos geográficamente y que requieran una adecuada planificación y eficaz monitoreo y control. A partir de la carga periódica de información para su análisis en la toma de decisiones, basado en la tecnología de los Sistemas de Información Geográfica.
La implementación es en el Sistema de Riego de India Muerta, administrado por Comisaco S.A. y su cobertura es de aproximadamente 180.000 Hás. del departamento de Rocha.
El aporte diferencial con respecto a los desarrollos existentes en nuestro país, tanto a nivel estatal como privado, está en la escala con la que opera, el nivel de precisión absoluta en los elementos geográficos y que provee de las condiciones necesarias para la gestión del sistema, en tiempo real. Esto implica: evaluar condiciones históricas del uso, manejo y rendimiento por chacra, y necesidades de provisión de agua o potencialidades de recarga del sistema, monitoreo de redes de distribución, mejora de la eficiencia del uso del recurso agua y otras actividades.
Para el desarrollo del sistema, fueron utilizadas tecnologías de GPS, Fotogrametría Digital y software SIG especializados y programados para nuestros clientes.
El producto final es la modelización de la zona, a una escala adecuada e innovadora concatenada con la variable tiempo lo que permite trabajar en situaciones pasadas, presentes y futuras.

Palabras Claves: SIG, GPS, Fotogrametría Digital, Riego, Uso, Gestión, Comisaco S.A.

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AN INTEGRATED RICE YIELD FORECASTING SYSTEM IN EUROPE

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The European Union with the MARS (Monitoring Agriculture with Remote Sensing) project aims at applying recent acquisitions of crop modeling and remote sensing for delivering, every month, information on soil use, crop status, stress early warning, and yields forecasting. The study area includes Europe, North Africa (Maghreb) and Turkey.
The system is able to utilize data from different sources: high resolution images and data from ground truth campaigns, output of the Crop Growth Monitoring System (CGMS) related to soil, weather, crop variables, images of the NOAA-AVHRR and SPOT_VEGETATION satellites, allowing to recover information on vegetation, developing stage and growth condition of different crops, through NDVI analysis (Normalised Difference Vegetation Index).
CGMS is structured in three layers: in the first weather data are acquired and elaborated; in the second, through WOFOST crop growth model, the total potential biomass, potential yield, leaf area index are simulated; the third level integrates information for simulating yield. The system is utilized for several crops such as wheat, barley, corn, sugarbeat, potato, sunflower, but it has not been parameterised for rice. The present study aims at calibrating and validating the system for this crop.
Statistical data on yield, cultivated area, phenological calendar have been collected from local board and several cultural parameters such as SPAN, TBASE, SLATB, and FLTB, FOTB, FRTB, and FSTB have been changed.
Good results have been obtained for Spain, France, Grece and Portugal whereas for Italy the model did not perform satisfactorily so that a forcing model process (integration of CORINE, LANDSAT and NOAA-AVHRR data) was necessary.

Key words: yield forecasting, UE rice production, Remote sensing and modelling

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IMPACT OF THE ASIA-PACIFIC ECONOMIC COOPERATION AGREEMENT AND THE FREE TRADE AREA OF THE AMERICAS AGREEMENT ON INTERNATIONAL RICE TRADE
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Among other factors, the high level of protection and therefore distortion in the international rice market determines the low level of international trade of this commodity. The process of economic integration most nations are going through may have a positive impact on international trade by lowering the level of distortion. Among the evolving regional trade agreements, the most important one regarding rice trade is the APEC, signed in 1989. This bloc accounted for 37% (9.7 mmt) of total imports and 67% (17.7 mmt) of total exports during 1999. Another important agreement under discussion that may have some substantial impact on world rice trade is the FTAA. Aggregate exports made by FTAA exporters were 4.3 mmt during 1999, whereas aggregate imports were 3 mmt. Intra-regional trade was approximately 2.4 mmt. The objective of this study is to analyze the impact of APEC and FTAA on international rice trade and prices. We formulate a spatial price equilibrium model of the world rice market to analyze the trade flow changes for each type of rice. Trade diversion and trade creation effects as a result of these agreements are measured. The new global market equilibrium is expected to define higher prices as well as quantity traded. A large trade creation effect is expected as a result of APEC completion. Regarding FTAA, the trade creation effect is expected to be smaller, given the smaller volume traded and level of protection used within the Western Hemisphere. Trade diversion from FTAA is also expected to be small since trade flows between members and low cost non-member exporters are relatively unimportant.
Keywords: regional trade agreements, trade creation, trade diversion, liberalization.

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INFORMATION SYSTEMS IN BRAZILIAN RICE SECTOR
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More than 50 percent of Brazilian rough rice production is concentrated in Rio Grande do Sul and Santa Catarina states. Even though, there is a trend of widespreading the activity, due to rising prices in the last years. This dispersion of production leads growers and other agents to require more dynamism on information, in order to minimize the gap between distant regions. It explains the increasing importance of Internet towards the democratization of information. Many studies have pointed to a rising use of information technology in the rural area – and the growing use of Internet as well. This fact, added to the lack of information in rice sector, motivated the creation of the "Brazilian Rice" project (projeto "Arroz Brazileiro"), launched in June 2002.
The project's purpose is to contribute to the rice sector development, through the divulgation of news and other information on domestic and international rice market. "Brazilian Rice" website had its number of visitors increased by 48 percent between September and November 2002, what indicates that demand for information is strong in this sector.

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NARROWING THE RICE YIELD GAP FOR FOOD SECURITY AND POVERTY ALLEVIATION UNDER THE ENVIRONMENT OF GLOBAL WARMING
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The narrowing of the rice yield gap through varietal improvement and crop management during the last three decades have substantially increased rice production to meet the population demand. However, the growth rate of the world's rice production has been declining substantially since 1990.
This causes concern with regard to world food security; keeping in mind of the continued growth of the world's population. In addition, the majority of rice farmers and their families are still living in poverty. In 2000, the harvested area of irrigated rice constituted about 57% of the world's rice harvested area, but irrigated rice contributed about three-quarters of the world's total rice production. Narrowing yield gap in irrigated rice, therefore, is crucial with regard to the world's sustainable rice production, food security and poverty alleviation. The rice integrated crop management (RICM) systems have proven to be effective in narrowing the yield gap of irrigated rice, in increasing the incomes from rice production, and in reducing the environmental degradation. The growth and productivity of irrigated rice, however, is sensitive to changes in the environmental factors, especially the changes in the incidence of solar radiation, the air temperature and the concentration of atmospheric carbon dioxide. The provision of geo-reference and time-reference information on changes in temperature regimes under global warming, in the short term, could effectively contribute to the narrowing of rice yield gap. In addition, the conservation, evaluation, and utilization of the diversified capacities of rice varieties in-terms of tolerating high temperates, more efficient fixation of carbon dioxide, and better tolerance to flooding and salinity would be critical for succesful breeding of rice varieties with higher yielding potential under the environment of global warming.

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SISTEMAS DE INFORMAÇÃO NA ORIZICULTURA BRAZILEIRA
ROSSMANN, HEIKO; BARATA, TIAGO SARMENTO; GAMEIRO, AUGUSTO HAUBER
Natural Solucoes Setoriais, Brazil

No Brazil, apesar de mais de 50% da produção Brazileira de arroz em casca estar concentrada no Rio Grande do Sul e em Santa Catarina, existe uma tendência de pulverização da atividade em função da valorização do produto observada nos últimos anos. Esta dispersão da produção faz com que, tanto os produtores quanto os demais agentes da cadeia produtiva do arroz, tenham tendência a exigir uma maior dinamização da informação, minimizando o isolamento de algumas regiões produtoras. Neste sentido, a Internet vem se tornando, cada vez mais, uma importante ferramenta para a democratização da informação. Diversos estudos têm apontado crescimento do uso da informática no meio rural, acompanhado pelo crescimento do acesso à Internet. Assim, somado ao fato da carência de informação no setor, foi lançado em junho de 2002 o projeto "Arroz Brazileiro". O intuito do projeto é colaborar com o desenvolvimento do setor orizícola Brazileiro, por meio da divulgação de informações do mercado nacional e internacional, e possibilitar o acompanhamento dos acontecimentos por todos os integrantes desta cadeia produtiva. Observou-se um aumento de 48% no número de visitantes do site em apenas três meses, de setembro a novembro, demonstrando que existe demanda por informação neste setor.

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COMPETITIVENESS BETWEEN IRRIGATED AND UPLAND RICE IN BRAZIL
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There are many doubts about competitiveness between irrigated (in southern Brazil) and upland rice production (mainly in Center-West). Irrigated rice has significantly higher yields. On the other hand, it demands higher land systematization, energy for irrigation and use of inputs. Upland rice cultivation presents lower yields, but generally has comparatives advantages that allow the dilution of many costs (like land opportunity, capital and machinery). These comparatives advantages often result from an agricultural dynamic that includes cattle, corn, soy and cotton growing, besides rice. Moreover, upland rice is important because is used to open new areas or recover depreciated ones – essential functions in agricultural frontiers regions.
In many parts of South Brazil, growers face the lack of alternatives in rural production, once local weather and soil conditions limit other agricultural products' cultivation. This lack of alternatives certainly is a restriction to competitiveness in many southern farms.
Quantitative and qualitative information were obtained in meetings with producers in important rice regions in Rio Grande do Sul state (as Camaqua, Pelotas, Santa Vitoria do Palmar and Alegrete) and in Mato Grosso state (Sorriso, Primavera do Leste, Campo Novo do Parecis). These information allowed the calculation of production costs, that were the base of this study.

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COMPETITIVIDADE ENTRE O ARROZ IRRIGADO E DE TERRAS ALTAS NO BRAZIL
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Ainda há muitas dúvidas em relação à competitividade entre os sistemas de produção de arroz irrigado, no Sul do Brazil, e o de terras altas, especialmente na região Centro-Oeste. O arroz irrigado apresenta produtividade significativamente superior ao de terras altas, porém com uma maior necessidade de sistematização de área, gasto de energia para irrigação e, supostamente, maior aporte de insumos. O cultivo de terras altas, apesar da menor produtividade, geralmente está inserido em uma dinâmica agrícola (com milho, soja, algodão, pecuária etc) que lhe permite uma grande vantagem comparativa, possibilitando a diluição de importantes itens de custo, como o de oportunidade da terra, do capital e do maquinário. Além do que, o arroz de terras altas apresenta o relevante papel de cultura pioneira para abertura de novas áreas e/ou renovação de áreas degradadas, funções fundamentais na região de fronteira agrícola. Considera-se, ainda, a falta de opções para os agricultores de diversas áreas no Sul, imposta pelas condições edafoclimáticas naturais da região, que não permitem o cultivo comercial de outras culturas. Certamente essa falta de oportunidade é uma restrição à competitividade de muitas fazendas sulistas. Por meio de reuniões com técnicos e produtores, em regiões representativas nos municípios do Sul (Camaquã, Pelotas, Santa Vitória do Palmar e Alegrete), bem como em municípios do Mato Grosso (Sorriso, Primavera do Leste e Campo Novo do Parecis), levantou-se informações quantitativas e qualitativas que possibilitaram o cálculo dos custos de produção para a realização da pesquisa.

