

APPENDIX 1

National Program 304 – Crop Protection and Quarantine

ACCOMPLISHMENT REPORT 2007 – 2012

Current Research Projects in National Program 304*

SYSTEMATICS

1245-22000-262-00D

SYSTEMATICS OF FLIES OF AGRICULTURAL AND ENVIRONMENTAL IMPORTANCE; Allen Norrbom (P), Sonja Jean Scheffer, and Norman E. Woodley; Beltsville, Maryland.

1245-22000-263-00D

SYSTEMATICS OF BEETLES IMPORTANT TO AGRICULTURE, LANDSCAPE PLANTS, AND BIOLOGICAL CONTROL; Steven W. Lingafelter (P), Alexander Konstantinov, and Natalie Vandenberg; Washington, D.C.

1245-22000-264-00D

SYSTEMATICS OF LEPIDOPTERA: INVASIVE SPECIES, PESTS, AND BIOLOGICAL CONTROL AGENTS; John W. Brown (P), Maria A. Solis, and Michael G. Pogue; Washington, D.C.

1245-22000-265-00D

SYSTEMATICS OF PARASITIC AND HERBIVOROUS WASPS OF AGRICULTURAL IMPORTANCE; Robert R. Kula (P), Matthew Buffington, and Michael W. Gates; Washington, D.C.

1245-22000-266-00D

MITE SYSTEMATICS AND ARTHROPOD DIAGNOSTICS WITH EMPHASIS ON INVASIVE SPECIES; Ronald Ochoa (P); Washington, D.C.

1245-22000-267-00D

SYSTEMATICS OF HEMIPTERA AND RELATED GROUPS: PLANT PESTS, PREDATORS, AND DISEASE VECTORS; Thomas J. Henry (P), Stuart H. McKamey, and Gary L. Miller; Washington, D.C.

INSECTS

0101-88888-040-00D

OFFICE OF PEST MANAGEMENT; Sheryl Kunickis (P); Washington, D.C.

0212-22000-024-00D

DISCOVERY, BIOLOGY AND ECOLOGY OF NATURAL ENEMIES OF INSECT PESTS OF CROP AND URBAN AND NATURAL ECOSYSTEMS; Livy H. Williams III (P) and Kim Hoelmer; Montpellier, France.

* Because of the nature of their research, many NP 304 projects contribute to multiple Problem Statements, so for the sake of clarity they have been grouped by focus area. For the sake of consistency, projects are listed and organized in Appendix 1 and 2 according to the ARS project number used to track projects in the Agency's internal database. A (P) after a scientist's name indicates the project's principal investigator.

0212-22000-026-00D

FOREIGN EXPLORATION FOR NATURAL ENEMIES OF INVASIVE SPECIES; Daniel A. Strickman (P); Montpellier, France.

1245-22000-270-00D

DEVELOPMENT OF BIOLOGICAL CONTROL TECHNOLOGIES AND STRATEGIES FOR ARTHROPOD PESTS OF PERENNIAL TROPICAL CROPS IMPORTANT TO THE UNITED STATES, COFFEE; Fernando E. Vega (P); Beltsville, Maryland.

1245-22000-272-00D

INSECT MANAGEMENT SYSTEMS FOR URBAN SMALL FARMS AND GARDENS – Donald C. Weber (P), Susan D. Lawrence, Aijun Zhang, Phyllis A. Martin, Michael Blackburn, Robert Harrison, Kamlesh R. Chauhan, and Dawn Gundersen-Rindal; Beltsville, Maryland.

1245-22000-273-00D

SUSTAINABLE MANAGEMENT OF INVASIVE AND INDIGENOUS INSECTS OF URBAN LANDSCAPES; Matthew H. Greenstone (P), Ashot Khrimian, Dawn Gundersen-Rindal, Robert Lee Harrison, Michael Blackburn, Phyllis A. Martin, Aijun Zhang, and Susan D. Lawrence; Beltsville, Maryland.