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BRAZILIAN RICE IMPORTS IN THE LAST TEN YEARS
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Brazil has not produced enough rice to meet domestic demand, because of internal factors (like growers in debts and high production costs), as well as external factors (as other country's competitiveness). This paper analyzes supply situation in Brazil, emphasizing imports of rough and milled rice, in the last 10 years (1992-2001). During this period, the country imported, in average, 450 thousand tons of rough rice per year, what corresponds to 4.5 percent of Brazilian production. Argentina and United States are the largest sellers of rough rice to Brazil, accounting, respectively, for 38 percent and 36 percent of domestic imports, in the last 10 years. Uruguay is also an important supplier, representing 23 percent of Brazilian's rough rice imports in this period. Paraguay answered for 2 percent and the other countries (mainly Asian ones), for 1 percent. Brazilian imports of rice with some degree of milling mostly come from Mercosul countries. Together, Argentina and Uruguay supplied 90 percent of cargo rice imported by Brazil. Thailand, Vietnam and United States responded, each one, for about 2 percent of national imports. Other countries represented 4 percent of domestic imports. This study deals with socioeconomic facts in Brazil, as agricultural policies, economic openness, Mercosul creation, among others.

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IMPORTAÇÕES BRAZILEIRAS DE ARROZ NOS ÚLTIMOS 10 ANOS
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O Brazil não tem sido auto-suficiente no abastecimento de arroz para sua população, seja por motivos internos (endividamento dos agricultores, custo de produção etc), seja pela competitividade do arroz de países fornecedores. Esses podem ser tanto os países vizinhos do Mercosul, especialmente Uruguai e Argentina, como também aqueles fora do bloco econômico, como os Estados Unidos e países da Ásia. Este trabalho procura analisar o quadro de suprimento no Brazil, enfatizando as importações Brazileiras de arroz em casca e beneficiado, nos últimos 10 anos (1992-2001). Nesse período o País importou, em média, aproximadamente 450 mil toneladas anuais de arroz (base em casca), o que equivale a 4,5% da produção nacional. A Argentina e os Estados Unidos lideram o fornecimento de arroz em casca, tendo participado com 38% e 36%, respectivamente, das importações Brazileiras no período. O Uruguai também é importante fornecedor, tendo respondido por 23% das importações de arroz em casca pelo Brazil. O Paraguai forneceu 2% e todos os demais países, 1%. As importações de arroz que passou por algum beneficiamento são fortemente lideradas pelos parceiros do Mercosul, sendo que Argentina e Uruguai forneceram, juntos, 90% do arroz descascado importado pelo Brazil. Tailândia, Vietnã e Estados Unidos forneceram, cada um, aproximadamente 2% das importações nacionais. Demais países responderam por 4%. A pesquisa aborda esses aspectos, correlacionando os números com os acontecimentos socioeconômicos vividos pelo Brazil, especialmente suas políticas agrícolas, sua abertura econômica, a formação do Mercosul, dentre outros.

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RELATIONS BETWEEN IRRIGATED AND UPLAND RICE PRICES IN BRAZIL
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Rice production system is very different from one region to another in Brazil. In the South, it is characterized by irrigation, use of high technology and high yields. In the Center-West, upland rice production predominates, with lower yields. This paper aims to analyze rice price relation in farm, both to irrigated and upland rice, in the last 22 years. For that, an index obtained through the division of average prices paid for growers in Goias state (Center-West) and in Rio Grande do Sul state (South region) was created. Considering monthly prices from January 1980 to July 2002 (259 months), it is observed that Goias prices were higher in only 69 months (27 percent) – what is explained mainly for the higher quality of Rio Grande do Sul's rice. Nevertheless, federal government intervention, through minimum prices policies, specifically Government Acquisition Program (AGF), strongly interfered on prices behavior.
In the middle of the 80's, 30 percent of AGF's total funds were allocated to Goias and only 10 percent to Rio Grande do Sul. As a consequence, rice prices in Goias were near or even higher to Rio Grande do Sul's prices. In 1985 and 1988, upland rice prices were 7 percent above irrigated ones. On the contrary, in the 90's, Rio Grande do Sul received a larger amount of AGF's funds and local prices increased. In 1995, for instance, 76 percent of AGF's money were sent to Rio Grande do Sul and only 4 percent to Goias. As a result, Goias average price was 18 percent below South's prices. Anyway, governmental intervention has been reduced and other factors have determined prices behavior. This study shows this evidences and analyzes additional factors.

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RELAÇÃO ENTRE PREÇOS DO ARROZ DE TERRAS ALTAS E IRRIGADO NO BRAZIL
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O sistema de cultivo nas principais regiões Brazileiras é bastante distinto, caracterizado, no Sul, pela irrigação, modernas tecnologias e elevada produtividade, enquanto no Centro-Oeste predomina o cultivo de "terras altas" (sequeiro), com produtividade inferior. O objetivo do trabalho é analisar o comportamento da relação de preços do arroz na fazenda, nesses dois sistemas, nos últimos 22 anos. Cria-se um índice obtido pela razão entre os preços médios pagos aos produtores do Centro-Oeste e do Sul, representados pelos estados de Goiás (GO) e Rio Grande do Sul (RS), respectivamente. Considerando os preços mensais entre janeiro de 1980 e julho de 2002 (259 meses), tem-se que em apenas 69 meses (27%) os preços em GO estiveram acima dos do RS. A principal explicação reside na qualidade superior do arroz irrigado. Todavia, a intervenção do governo federal, pela Política de Garantia de Preço Mínimo, na qual o principal instrumento é a Aquisição do Governo Federal (AGF), teve forte influência sobre essa relação. Em meados dos anos 80, GO recebeu 30% do recurso total para AGF (o RS, apenas 10%). Como conseqüência, os preços estiveram próximos ou superiores aos do RS. Em 1985 e 1988, os preços do arroz de sequeiro estiveram 7% superiores. Nos anos 90, ocorreu o inverso: o RS passou a receber a maior parcela do AGF, garantindo preços melhores. Em 1995, por exemplo, o RS recebeu 76% desse recurso e GO, 4%, sendo que o preço médio em GO ficou 18% abaixo do RS. Mas essa intervenção vem sendo reduzida, de modo que outros fatores passam a influenciar. A pesquisa demonstra essas evidências e procura explorar esses fatores adicionais.

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FORECASTING AUSTRALIAN RICE YIELDS
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Yield forecasts are needed by the Australian rice industry to schedule loans, payments to ricegrowers, transport, storage and sales. The main source of yield variation is cold damage during reproductive development, but recent evidence suggests that low temperatures at other stages, particularly vegetative development, also cause yield loss. Other sources of yield variation are solar radiation, new cultivars, increased inputs and the use of deep water to insulate young pollen grains against cold damage. All crops are fully irrigated, so water supply plays no part in yield variation. Since most of the variation is known by the time of flowering, yield can be forecast about 6 weeks before harvest.
Reliable yield and weather data from three regions for periods of up to 47 years are available for model development. During that time, when mean yields increased from 5 to 9.5 t/ha, 3 main cultivars occupied most of the area sown: Caloro from 1955 to 1972, Calrose from 1967 to 1992 and Amaroo from 1987 to 2002. By allowing for the yield increases due to cultivar changes it is possible to model yield for 173 region-year combinations. Two forecasting systems were tested. One was a set of regression models for individual regions, based on monthly temperatures. The other was a dynamic model that simulated daily growth in relation to solar radiation and temperature for all regions. Both systems included variables describing the technological changes and both led to acceptable yield forecasts, with a standard error of prediction of about 0.5 t/ha.

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JOB AND INCOME GENERATED BY RICE PRODUCTION IN RIO GRANDE DO SUL (BRAZIL)
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Rice has been planted in Rio Grande do Sul state for a century and is an important product in local economy. This state responds for almost 50 percent of Brazilian rice production. This paper aims to quantify the number of jobs and the income generated by rice activity, through technical and socioeconomic updated data. Macroeconomic data were obtained from official statistics sources. Technical coefficients, as well as inputs and services values, came out in meetings with growers from three important regions: Camaquã, Pelotas and Santa Vitória do Palmar, which represent 13 percent of rice planted area in Rio Grande do Sul. Rio Grande do Sul will cultivate around 974 thousand hectares of rice in 2002/03 season. Yield is expected to be around 5,690 kg/ha. Rough rice production is likely to sum up to 2 billion reals, which accounts for more than 2 percent of the state's GDP. Inputs (fertilizers, seeds, defensives and fuel) are estimated to amount to 610 million reals, while services (machinery, transportation and work-force) should sum to 647 million reals. Land income, water and capital are foreseen to be around 503 million reals. Net margin will probably be about 237 million reals. Near 20 thousand people are permanently hired to work in rice fields, what represents 1 percent of men active population in the state. This study shows, with details, the quantity and the values of each production factor in the three analyzed regions, as well as in the whole state.

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GERAÇÃO DE EMPREGO E RENDA PELA OIRIZICULTURA NO ESTADO DO RIO GRANDE DO SUL, BRAZIL

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Produzido há um século no Rio Grande do Sul, o arroz é um importante produto agrícola estadual, bem como um dos setores mais relevantes da economia, sendo responsável por quase 50% da produção Brazileira. O objetivo é quantificar a geração de emprego e renda na atividade, utilizando dados técnicos e socioeconômicos atualizados. Os dados macroeconômicos foram obtidos junto a órgãos estatísticos. Os coeficientes técnicos, bem como os valores dos insumos e serviços foram obtidos por meio de reuniões com técnicos e agricultores representativos de três importantes regiões: Camaquã, Pelotas e Santa Vitória do Palmar, que abrangem 13% da área. As informações foram extrapoladas para todo o Estado. O Rio Grande do Sul deve cultivar 974 mil hectares de arroz na safra 2002/03. A produtividade média esperada é 5.690 kg/ha. O valor da produção orizícola (em casca) deverá situar-se ao redor de R$ 2 bilhões, o que representaria mais de 2% do PIB total do Estado. Em insumos (fertilizantes, sementes, defensivos e combustíveis) estima-se um total de R$ 610 milhões. Os serviços (manutenção de máquinas, transporte, mão-de-obra etc) totalizam R$ 647 milhões. A remuneração da terra, água e capital é prevista em R$ 503 milhões. A margem líquida deverá estar ao redor de R$ 237 milhões. A lavoura arrozeira emprega, permanentemente, o equivalente a 20 mil pessoas no trabalho de campo, quase 1% da população ativa masculina do Estado. A pesquisa apresenta, detalhadamente, a quantidade e valor de cada fator de produção nas três regiões estudadas, bem como no total estadual. A relevância socioeconômica da atividade é evidente.

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SISTEMAS DE PRODUCCIÓN-DECISION ARROZ-PASTURAS-GANADERIA

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Tradicionalmente los sistemas de producción se han caracterizado de acuerdo a los componentes físicos, dejando de lado al componente humano de los mismos, principal objetivo de la mayor parte de las políticas de desarrollo agrícola. Cada vez esta siendo más reconocida la importancia de lograr una mejor comprensión del proceso de toma de decisiones a nivel predial, como último filtro a pasar en cualquier proceso de cambio técnico (Dent 1995, Ferreira 1997). Este estudio busca comprender mejor el proceso de toma de decisiones a través de la caracterización de los Sistemas de Producción-Decisión (SP-D, que comprenden a la unidad de explotación y unidad de toma de decisiones) relacionados a los sistemas de producción arroz ganadería en el ámbito nacional, aplicando como marco teórico el enfoque económico evolucionista. La metodología utilizada implico la realización de una encuesta y posterior análisis multivariado tomando como *unidad de estudio al sistema compuesto por la unidad productiva y la unidad de toma de decisiones* (una o varias personas). A efectos de realizar la caracterización se utilizaron las técnicas de análisis de correspondencias múltiples y sobre los factores obtenidos se realizó un análisis de cluster. Este procedimiento permitió desarrollar una tipología de los sistemas de producción-decisión arroz-pasturas-ganadería. El análisis sugiere que los grupos innovadores y moderadamente innovadores están más abiertos para aprovechar las sinergias de la implementación de la asociación entre la producción de arroz y la ganadería generando sistemas más sostenibles del punto de vista ambiental y económico. El enfoque evolucionista constituye un marco teórico que permite comprender mejor la micro-dinámica del proceso decisorio a nivel de este tipo de empresas.
Palabras Clave: Sistemas de producción, toma de decisiones, enfoque evolucionista.

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RICE-PASTURE-LIVESTOCK FARM DECISION-MAKING UNITS

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Classically, studies about rice have characterized production systems according to physical relationships and output, ignoring the human component, major target of agricultural development policies. Nowadays, it is widely recognized the need to better understand the decision making process at farm level, given that it is the last test to pass in any process of technical change (Dent 1995, Ferreira 1997). The aim of this study is to develop a better understanding of the decision making process at farm level, characterizing the rice-pasture-livestock Farm Decision Making Units (FD-MU), on the basis of an evolutionary approach. The Methodology was based on a survey and multivariate analysis taking as unit of study the production system and the decision making unit (one or more individuals). In order to characterize and classify the FD-MU correspondence analysis were utilized to obtain factors and those were used to run a cluster analysis. The procedure allows to develop a typology of the rice-pasture-livestock farm-decision making units. The analysis suggests that innovative and moderately innovative groups are more aware to identify and adopt the synergies from an integrated rice-pasture-livestock production systems through the association among rice and livestock farmers, resulting in more environmentally and economically sustainable systems. The evolutionary approach provides a good theoretical background in order to better understand the micro dynamics of these farm decision making enterprises.
Key words: production systems, decision making process, evolutionary approach.

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WHAT IS THE REAL FOOD SECURITY FOR JAPAN?
Implications from Japanese Compulsory Diversion Program and Global Development of Rice Economies

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The food security issue has been a major controversial issue for any countries particularly when each series of world trade negotiations opens. Producers in a well-developed country such as Japan argue that dependence on foreign produced food is risky assuming a case that the country is attacked and supply sources are blocked. Also, "explosion of world population" has been a keyword for promotion (protection) of domestic agriculture. In Japan, the rice diversion program has been implemented in a very compulsory manner requiring every single rice producer to cut back areas planted during the last 3 decades. As a result, productivity did not get improved much and the rice market prices are still triple of the prevailing retail prices in the U.S. even after some decreases in prices following implementation of rice imports in 1995. In addition, the 1993 crop failure in Japan was quite detrimental to the domestic rice market. The government appeared to be at loss without having any strong measures cope with due to lack of international channels and resources of rice for Japan. This type of natural disaster can happen any time. And it is a burden for the consumers to pay extra money for rice. Accordingly, it may be an idea from a food security point of view for an economically developed country like Japan to develop good sources of rice supply in foreign countries with a more open market system domestically.

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MODEL FOR ESTIMATION OF COST AND BENEFITS OF RICE CULTIVATION IN URUGUAY.

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For better planning of his rice cultivation, the farmer must know which will be his economic target, and for this purpose, he must know the cost of each one of the factors that intervene in the complex production equation. The Model for Estimation of Cost and Benefits offers to the farmer, an easy and fast way to estimate the production cost. Each farmer has his own cost, therefore, the model DOES NOT represent the production cost of rice cultivation in Uruguay, but it ESTIMATES the cost of an Uruguayan farmer for his particular conditions. This tool will help farmers to estimate costs in advance, and facilitate crop planning. At the same time, it will permit the monitoring of the incurred costs. The model is based on Excel program, providing sheets to register technical and economic data incurred in the field, which are closely related. The final result is cost estimation of rice cultivation for the particular situation in which the farmer planned or managed his crop.

Key Words: Costs, Rice

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MODELO PARA LA ESTIMACION DE COSTOS Y BENEFICIOS DEL CULTIVO DE ARROZ EN EL URUGUAY.

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Para la mejor planificación de su empresa el productor arrocero debe conocer cual será su resultado económico. Para ello debe de conocer el costo de cada uno de los factores que intervienen en la complicada ecuación de producción. El Modelo de Estimación de Costos y Beneficios pretende ser una herramienta que brinde al productor, de forma sencilla y rápida, la estimación del costo de producción. Cada productor tiene su propio costo, por lo tanto, el resultado final del programa NO representa el costo de producción del cultivo de arroz en el Uruguay, sino que ESTIMA el costo de un productor Uruguayo en su SITUACIÓN PARTICULAR. Con esta herramienta se podrán estimar los costos antes de la realización del cultivo, a efectos de la planificación del mismo. A su vez permitirá la verificación de los costos incurridos. Se tomó como base el programa Excel para elaborar planillas de datos técnicos y económicos incurridos en el cultivo, los cuales están íntimamente relacionados entre sí. El resultado final es el costo del cultivo de arroz para la situación particular en la que el productor planificó o administro su cultivo.

Palabras Claves: Costos, Arroz
Presentación en cartel.

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AUSTRALIAN RICE TAKES THE LEAD IN ENVIRONMENTAL AND INDUSTRY REFORM

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The Australian Rice industry is becoming a recognised leader in meeting environmental challenges. The sustainable management of natural resources is a priority of the industry and it is in all communities across rural Australia. Over the last 10 years, the Australian rice industry has focussed on reducing water use while increasing relative production – an increase in efficiency by 60%. This has been underpinned by a very proactive research and development program and industry self-regulation. As a result, Australian rice growers achieve yields amongst the world's highest making them one of the world's most efficient producers of rice and other crops grown in rotation with rice and one of the lowest users of chemicals and fertilisers. Ricegrowers in Australia have recently developed a broad-based environmental policy with a view to engaging all growers and the local communities in environmental stewardship. The policy is based on principles such as partnership across all relevant sectors, participation of all growers, reliance on strong scientific input into development of best practices and new opportunities, innovation and acknowledgment of good work being undertaken within the industry. The policy and its action plans have received tremendous support from government, community groups and NGO's. Within this policy, key programs focus on restoration of biodiversity, reduction of greenhouse gases, research into healthy rivers and landscapes, and an improvement in all aspects of storage and manufacturing and marketing of rice products. The results have so far put the Australian rice industry in a position of leadership in Australia with the first Biodiversity Strategy and Plan and the first Greenhouse strategy in the agricultural sector. Another program called the Environmental Champions provides a unique and flexible, five - level accreditation program giving recognition to rice growers demonstrating environmental responsibility and innovation. The process and framework will become a model for other Australian Irrigation industries.

Keywords: Environmental Stewardship, Biodiversity, Greenhouse Challenge, Change Management, Farmer Accreditation

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ALTERNATIVE IRRIGATION METHODS FOR RICE-BASED CROPPING SYSTEMS: PERMANENT BEDS AND SUB-SURFACE DRIP.

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In the rice-based cropping systems of the Murrumbidgee and Murray River Valleys of Southern Australia previous research has shown the benefit of raised beds for non- rice crops, the potential for rice grown on beds using furrow irrigation and of growing crops immediately after the rice phase. Rice grown on beds has demonstrated a reduced crop water use but no change in WUE due to lower yields. However, growing wheat immediately after rice has resulted in a net discharge from the groundwater system of about 1ML/ha and an increased WUE of the rice wheat system. There may be still be significant cropping system advantages to be derived from growing rice on raised beds. To remain economically and environmentally sustainable ricegrowers need to readily respond to market opportunities, increase productivity, increase water use efficiency and manage watertables (and hence soil and water salinity). This work seeks to investigate the use of permanent beds for both rice and other crops in sequence. We aim to demonstrate that a change in cropping systems from where rice is grown on the flat to permanent bed cropping systems (including double cropping) which includes rice on beds, can increase profitability, water use efficiency, sustainability, and ease of management. A replicated field experiment has been established which compares conventional flooded rice, rice grown on furrow irrigated beds and rice grown on beds using sub-surface drip irrigation. Cropping sequence comparisons include rice, fallow, wheat; rice, wheat, fallow; rice, barley/canola, soybean/late sown wheat, rice. Crop, and irrigation performance are being investigated. To date the field experiment has been initiated and the irrigation treatments and the initial rice crop established. The project will provide a side-by-side comparison of conventional and innovative rice- based farming systems. The project will allow further calibration and validation of CERES crop models for wheat, rice, barley, and soybeans, and develop the capability to account for the impact of the use of permanent beds within rice-based cropping systems. Successful completion of the experiment will allow development of guidelines for improving the profitability, water use efficiency and sustainability of cropping systems that include rice. Adoption of these systems will increase sustainability, resource-use efficiency, yield and profitability of irrigated cropping systems based on rice through improved soil, water and nutrient management in the rice-based cropping systems of southern Australia.