1907-22000-019-00D

IPM-BASED STRATEGIES FOR INCORPORATING MICROBIAL BIOLOGICAL CONTROL FOR MANAGEMENT OF GREENHOUSE AND NURSERY CROP PESTS; John D. Vandenberg (P) and Stephen P. Wraight; Ithaca, New York.

1907-22410-005-00D

FUNGAL RESOURCES FOR BIOLOGICAL CONTROL AND HIGH-VALUE USES; Donna M. Gibson (P), Richard A. Humber, and Stuart Krasnoff; Ithaca, New York.

1926-22000-023-00D

BIOCONTROL OF INVASIVE PESTS SUCH AS EMERALD ASH BORER AND QUARANTINE SERVICES; Jian J. Duan (P) and Douglas G. Luster; Newark, Delaware.

1926-22000-024-00D

GENETICS AND EVOLUTION OF HOST SPECIFICITY OF INSECT BIOLOGICAL CONTROL AGENTS, EMPHASIZING APHIDS AND MOTHS; Keith R. Hopper (P); Newark, Delaware.

1926-22000-026-00D

CLASSICAL BIOLOGICAL CONTROL OF INSECT PESTS OF CROPS, EMPHASIZING TARNISHED PLANT BUG, SOYBEAN APHID, AND BROWN MARMORATED STINK BUG; Kim A. Hoelmer (P) and Douglas G. Luster; Newark, Delaware.

1926-22000-027-00D

BIOCONTROL AND OTHER TECHNOLOGIES FOR CONTROL OF INVASIVE SPECIES, WITH EMPHASIS ON ASIAN LONGHORNED BEETLE AND RELATED SPECIES; Michael T. Smith (P) and Douglas G. Luster; Newark, Delaware.

3607-22000-012-00D

MANAGEMENT OF INSECTS THAT ATTACK HORTICULTURAL, TURF, AND NURSERY CROPS; Michael E. Reding (P), Christopher Ranger, James E. Altland, and Charles R. Krause; Wooster, Ohio.

3620-22000-010-00D

SEMIOCHEMICALS FOR THE MANAGEMENT OF AGRICULTURAL PESTS; Allard A. Cosse (P) and Alejandro P. Rooney; Peoria, Illinois.

3620-22410-014-00D

PRODUCTION, STABILIZATION AND FORMULATION OF MICROBIAL AGENTS AND THEIR NATURAL PRODUCTS; Mark A. Jackson (P), Robert W. Behle, Christopher Dunlap, and Alejandro P. Rooney; Peoria, Illinois.

3622-21220-007-00D

PLANT RESISTANCE, BIOLOGY, AND RESISTANCE MANAGEMENT OF CORN PESTS, WITH EMPHASIS ON WESTERN CORN ROOTWORM; Bruce E. Hibbard (P) and Melvin J. Oliver; Columbia, Missouri.

3622-22000-035-00D

DEVELOPMENT OF HIGH QUALITY, COST-EFFECTIVE, MASS-REARED BIOCONTROL AGENTS FOR SMALL AND URBAN FARMS, ORGANIC FARMS AND GREENHOUSES; Holly J. Popham (P), Thomas A. Coudron, David W. Stanley, and Kent Shelby; Columbia, Missouri.

3622-22000-036-00D

EICOSANOID-MEDIATED AND MOLECULAR IMMUNE SIGNALING INHIBITORS IN PIERCING/SUCKING INSECT PESTS OF SMALL AND URBAN VEGETABLE FARMS; David W. Stanley (P), Thomas A. Coudron, Holly J. Popham, and Kent Shelby; Columbia, Missouri.

3625-22000-017-00D

ECOLOGICALLY-BASED MANAGEMENT OF INSECT PESTS OF CORN, WITH EMPHASIS ON CORN BORERS, ROOTWORMS, AND CUTWORMS; Richard L. Hellmich II (P), Craig A. Abel, Thomas Sappington, Nicholas C. Lauter, and Brad S. Coates; Ames, Iowa.