Keywords: permanent beds, subsurface drip, rice-based cropping systems

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WATER REGIMES, ORGANIC MATTER, AND N DYNAMICS IN PADDY SOIL SYSTEM

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Background and objectives Submerged paddy soil system has advantages in conservation of soil N fertility and natural N enrichment by biological N_2 fixation (BNF). Utilization of organic matter (OM) is important for BNF and also for efficient nutrients recycling in sustainable paddy system. On the other hand, because of recent expansion of direct seeding techniques and water-saving culture, alternate water regimes, submerged-aerobic-submerged cycle, are becoming more common. Consequently, an impact on N dynamics and long-term N balance, which is brought about by the alternated water regimes, should be evaluated. The study aimed to clarify: (1) long- term N fertility and OM management, (2) effect of alternate water regimes on BNF, N loss, and N_2O emission.

Materials and methods Long-term N balance was estimated in continuous N management experiments. N dynamics as affected by alternate water regimes and OM was investigated mainly in pot experiments.

Results and discussion The N balance in long-term no N applied plot indicated 22.3 kg ha^{-1} $year^{-1}$ was enriched in plow layer in northern Japan. BNF is enhanced with the addition of OM, especially when fresh OM was applied on the surface. Continuous straw application increased N uptake of rice particularly at later growth stages. Alternate water regimes enhanced BNF when the soil was re-flooded, possibly due to provision of substrate for BNF formed during aerobic period. On the other hand, alternate water regimes lead to the risk to increase the N loss by denitrifiction and N_2O emission.

Conclusion Sustainable N fertility and N enrichment OM were demonstrated in submerged paddy soils. On the other hand, substantial impact of temporal aerobic conditions on N dynamics indicated a need for developing N and OM management in accordance with water regimes to maximize the indigenous ability of paddy soils to sustain N fertility.

Keywords: water regimes, N_2O, N_2fixation, organic matter

018

ELECTROMAGNETIC INDUCTION (EM) TECHNOLOGY TO ACHIEVE WATER SAVINGS AND ENVIRONMENTAL PROTECTION IN THE AUSTRALIAN RICE INDUSTRY

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Significant recharge to the groundwater system can potentially occur under continuously flooded rice, resulting in rising groundwater levels and increased risk of soil and stream salinisation. Further, increasing competition for water and demands for water to be available for the riverine environment results in ricegrowers being continually challenged to increase water use efficiency (WUE). Reduced groundwater recharge is essential for sustainable rice-based, irrigated farming systems. Our aim was to develop an improved approach to define lands where high levels of groundwater accessions are likely to occur under flooded rice fields. We explored the use of an EM instrument linked to dGPS and computer mapping software to investigate variation in soil apparent electrical conductivity (ECa). We then used ECa value targeted soil sampling to explore variation in soil physico-chemical properties to 4m depth (electrical conductivity, chlorides, clay content, soluble cations, sodium absorption ratio (SARe) and exchangeable sodium percentage (ESPe)) and season long soil infiltration within rice fields in the Murrumbidgee and Murray River Valleys. Rice fields had considerable spatial variation in ECa values. This ECa variation was related to variation in soil texture, ECe and SARe/ESPe profiles. Large variation in season long soil infiltration was observed between high and low ECa valued measurement sites. The EM mapping approach has been especially successful in identifying the location of sand lenses associated with prior stream formations that are a focus of the current rice land assessment process. Redesigning rice irrigation layouts to avoid such areas or treating such areas by puddling or compaction can be undertaken. This can achieve higher WUE in terms of crop production and reduce environmental impact in environments (excessive infiltration potentially leading to soil / water salinity issues) where high rice water use occurs. The results further indicate that riceland suitability assessment in our environment could be enhanced by using soil sodicity (ESPe) as a defining criteria, as groundwater accessions could be further reduced by better identification of high water use locations. EM technology has improved the existing rice soil texture assessment process, providing a more specific basis on which to determine sites for soil texture assessment. It has been rapidly adopted by irrigation companies, resulting in significant water savings to ricegrowers. The inclusion of soil sodicity as a soil suitability criteria is currently being considered by irrigation companies and rice industry regulators.

Keywords: deep drainage, recharge, electromagnetic, EM, riceland assessment

028

EFFECT OF RICE CROP ON SOIL PHYSICS PROPERTIES IN ENTRE RIOS (ARGENTINA)

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During the 90s an increase of problems of emergence and poor seedling establishment were reported associated with intensive soil use for rice production. Excesive labour on land preparation, soil flooding during 90 days, irrigation water quality and harvest traffic with heavy machinery were the main factors of soil physic degradation. The objetive of this work was to show the modifications of soil properties caused by rice crop system on Vertisols of Entre Rios province. Soil structure variability was evaluated by the cultural profile method coupled with measures of bulk density and mechanical resistance in two soil water contents at harvest. In another site, the effect of rice crop in an agricultural rotation was evaluated by mechanical resistance profile and soybean rooting system distribution. Changes in soil aggregates stability, organic matter content and exchangeable sodium content caused by different number of rice crop in a experimental rice. Rice harvest in wet soil condition caused soil massive state and severe compaction under tire marks where soil structure recovery is difficult and slow. This effect is evident up to 30 cm depth. In a field with agricultural rotation that include rice the mechanical resistance profile showed a typical disk plough hardpan and compaction below 30 cm depth were soybean roots develop less than in non rice rotation. Organic matter content and aggregates stability fall and exchangeable sodium rise with the number of rice crop.
In the rice crop system, soil physical modifications achieve a greater depth than other crops. Mechanical resistance records are in accordance with structural state described by the cultural profile method. Organic matter and aggregate stability decrease with number of rice crop due to increased soil labors.
Key words: Vertisols, paddy soils, cultural profile, mechanical resistance.

028

MODIFICACIONES EN LAS PROPIEDADES FÍSICAS DE LOS SUELOS DE ENTRE RÍOS (ARGENTINA) POR EL USO ARROCERO

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Durante el proceso de intensificación del uso del suelo para arroz de la década del 90 en Entre Ríos (Argentina) se incrementaron los problemas para la implantación de los cultivos (encostramiento). El excesivo laboreo en la preparación del terreno, la inundación durante 90 días, la calidad del agua utilizada y el tráfico durante la cosecha empleando maquinaria de alto peso en condiciones de humedad excesiva, son los principales factores responsables del deterioro físico de los suelos arroceros. El objetivo es poner de manifiesto modificaciones en el estado físico de suelos vertisólicos por el uso arrocero. Se efectuaron descripciones del perfil cultural acompañado de medidas de resistencia mecánica a la penetración (RMP), en dos situaciones según la humedad del suelo a cosecha. En un lote de soja se estudió el efecto del arroz en la rotación utilizando el perfil de RMP y la distribución del sistema radical en dos sectores uno con y otro sin arroz en la rotación. Se presentan los cambios en estabilidad de agregados (EA), contenido de materia orgánica (M.O.) y sodio intercambiable (CSI) de un suelo sometido a rotaciones diferentes. Se observó que en condiciones de suelo muy húmedo a cosecha se produce un estado masivo, de severa compactación de difícil y lenta recuperación. La compactación por el paso de la cosechadora se transmite en profundidad hasta los 30 cm. El perfil de RPM mostró la presencia de piso de arado y compactación por debajo de los 40 cm, que se corresponden con una menor colonización por las raíces de soja en el lote con arroz. El contenido M.O. y la EA disminuyeron y el CSI aumentó con la frecuencia de arroz en la rotación. En el sistema arrocero, el perfil cultural se ve alterado hasta una profundidad mayor a la habitualmente considerada. Los registros RMP reflejan los estados estructurales descriptos en el perfil cultural. El contenido de M.O. y la EA disminuyen con los años de arroz debido al mayor laboreo.
Palabras clave: suelos vertisólicos, suelos arroceros, perfil cultural, resistencia mecánica a la penetración.

030

GERMINATION OF RICE SEEDS (*Oryza Sativa* L.) IN THE PRESENCE OF NH4Cl

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The contamination of areas by poluents may cause stress in most of plants. The extent to which their vital functions are affected and, whether or not the damages are visible, depend on several factors, biotic or abiotic. However, up to date few studies were performed aiming to find out the role the pollutant toxicity plays on the seed quality. Based on that, the goal of this research was to analyze and describe the effect the NH_4Cl. has on the germination and vigor of rice seed. The present study was conducted at the seed physiology lab of the Botanical department of Federal University of Pelotas. Samples of rice seeds cv. BR-410, season 2000/2001 were utilized. The seeds were soaked for one hour in concentrations of zero, 5, 10,15,20 and 30 mg l^{-1} of NH_4Cl.. After the soaking, the seeds were evaluated by the germination test, first counting of germination, enzyme-amylase activity in14 days, emergence of seedling in 21 days, seedling dry mass in 21 days, stem and root length in 21 days and electrical conductivity. Among the analyzed concentrations it was possible to verify that the rice BR-IRGA 410 presented satisfactory results as a bio-indicative plant for the tested pollutants, showing to be sensitive to the tests performed. The ammonia chloride reduces the physiologic quality of the rice seeds cv. BR- 410.
Key words: poluents, physiology quality, seeds, rice

030

GERMINAÇÃO DE SEMENTES DE ARROZ (*Oryza sativa* L.) NA PRESENÇA DE NH_4Cl

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A contaminação de áreas através de poluentes pode ocasionar estresse na maioria das plantas. A extensão em que as funções vitais são afetadas pelos poluentes, e se há danos visíveis, depende de muitos fatores, tanto bióticos como abióticos. No entanto, até o momento poucos estudos foram realizados no sentido de conhecer o papel da toxidade de poluentes na qualidade das sementes. Com base no exposto, a finalidade desta pesquisa foi analisar e descrever o efeito de NH_4Cl na germinação e no vigor de sementes de arroz. O presente estudo foi conduzido no laboratório de Fisiologia de Sementes do Departamento de Botânica da Universidade Federal de Pelotas. Foram utilizadas amostras de semente de arroz cv. BR-410, safra 2000/2001. As sementes foram embebidas por uma hora nas concentrações zero, 5, 10, 15, 20 e 30mg l^{-1} de NH_4Cl. Após a embebição as sementes foram submetidas ao teste de germinação; primeira contagem da germinação; atividade da enzima a-amilase aos sete e 14 dias; emergência de plântulas aos 21 dias, matéria seca de plântulas aos 21 dias, comprimento de parte aérea e raízes de plântulas aos 21 dias e condutividade elétrica. Dentre as concentrações testadas verificou-se que o arroz BR-IRGA 410 apresentou resultados satisfatórios como planta bioindicadora para os poluentes testados, apresentando sensibilidade nos testes realizados. O cloreto de amônia reduz a qualidade fisiológica das sementes de arroz cv. BR-410.
Palavras Chave: poluentes, qualidade fisiológica, sementes, arroz

045

NITROGEN FIXATION BY HETEROCYSTOUS CYANOBACTERIA IN URUGUAYAN RICE FIELDS

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Cyanobacteria play a vital role in the maintenance of flooded rice field fertility. They can contribute, as other nitrogen fixing organisms, to build up the soil nitrogen pool.
Biological nitrogen fixation in rice cultivation has been studied mostly in Asia and Europe where crop management is quite different from Uruguayan rice fields.
Among the many factors affecting cyanobacterial growth and nitrogenase activity, herbicides are important ones.
To evaluate the abundance, diversity and nitrogen fixing ability of heterocystous cyanobacteria in Uruguayan ricefields, studies in Paso de la Laguna (INIA-Treinta y Tres) were carried out during three consecutive crop seasons.
About 90% of the heterocystous cianobacteria found in the soil belonged to the genus *Nostoc* and *Anabaena*. The highest number of heterocystous cyanobacteria, 1.6 x 10^4 CFU, was found 8 weeks after flooding.
The nitrogen fixing ability was evaluated in rice fields as nitrogenase activity *in situ* which reached maximal values 12 weeks after flooding.
The lack of significance of nitrogen treatment suggests that nitrogen fixation is governed by other factors and not only by nitrogen fertilizer.
Two of the most abundant heterocystous cyanobacterial isolates were tested for tolerance to propanil and quinclorac, herbicides commonly used in Uruguay.
Propanil and quinclorac at field recommended doses affected oxygen photoevolution but nitrogenase activity was only inhibited by propanil.
Inoculation with native cyanobacterial propagules may shorten the time necessary for their multiplication and soil colonization.
Keywords: cyanobacteria, nitrogen fixation

048

THE PERSISTENCE OF RICE PESTICIDES IN FLOODWATERS: INFLUENCE OF WATER MANAGEMENT

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The sustainability of the Australian rice industry depends on maintaining its 'clean and green' image to retain and extend overseas markets. Information is required on the persistence of rice pesticides so as off-site impacts can be assessed and minimised. Local irrigation authority guidelines recommend that rice water should be with-held on-farm for 21-28 days of pesticide application. Usually on-farm storage is adequate but during severe storms and at critical growing periods excess drainage is sometimes inevitable. Chemical persistence was studied by taking water and soil samples at regular intervals from field trials in the Murrumbidgee Irrigation Area (MIA), eastern Australia. The chemicals investogated were molinate, chlorpyrifos, benzofenap and clomazone. Field plots were automatically monitored for water temperature, electrical conductivity, pH and water depth and circular flumes were installed to measure water supply flows. Maximum concentrations of molinate applied at 3.36kg a.i. /ha was 1264 ìg l^{-1}, clomazone applied at 0.24kg a.i./ha was 252 ìg l^{-1}, chlorpyrifos at 0.075kga.i/ha was 30 ìg l^{-1} and benzofenap at 0.6 kg a.i./ha was 14.4 ìg l^{-1}. Over a 5 day period molinate concentrations had dissipated by 67%, clomazone by 8%, chlorpyrifos by 83% and benzofenap by 77%. $T_{1/2}$ were 4 days, 40 days and < 1 day for molinate, clomazone and both chlorpyrifos and benzofenap respectively. Ongoing research will determine how soil/water partitioning behavior of different chemicals is affected by water depth and dilution and the significance of environmental variables for with-holding periods.
Palabras Claves / Key Words pesticides, rice, sustainability

054

EFFECT OF NITROGEN FERTILIZATION AND INOCULATION WITH CYANOBACTERIA ON NITRIGEN STATUS OF RICE

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heterocystous cyanobacteria, ^{15}N-labeled fertilizer
As the average heterocystous cyanobacterial density in Uruguayan rice fields was lower than the reported for other rice fields, inoculation with native cyanobacterial strains appeared as a possibility of a supplementary nitrogen input to this ecosystem.
Field experiments were conducted during two crop seasons in which heterocystous cyanobacterial density and nitrogen incorporation to the plant were evaluated from ^{15}N-labeled fertilizer and inoculated with cyanobacteria assays.
The aim of this study was to quantify how much nitrogen from fertilizer was incorporated to rice and to establish if cyanobacterial inoculation contributed to nitrogen nutrition and yield of rice.
Heterocystous cyanobacteria number was not different in inoculated plots and grain yield was unaffected by cyanobacteria inoculation.
A significant fraction of cyanobacterial fixed nitrogen was neither available to the rice plant during the growth period of the crop nor to the following crop (ryegrass), when nitrogen fertilizer was applied at sowing.
The use efficiency of N from fertilizer was of 16% when applied at sowing.
An assay applying ^{15}N-labeled fertilizer at three different moments of the crop cycle was established.

058

MICROBIAL PROCESSES AND POPULATIONS AS INDICATORS OF SUSTAINABLE RICE PRODUCTION

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To evaluate sustainability of agricultural practices (irrigated rice production), an ecological microbial approach can be used to reflect quality and fertility of soils. Microorganisms are central to many processes in the environment regulating nutrient cycling in soil-water ecosystems and supplying many of the plant nutrients. It has been reported that a decrease in microbial diversity can lead to flooded rice soils to be resilient to intensification pressures. Our previous work on rice floodwater suggested that the bacteria involved in the nitrogen cycle were the most influenced by cultivation. This work aimed to combine a molecular and process approach to assess microbial diversity in the floodwater-sediment interface, focusing on bacteria of the nitrogen cycle. Microbial community composition and metabolic activity (characterization of culturable microorganisms, maximum denitrifying activity, genetic fingerprints using the technique known as T-RFLP (terminal restriction fragment length polymorphism) and cloning methods were used. Heterotrophs, ammonium-oxidizers, denitrifiers, methanotrophs, nitrogen-fixers (aerobic, anaerobic and microaerophilic), ammonifiers and anaerobic phototrophs were enumerated. Community structure data obtained via the different approaches were analyzed and compared. Sequencing data revealed the presence of an important variety of known cultured and uncultured bacteria as well as non-described bacteria. Overall, the results indicate that the soil-water interface harbors a diverse bacterial community potentially important in the interaction with rice plants.
Keywords: sustainability; microbial diversity; soil-water interface

075

TROPHIC RELATIONSHIPS RELATED WITH RICE CROPS.

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Birds, amphibians and arthropods are the most numerous animals groups.. This paper describes possible trophic relationships among the groups mentioned above and maturing rice crop. Birds and amphibians species were identified. Arthropods were named to the lowest possible taxonomical level. Relative abundance were obtained not only from field samples of mentioned groups, but also previous studies. Among birds, omnivorous and insectivorous were present. Some pray on frogs, not only at adult but tadpole stage. Amphibian diet were based mainly on arthropods. Considering the importance of these groups and their pray-predator relationships, a possible role of regulating their population abundance was suggested. About their main relationship with rice crop and their effect on the arthropods diversity and abundance it seemed not to be very important for birds. Amphibians role and their effect on the system should be more developed.
Key words: trophic relationships, birds, arthropods, amphibians, rice.

075

RELACIONES TRÓFICAS ASOCIADAS AL CULTIVO DE ARROZ.

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Dentro del cultivo de arroz los grupos animales más numerosos son las aves, anfibios y los artrópodos. En este trabajo se describen las posibles interacciones tróficas entre los grupos mencionados, presentes en el agro-ecosistema del arroz en maduración. Fueron identificadas las especies de aves, anfibios, y en los artrópodos se realizó hasta el nivel más bajo posible. Los datos de abundancia relativa se obtuvieron en base a muestreos de los grupos mencionados, así como a estudios previos. Dentro del grupo de aves registradas estuvieron presentes especies insectívoras y omnívoras. Algunas se alimentan de anfibios, tanto en su etapa adulta como en su etapa larval. La dieta de los anfibios se basan casi exclusivamente en el consumo de artrópodos. Considerando la importancia de los grupos en el sistema y su relación presa-predador, sugeriría un posible papel regulador de sus abundancias poblacionales. En cuanto a su relación estricta con el cultivo de arroz los efectos sobre la entomofauna que serían de interés para el mismo no parecen ser importante en el caso de las aves. El conocimiento del papel de los anfibios y su efecto sobre este sistema exige un mayor desarrollo.
Palabras clave: relaciones tróficas, aves, artrópodos, anfibios, arroz

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PERFORMANCE OF RICE AND FISH IN RICE-FISH CULTURE

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The production of irrigated rice with fish, rice-fish culture, it is one system able of increase the income specially of small farms. However, there is no information of quantity end the best time of entry of fish. One experiment was carried on growing season 2001/2002 aiming to evaluate the effect of the quantity of fish, time of entry in rice culture, in the fish productivity, as well as water physicochemical parameters. The experimental design was randomized complete block with three replications and the treatments were three times of entry of the fingerlings: seeding, 20 days after seeding and, after harvest and two quantities of fish: 3000 and, 6000 fingerlings.ha^{-1}, tree replications with the species : common, grass, silver, big head carps and, silver catfish in rates of 60, 20, 5, 5 and, 10%, respectively. It was utilized rice in mix of pre-germinate system and IRGA 419 cultivar. The area with rice-fish culture yielded rice grains 7,662 kg.ha^{-1} and area without fish, yielded 7,426 kg.ha^{-1}. The fish productivity was 521 kg.ha^{-1}; the common carp presented the most productivity: 356 kg.ha^{-1}. Survival was highest for silver catfish: 61.8%, following grass carp: 53.6%. Weekly, the water quality was analyzed and it presented few alterations in treatments. The present results allow us to conclude that the rice-fish culture is feasible.

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DESEMPENHO DE ARROZ E PEIXES NA RIZIPISCICULTURA

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A produção de arroz irrigado no consórcio com peixes, rizipiscicultura, apresenta-se como um sistema capaz de aumentar a rentabilidade, especialmente das pequenas propriedades, devido ao ganho obtido com os peixes e a redução de custos de produção do arroz. Contudo, ainda não se dispõe de informações da quantidade e da melhor época de colocação dos peixes na área. Na safra agrícola 2001/2002, foi conduzido um experimento com o objetivo de avaliar o efeito de densidades de povoamento de peixes e das épocas de colocação dos mesmos na lavoura de arroz, sobre a produtividade dos peixes, além de características físicas e químicas da água. O delineamento experimental foi blocos ao acaso com três repetições, em bifatorial, com três épocas de colocação dos peixes: na semeadura; 20 dias após semeadura; após colheita e, duas densidades de povoamento: 3000 e 6000 alevinos.ha^{-1}. As espécies de peixe utilizadas foram: carpas: húngara, capim, prateada, cabeça grande e o jundiá, na proporção de 60, 20, 5, 5 e 10%, respectivamente. O sistema de cultivo foi mix de pré-germinado e a cultivar IRGA 419. A área com rizipiscicultura produziu 7662 kg.ha^{-1} de arroz, e a área sem peixes, 7426 kg.ha^{-1}. A produtividade dos peixes foi de 521 kg.ha^{-1}, sendo a espécie carpa húngara a que apresentou maior produtividade: 356 kg.ha^{-1}. Jundiá apresentou maior sobrevivência: 61,8%, seguido pela carpa capim: 53,5%. Semanalmente, foram realizadas análises de qualidade da água, observando-se poucas alterações entre os tratamentos. Conclui-se que a rizipiscicultura é uma alternativa viável.

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MONITORAMENTO DE HERBICIDAS NA CULTURA DO ARROZ CULTIVADO NO SISTEMA PRÉ-GERMINADO

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No Rio Grande do Sul (Brazil), a lavoura arrozeira é apontada como um contaminante potencial das águas de superfície, entretanto ainda não se dispõe de dados que comprovem esta afirmação. Com base nisso, em 2000/01 e 2001/02, fez-se um estudo com a finalidade de monitorar a qualidade da água na lavoura de arroz irrigado cultivado no sistema pré-germinado. Foram estabelecidos parcelas (16 m^2) onde aplicou-se (em g ha^{-1}) os herbicidas: bentazon (960), clomazone (500), propanil (3600), quinclorac (375) e 2,4-D (200). As coletas foram realizadas antes da aplicação e no 1º, 7º, 14º, 21º, 28º, 60º e 130º dias após a aplicação dos herbicidas. Para a determinação da concentração dos produtos na água, utilizou-se alíquotas das amostras que depois de acidificadas, foram passadas por um cartucho do tipo extração em fase sólida (SPE) contendo 200 mg de resina C_{18}, para a pré-concentração dos mesmos. Seguiu-se a eluição com 2 x 0,5 mL de metanol, e procedeu-se, então a determinação por HPLC-UV, empregando-se metanol e água como fase móvel e coluna C_{18}. Pelos resultados, ao final da primeira semana, a concentração dos herbicidas estava acima do limite tolerável (1 a 3 mg L^{-1}), exceto para propanil. A partir do 14º dia, em geral, os resíduos encontravam-se abaixo de 3 mg L^{-1}, limite adotado por algumas agências ambientais. Para clomazone detectaram-se resíduos nas amostragens até 28 dias. Os resultados sugerem, como limite de segurança, retenção da água dentro da lavoura por um período mínimo de 28 dias após a aplicação dos herbicidas.

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PADDY FIELDS IRRIGATION AND GROUNDWATER TABLE DYNAMIC

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A piezometers net lets to monitor the groundwater-table dynamic in a paddy field area of about 50000 hectares. The excursion of the phreatic level, daily monitored from 1968, presents a different behaviour in the territory and is strictly linked to the nature of the local soil. It is known that the variation of the groundwater-table depends to a great part from the infiltration of the water present at the surface (Bradley, 1996).

The infiltration process can be distinguished schematically in two phases: a first phase of infiltration in the unsaturated soil, a second phase in saturated soil with the rise of the groundwater-table level. In the first phase the infiltration process of the unsaturated terrain happens under the push of the force of gravity and the capillary forces of adhesion of the water to the walls of the tiny canals present in the soil and in the second phase considering the flow q_z constant and prevalent such that the raising of the level of the aquifer with good approximation can be retained as due to the flow rate of water from the surface.

In this way the flow rate along the vertical direction can be written with the relationship: $q_z(t) = -\overline{K}_z \frac{\overline{H} + l(t)}{l(t)}$, having taken the conductivity $\overline{K}_z$ as a medium value, H is the irrigation water depth and $l(t)$ is the soil stratum thickness crossed by water filtering, which change with groundwater-table rising. The depth H is small (0.1 m) compared with l usually over 1 m, then the previous relation becomes $q_z(t) \cong -\overline{K}_z$.

It can be shown, using the groundwater-table equations, that the following relationship is consistent: $\overline{K}_z = -C\frac{\partial h}{\partial t}$, where C is constant in a homogeneous soil and h is the groundwater–table level.

Hence the average hydraulic conductivity of the soil is proportional to the velocity of the groundwater-table rising, so it is directly proportional to the flow rate infiltrated and a greater velocity means a higher possibility that a substance from the surface should be transported in the aquifer. On the other hand it is simpler to monitor the velocity of the groundwater table rise in a piezometric well than to measure the hydraulic conductivity of the undisturbed soil.

Groundwater level monitoring, Hydraulic conductivity, Flow equations, Environmental contamination.

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RICE AND DURUM WHEAT CULTIVAR INNOVATIONS ADAPTED TO ORGANIC PRODUCTION : A NEW CHALLENGE

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To face and better manage the development of new varieties in a society calling for more and more transparency, the French National Agronomic Research Institute (INRA) has get involved in an ambitious reflexive programme about the question of "impacts, acceptability and management of varietal innovations", engaging all its thematic research departments. New collaborations between social and technical sciences are promoted to produce, from exemplary case studies, generic concepts and tools to assess the different types of impact of a new variety. Breeding and management of new genetic materials adapted to organic farming conditions constitute an appropriate theme to develop such an integrated process. A pluridisciplinary research team, associating plant breeders, soil scientists, ecologists, agronomists, economists, sociologists, in close collaboration with professionals, will try to assess both the agroenvironnemental and socioeconomic impacts of changes, by studying current dynamics around original rice and durum wheat cultivars adapted to organic production in different territories, especially in Camargue.(France).This action-research programme is built around thematic activities in relevant domains :

- Plant breeding:- Varietal types: to study the interest of mixed lines or populations compared to pure lines commonly used under conventional conditions, in order to ensure pathogene resistance durability. - Breeding method : to find alternative breeding methods to increase and manage genetic variability, like recurrent and participatory breeding methods.
- Agronomy: - to understand soil organic nitrogen dynamics- to elaborate agronomic diagnosis to characterise each environment in order to better understand G x E Interactions. - to manage cropping systems and rotations.
- Socio-Economy:-to assess social and economic factors of organic conversion by producers- to analyse sociological and economical mechanisms of innovative collective action assuming economic practices embedded in social systems.
- Management - to build a collective learning network at territorial level by linking different "roles" relative to the cultivar innovation project.- to develop a co-breeding program involving producers

These thematic researches aiming at specific evaluation tools are combined with collective activities designed for a generic and pedagogic integration of results in a co-constructive interdisciplinary process.

Palabras Claves / Key Words: *Rice, Durum wheat, Organic Production, Participatory Plant breeding, Impact Assessment Interdisciplinarity.*

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STRATEGIES FOR CONSERVING VERTEBRATE BIODIVERSITY ON RICE FARMS IN AUSTRALIA

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There is a growing consensus that (1) modified landscapes such as rice farms can harbour considerable biodiversity, (2) conserving biodiversity is both essential and beneficial to the rice industry, and (3) community and farmer involvement are critical to the successful implementation of a biodiversity plan for the industry. What strategy should be adopted to conserve biodiversity in such landscapes, given the plethora of possible approaches? We advocate a mixed and diverse approach to promote biodiversity. Such a strategy would include both managing rare or significant species (higher cost, bigger impact) and the general promotion of biological communities (lower cost and smaller impact). The former should comprise expert monitoring while the latter should involve farmers and the general community. Herein we focus on management of significant vertebrate species. We discuss how to decide which species we should manage, and develop a hierarchy to prioritise species for allocation of resources. The hierarchy is based on (government) conservation status, commonness at a range of spatial scales, and logistical and financial feasibility.

We present these ideas in the context of conserving biodiversity in the rice-growing areas of Australia.

Key words: biodiversity, vertebrates, rice, surveys, conservation

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INTENSIVE RICE - CATTLE AND SHEEP PRODUCTION SYSTEM (RICE-LIVESTOCK PRODUCTION UNIT - UPAG)
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Rice cropping in Uruguay is rotated with pastures for livestock production, in a low intensity system of using natural resources. This structure has maintained good indexes of physical, economical and environmental sustainability. During the 90's a continuos increase of rice acreage in the Merim Lagoon Basin, induced an intensification of the rice frequency in the rotation. In this context in 1999 a long term project was installed, aiming a more intensive rice-livestock production system. The main objectives were to validate new technologies of rice farming and livestock production, and to generate the technological tools to maintain the same sustainability indexes of the past, but with a more intense use of the soil under rice crop. The Rice-Livestock Production Unit (UPAG) is located in Paso de la Laguna Research Station at INIA Treinta y Tres, and occupies 80 ha. It is divided in 7 lots, and five of them are under rice-pastures rotation. This rotation includes two rice crops in five years under the following sequence: rice – annual grasses and summer soil tillage and leveling - rice – two years of perennial forages. Livestock production is focused in steer fatting and lamp fatting plus wool production. Physical and economical data is registered in the UPAG, and sustainability of natural resources is monitored. In the first three years of activity this Unit produced an average of 6.500 kg/ha of rice, 250 kg/ha of beef, 100 kg/ha of lamp meet and 30 kg/ha of wool.

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SISTEMA INTENSIVO DE ARROZ CON GANADERÍA VACUNA Y OVINA (UNIDAD DE PRODUCCIÓN ARROZ-GANADERÍA – UPAG)
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En el Uruguay la producción de arroz se desarrolla en rotación con pasturas para la producción ganadera, en un sistema de baja intensidad de uso de los recursos naturales. Este sistema ha permitido mantener muy buenos índices de sostenibilidad productiva, económica y ambiental. En la década del 90 el aumento continuo del área arrocera en la Cuenca de la Laguna Merín, obligó a la intensificación del uso agrícola del suelo. En este contexto se instaló en 1999 un proyecto de largo plazo, de integración del arroz con la ganadería en un sistema más intensivo. El objetivo del mismo es validar nuevas tecnologías de arroz y ganadería y generar información que permita mantener los índices de sostenibilidad anteriores, con un mayor uso arrocero del suelo. La Unidad de Producción Arroz-Ganadería (UPAG) está ubicada en la Unidad Experimental Paso de la Laguna de INIA Treinta y Tres y cuenta con un área total de 80 ha. Está dividida en 7 potreros , cinco de los cuales integran la rotación arroz -pasturas. Dicha rotación tiene dos años de arroz en cinco y la siguiente secuencia: arroz – pasturas anuales y laboreo de verano – arroz - pasturas perennes por dos años. La producción ganadera se basa en engorde de novillos, engorde de corderos y producción de lana. La UPAG lleva registros de producción física y económica y se monitorean indicadores de sostenibilidad de los recursos naturales. En los cuatro primeros años mantiene una productividad de 6.500 kg/ha de arroz, 250 kg/ha de carne vacuna, 100 kg/ha de carne ovina y 30 kg/ha de lana.

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EFFECTS OF THE INOCULATION WITH AZOSPIRILLUM BRAZILENSE ON RICE SEEDLINGS (ORYZA SATIVA).
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The crop's success widely relies on the rapidly setting-up of the seedling, affirming an appropriate aerial coverage and the anchorage to the ground. This is habitually achieve with high effectiveness by means of the use of fertilizers, but the unfavorable environment impact inherent at the use of that technology is know too. This lead us before a commitment balance between crop's yield optimization and environment protection. It has been analyzed in rice seedlings the effects of the inoculation with Azospirillum Brazilense, diazotrofic bacteria and plant growth promoter, under conditions of N non-availability for plants. Three treatments have been assessed: inoculated (non-N) and the uninoculated positive and negative controls (with N and non-N, respectively). The assays were made in sterilized substratum, in culture chamber at 25±2ºC and 12h photoperiod. The plants were sequentially harvested (10—20—30 days from emerging). It's has been done morphologically measurements: length, fresh and dry weight (aerial and radical); and biochemistry determinations: total N, soluble carbohydrates, and organic acids contents, and enzymatic activities (GDH-GS-GOGAT) along with the western-blot assays. The inoculated seedlings turned out to be significantly favoured with regard to negative control in morphological and biochemistry aspects. Further investigations would be needed to lead the Azospirillum Brazilense utilization to the productive plane like a biofertilizer.
Keywords: growth promoter bacteria, nitrogen biological fixation, organic acids

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EFECTOS DE LA INOCULACIÓN CON AZOSPIRILLUM BRAZILENSE EN PLÁNTULAS DE ARROZ (ORYZA SATIVA)
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El éxito de un cultivo depende en gran medida del rápido establecimiento de las plántulas, asegurando una adecuada cobertura aérea y anclaje al suelo. Habitualmente esto se logra con gran efectividad mediante el uso de fertilizantes, pero también es sabido el impacto ambiental desfavorable que produce esta tecnología. Esto nos lleva ante un balance de compromiso entre optimizar los rendimientos agrícolas y proteger al medio ambiente. Se evaluaron en plántulas de arroz los efectos de la inoculación con Azospirilium Brazilense, bacteria diazotrófica y promotora del crecimiento vegetal, en ausencia de N disponible para la planta. Se llevaron a cabo tres tratamientos: inoculado (sin N) y los controles positivo y negativo no inoculados (con y sin N, respectivamente). Los ensayos se efectuaron sobre sustrato esterilizado, en cámara de cultivo a 25±2ºC y 12h de fotoperíodo. Las plantas fueron cosechadas secuencialmente (10—20—30 días desde la emergencia). Se realizaron mediciones morfológicas: longitud, peso fresco y seco (aéreo y radical); y determinaciones bioquímicas: contenido de Ntotal, carbohidratos solubles, ácidos orgánicos y actividades enzimáticas (GDH-GS-GOGAT) junto con ensayos de western-blot. Las plántulas inoculadas resultaron favorecidas significativamente respecto al control negativo tanto en aspectos morfológicos como bioquímicos. Nuevas investigaciones serían necesarias para llevar al plano productivo la utilización de Azospirillum Brazilense como biofertilizante.
Palabras clave: bacterias promotoras del crecimiento, fijación biológica del nitrógeno, ácidos orgánicos.

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AGRONOMIC POTENCIAL OF NITROGEN FIXING ENDOPHYTIC BACTERIA OF RICE.

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In Uruguay rice is generally grown in rotation with pastures; however, the use of nitrogen fertilizers is common. It is intended to reduce its application using the growth promotion potential of endophytic bacteria. These colonize the root interior and in some cases they can disperse systemically without forming specialized structures. Some of them can be transmitted in the grain. They present advantages comparing with rhizospheric bacteria, as they do not compete with soil microorganisms, are protected from environmental changes and establish a more direct exchange of metabolites with the plant. Nitrogen fixing bacteria were isolated and quantified from cultivars El Paso 144 and INIA Tacuarí, and their potential to promote growth was determined. Quantification and isolation started from 1 gram of superficially disinfected and macerated aerial part. The culture medium JMV was employed for Burkholderia, NFb for Azospirillum, Herbaspirillum and Azoarcus, and Renie for Bacillus. The majority of the samples presented more than 105 presumed nitrogen fixing endophytic bacteria per gram of tissue. El Paso showed higher concentrations than Tacuarí. 48 isolations from JMV, 55 from NFb and 13 from Renie were conserved in 20% glycerol at –20ºC. The capacity of the isolations to fix nitrogen was studied by the acetylene reduction technique. 44% of these turned out to be nitrogen fixers. Tests in growth chambers using surface sterilized grains sowed in tubes with Hoagland medium with 108 cells of each isolation, in the presence and absence of KNO3 were done. 23% of the isolations from JMV and NFb promoted growth in a 20% to 100% in relation to the non inoculated control. 85% of the isolations from Renie promoted, and 36% of these showed levels from 100% to 150%. These studies follow with greenhouse and field experiments and may be of significance in the sostenibility of the crop and of importance in the crop improvement and fertilization plans
Key words: bacteria, endophytic, nitrogen, fixation, promotion.

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POTENCIAL AGRONÓMICO DE BACTERIAS FIJADORAS DE NITRÓGENO ENDÓFITAS DE ARROZ.

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En Uruguay el arroz se cultiva generalmente en rotación con pasturas; sin embargo, es común el uso de fertilizantes nitrogenados. Se intenta reducir su aplicación mediante el uso del potencial de promoción del crecimiento de bacterias endófitas. Estas colonizan el interior de las raíces y en algunos casos se dispersan sistémicamente sin formar estructuras especializadas. Algunas pueden transmitirse en el grano. Presentan ventajas frente a las rhizosféricas, pues no compiten con los microorganismos del suelo, están protegidas de cambios ambientales y establecen un intercambio más directo de metabolitos con la planta. Se aislaron y cuantificaron bacterias fijadoras de nitrógeno endófitas de las variedades El Paso 144 e INIA Tacuarí, y se determinó su potencial de promoción del crecimiento. Para la cuantificación y el aislamiento se partió de 1 gramo de parte aérea desinfectada superficialmente y macerada. Se emplearon los medios JMV para aislar Burkholderia, NFb para los géneros Azospirillum, Herbaspirillum y Azoarcus, y Renie para Bacillus. La mayoría de las muestras presentaron más de 105 bacterias presuntas fijadoras de nitrógeno endófitas por gramo de tejido. El Paso mostró concentraciones mayores que Tacuarí. Se conservaron en glicerol al 20% a –20ºC 48 aislamientos de JMV, 55 de NFb y 13 de Renie. Se estudió la capacidad de los aislamientos de fijar nitrógeno por reducción de acetileno. Un 44% de estos resultaron fijadores de nitrógeno. Se realizaron ensayos de promoción en cámaras de crecimiento utilizando granos esterilizados superficialmente sembrados en tubos con medio Hoagland con 108 células del aislamiento correspondiente, en presencia y ausencia de KNO3. El 23% de los aislamientos de JMV y NFb promovieron el crecimiento en un 20% al 100% respecto al control sin inocular. Un 85% de los aislamientos de Renie promovieron, y 36% de estos mostraron niveles del 100% al 150%. Estos estudios prosiguen con ensayos de invernáculo y campo, y los resultados pueden ser de relevancia para la sostenibilidad y de interés en los planes de mejoramiento y fertilización del cultivo.
Palabras clave: bacterias, endófitos, fijación de nitrógeno, promoción.

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EVALUATION OF WATER QUALITY OF THE SUPERFICIAL AND GROUNDWATER RESOURCES IN THE RICE AREA OF ENTRE RIOS, ARGENTINA

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The interaction between water quality and the soils characteristics determine different approaches to evaluate the water ability for irrigation, depending on climate, crops, irrigation schedule and soils type.
In rice irrigation, were a high depth of water during a long period is maintained, the water quality related to the crops cycles and the lower permeability of soils would explain the superficial soil degradation.
The aim of the present research was evaluate the water quality from superficial and groundwater origin in the rice area of Entre Ríos, Argentina. 45 samples of groundwater, 35 located in the kernel area and 10 samples in the superficial reservoir area, related to superficial water samples were analyzed for the determinate of SAR, adjust SAR and Electrical Conductivity.
Guideline from Ayers and Westcot (1976) and Rhoades et al (1992) were take in account, theses consider the complex relation among a great number of variables.
The superficial water could be used for the rice irrigation, explained in the lowers SAR and EC, the groundwater are sodics bicarbonates. The quantity of sodium for the water irrigation was related with soils sodic increase and the structural degradation. So the rice irrigation based on groundwater could be used with caution.
Key words: irrigation – rice – water quality – Entre Ríos

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EVALUACION DE LA CALIDAD DEL AGUA PARA RIEGO DE ORIGEN SUPERFICIAL Y SUBTERRÁNEA EN EL ÁREA ARROCERA DE ENTRE RÍOS, ARGENTINA

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La interacción entre la calidad del agua y las características del suelo, determina que existan varios criterios para evaluar la aptitud del agua para riego en distintas regiones del mundo con climas, cultivos, sistemas de riego y suelos diferentes. En el caso del riego de arroz, donde se requiere el mantenimiento de una importante lámina de agua durante un largo período, la calidad de agua utilizada junto con la repetición de los ciclos de cultivo y la baja permeabilidad de los suelos, podría estar relacionada al deterioro observado de la estructura superficial del suelo.
El objetivo del presente trabajo fue evaluar la calidad del agua para riego de origen subterránea y superficial en el área arrocera de Entre Ríos. Para esto se tomaron 45 muestras de agua de pozos, 35 localizadas en el área núcleo y el resto en el área de presas, que se corresponden a sendas muestras de embalses, que fueron analizadas para la determinación de RAS, RAS ajustado y CE. Para la calificación de las aguas se siguieron las directrices propuestas por Ayers y Westcot (1976) y Rhoades *et al.* (1992), al contemplar mejor las relaciones complejas de un mayor número de variables.
Las aguas de origen superficial resultaron aptas para la utilización en el riego de arroz, dado que presentaron baja RAS y baja CE. Respecto a las aguas de origen subterráneo, las mismas fueron calificadas como bicarbonatadas sódicas. La cantidad de sodio aportada por el riego se relacionó con el incremento de sodio en el suelo y el deterioro de la estructura. Por tal motivo las aguas de origen subterráneo deberían utilizarse con precaución para el riego de arroz.
Palabras clave: riego – arroz – calidad del agua - Entre Ríos

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CHARACTERISTICS MICROBIAL AND PYRAZOLSUFURON-ETYL DEGRADATION IN A WATER SEEDED RICE SYSTEM SOIL

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Field and laboratory studies were conducted at Rio Grande and Pelotas, RS, from 1998 to 2002, to determine the influence of water seeded rice system (PGS) on characteristics microbial and pyrazolsufuron-etyl degradation, in a Typic Umbraqualfs Soil. Soil samples obtained from PGS commercial, were analyzed. The evolution of CO_2 from field plots was measured before and after pyrazolsufuron-etyl-treated paddy rice and after harvest. Negative linear tendency was observed of CO_2 evolved from the soil, in the times three measured. After the harvest, the increase microbial activity suggest the presence of decomposited microorganisms of the organic material and significance on nutrients ciclycal. The results suggesting the importance of *in put* organic material in soil for maintenance microbial diversity. A laboratory study assessed the degradation of pyrazolsufuron-etyl as influenced by water seeded rice system. Bacterial isolated from paddy rice was capable of growth on herbicide as the sole carbon and energy source. The isolated comprise six *Pseudomonas* species and an *Raoultella planticola*. Thus, the seven-member community was capable of growing at pirazolsufuron-etil concentration which was greater (200 $mg.L^{-1}$) than the living in the soil. It may be, therefore, that a much wider genetic potencial for biodegrdadation does exist in nature. The data presented herein demonstrate the susceptibility of pyrazolsufuron-etyl to utilized by a diverse microbial flora

Key words: *Oryza sativa*, environmental fate, pesticides, bacteria, biodegradation,.

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CARACTERÍSTICAS MICROBIANAS E DEGRADAÇÃO DO PIRAZOLSUFURON-ETIL EM UM SOLO CULTIVADO COM ARROZ NO SISTEMA PRÉ-GERMINADO

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Estudos, no e campo em laboratório, foram realizados em Rio Grande e Pelotas, RS, Brazil, de 1998 a 2002, para determinar a influência do sistema de cultivo de arroz pré-germinado (SPG) sobre as características microbianas e degradação de herbicida pirazolsufuron-etil, em um PLANOSOLO HIDROMÓRFICO típico do ecossistema de arroz irrigado. Amostras de solo obtidas de SPG comercial, neste ambiente, tratadas com pirazolsufuron-etil, foram analisadas. A evolução de CO_2 do arrozal foi medida antes e após a aplicação do herbicida, e após a colheita. Nas três épocas de medição foi constatada uma tendência linear negativa de evolução de CO_2 do solo. O aumento da atividade microbiana, após a colheita, sugere a presença de microrganismos decompositores da matéria orgânica, importantes na ciclagem de nutrientes. Os resultados evidenciam a importância do *in put* de matéria orgânica no solo para a manutenção da diversidade microbiana. Em laboratório foi avaliado o quanto a degradação do pirazolsufuron-etil é influenciada pelo SPG. Bactérias isoladas de arrozais cresceram na presença de pirazolsufuron-etil como única fonte de carbono e energia. Os isolados compreenderam seis espécies de *Pseudomonas* e uma *Raoultella planticola* e cresceram em concentração de pirazolsufuron-etil maior do que (200 $mg.L^{-1}$) a existente no solo. Portanto, é possível que exista um grande potencial genético para biodegradação na natureza. Os dados apresentados demonstram a suscepitibilidade de pirazolsufuron-etil para ser utilizado por uma flora microbiana diversa.

Palavras chave: Arroz irrigado, comportamento ambiental, pesticidas, bactéria, biodegradação.

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HERBICIDES RESIDUES IN WATER OF IRRIGATED RICE FIELDS, CULTIVATED UNDER THE PRE-GERMINATED SYSTEM.

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In Rio Grande do Sul State (Brazil), irrigated rice is considered as a potential surface water contaminant; however no real proofs are presented in this regard. During the 2000/01 and 2001/02 growing seasons a study was conducted aiming to assess the water quality in pre-germinated rice fields. On 16 m^2 plots were applied the herbicides (in g ha^{-1}): bentazon (960), clomazone (500), propanil (3600), quinclorac (375) and 2-4 D (200). Samples were collected before, and on the 1st, 7th, 14th, 21st, 28th, 60th and 130th day after herbicide application. For the determination of herbicides in the water, 250 mL of water was pre-concentrated in a cartridge of solid phase extraction (SPE) containing 200 mg of resin C_{18}. The elution was made with 2 x 0.5 mL of methanol and analyzed by HPLC-UV, using methanol and water as mobile phase and C_{18} column. The results shows that at the end of the first week, the concentration of herbicides en the water was above the tolerable limits (1 to 3 mg L^{-1}), except for the propanil. Starting from 14th day, in general, the residues of the herbicides were below 3 mg L^{-1}, limit adopted by some environmental agencies for surface waters. Clomazone residues were detected up to 28 days. The results suggests that retaing water inside the fields for at least 28 days con minimize herbicide residue effects on the environment.

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CHANGING ATTITUDES, CURRENT PRACTICES AND TRENDS IN RICE SOWING TECHNIQUES IN SOUTHERN NEW SOUTH WALES, AUSTRALIA
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Sowing techniques are a critical factor in the cost effective establishment of rice to produce consistently high yields. A number of techniques have been available to growers ranging from the traditional drill and flush sowing techniques, which includes direct drilling into pastures, to aerial sowing, usually of pre-germinated seed into flooded bays by aircraft, and more recently dry broadcast sowing. Dry broadcast sowing is a newer technique, consisting of broadcasting dry seed onto the ground in front of a flushing, followed immediately by permanent water or broadcasting dry seed onto the ground and straight to permanent water. All techniques have a range of advantages and disadvantages related to cultural and management conditions, risks and costs. From the early 1980s up until the mid 1990s, aerial sowing developed from less than 50% of sowings to over 95%. Over the same period drill sowings declined from being the major sowing method to less than 5% of sowings. In recent times there has been a trend away from conventional aerial sowing to the dry broadcast technique and to a lesser extent to aerial sowing of dry seed. The paper details the changes in sowing techniques, the comparative features of the techniques and the reasons for the changes associated with establishment problems, with the key management factors involved identified by a survey. It also discusses the effect of economic, soil characteristics, water management, field preparation, crop management and weather conditions on the choice of sowing technique and the establishment results.
Keywords: rice; sowing techniques, dry broadcast sowing, crop management

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TRAITS OF RICE CULTIVATION IN MEDITERRANEAN CLIMATE AREAS AND MEDRICE RESEARCH NETWORK
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Rice is cultivated in the Mediterranean climate areas on a total of about 1,900,000 ha, 400,000 out of which in the EU. The most important rice-producing countries are Egypt (600,000 ha), Iran (550,000 ha) Italy (220,000 ha), Russia federation (170,000) and Spain (110,000 ha).
The climate of some of these cultivation areas is cool, but warm summer nights during panicle development, when pollen formation takes place, helps to avoid cold-induced floret sterility.
Rice is mostly grown on fine-textured, poorly drained soils. The pH is between 4 and 8, and organic matter between 0.5% and 10% (this last value only on a limited surface area). In some regions soils are saline or very saline. Most of the irrigation water comes from rivers (Nile in Egypt, Po in Italy, Ebro in Spain, etc.) and lakes. In the Mediterranean climate areas rice is usually cultivated with a permanent flood, mainly with

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RESEARCH STUDENTS IMPROVING RICE PRODUCTION IN AUSTRALIA
Blanchard, Chris; Eamens, Andrew; Zhong Kai, Zhou; Oliver, Sandra; Baxter, Graeme; Weir, Kahli
Charles Sturt University, Australia

The Australia rice industry faces many challenges to remain economically viable and environmentally sustainable. Research aimed at increasing productivity, quality and sustainability will ensure the continued success of the Australian rice industry. Postgraduate students are making a significant contribution to the Australia rice research effort. This poster describes the achievements of a number of the postgraduates student enrolled at Charles Strut University and also describes the structures provided to support these students.
Much of the current postgraduate research in Australia is facilitated by the Cooperative Research Centre for Sustainable Rice Production (Rice CRC). The Rice CRC provides students with financial support as well as access to a multi-institutional support network. The project topics described in this poster include functional genomics, rice ageing, cold sterility, rice protein functionality, starch biosynthesis, and biodegradation of chemicals used in rice farming.

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INTEGRATED CROP MANAGEMENT FOR RICE PRODUCTION – ITS DEVELOPMENT AND ADAPTATION
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Rice Integrated Crop Management (RICM) has demonstrated a potential to improve yields. RICM aims to manage the growing of a rice crop as a total production system, that involves a wide range of component factors, that interact and are interdependent, to determine the yield, grain quality and environmental outcomes. Integrated crop management systems have developed slowly over the last 20 to30 years from a problem and single issue focus In the 1970s and 1980s to a broader approach of Integrated Management Programs involving pests, weeds and nutrition, along with parallel changes to extension strategies and methodology. Over the last 10 to 15 years the broader Rice Integrated Crop Management systems involving holistic approaches to management, have developed in many parts of the world to improve rice growing practices and yield and other results. The Australian Ricecheck Model is one successful program of RICM that integrates innovative approaches to management, based on objective recommendations, and the use of these as benchmarks against which to evaluate management, within a participatory and facilitative extension environment for the transfer and adoption of improved technology. RICM systems, adapting the Ricecheck model to regional potentials and constraints. are underway in Thailand, Indonesia and South America.

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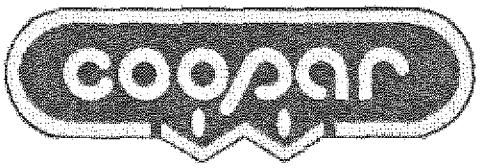
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