5302-43000-037-00D

CHEMICAL ALTERNATIVES TO METHYL BROMIDE FOR QUARANTINE AND POST-HARVEST PESTS; David M. Obenland (P), Joseph L. Smilanick, Charles S. Burks, Joel P. Siegel, Lodewyk P.S. Kuenen, Spencer S. Walse, Victoria Y. Yokoyama, and Chang-Lin Xiao; Parlier, California.

5302-43000-038-00D

NON-CHEMICAL ALTERNATIVES FOR POST-HARVEST PESTS OF FRESH FRUITS, DRIED FRUITS, TREE NUTS, AND OTHER DURABLE COMMODITIES; Judy A. Johnson (P), David M. Obenland, Charles S. Burks, Joel P. Siegel, Lodewyk P.S. Kuenen, Victoria Y. Yokoyama, and Chang-Lin Xiao; Parlier, California.

5305-43000-004-00D

CHEMICAL ALTERNATIVES TO METHYL BROMIDE FOR POST-HARVEST PEST CONTROL ON PERISHABLE COMMODITIES; Yong-Biao Liu (P); Salinas, California.

5320-22430-025-00D

BIOLOGY, CONTROL, AND AREA-WIDE MANAGEMENT OF FRUIT FLIES AND OTHER QUARANTINE PESTS; Roger I. Vargas (P), Eric B. Jang, Chiou Ling Chang, Grant T. McQuate, Scott M. Geib, and Nicholas Manoukis; Hilo, Hawaii.

5320-43000-016-00D

PRE AND POSTHARVEST TREATMENT OF TROPICAL AND OTHER COMMODITIES FOR QUARANTINE SECURITY, QUALITY MAINTENANCE, AND VALUE ENHANCEMENT; Marisa M. Wall (P), Eric B. Jang, Peter A. Follett, and Robert Hollingsworth; Hilo, Hawaii.

5347-22620-021-00D

SUSTAINABLE PEST MANAGEMENT STRATEGIES FOR ARID-LAND CROPS; Dale Spurgeon (P), Steve E. Naranjo, James R. Hagler, John A. Byers, Jeffrey A. Fabrick, Jimmy J. Hull, Steven J. Castle, and Colin S. Brent; Maricopa, Arizona.

5352-22000-020-00D

BIO-RATIONAL APPROACHES TO MANAGE INSECT PESTS OF POTATO CROPS; Peter J. Landolt (P), William R. Cooper, Joseph Munyaneza, and David R. Horton; Wapato, Washington.

5352-22430-001-00D

BIORATIONAL MANAGEMENT OF INSECT PESTS OF TEMPERATE TREE FRUITS; Peter J. Landolt (P), Wee Yee, Alan Knight, William Cooper, David Horton, Thomas Unruh, Stephen Garczynski, and Lisa Neven; Wapato, Washington.

5358-22000-037-00D

INTEGRATED PEST MANAGEMENT FOR INSECT PESTS OF HORTICULTURAL CROPS; Jana Lee (P), Martin Robert, and Denny J. Bruck; Corvallis, Oregon.

5430-43000-032-00D

ECOLOGY, GENOMICS, AND MANAGEMENT OF STORED PRODUCT INSECTS; Franklin H. Arthur (P), Guy Hallman, James Campbell, and Brenda Oppert; Manhattan, Kansas.

5436-22000-016-00D

ECOLOGY AND MANAGEMENT OF GRASSHOPPERS AND OTHER INSECT PESTS IN THE NORTHERN GREAT PLAINS; David H. Branson (P), Tatyana Rand, Robert Srygley, John Gaskin, and Stefan Jaronski; Sidney, Montana.

5442-21220-027-00D

INSECT CRYOPRESERVATION, DORMANCY, GENETICS AND BIOCHEMISTRY – William P. Kemp (P), Richard Roehrdanz, Joseph Rinehart, and George Yocum; Fargo, North Dakota.

5447-21220-005-00D

ECOLOGICALLY BASED PEST MANAGEMENT IN MODERN CROPPING SYSTEMS – Jonathan G. Lundgren (P), Louis Hesler, Randal Anderson, Walter Riedell, Sharon Papiernik, R. Michael Lehman, Shannon Osborne, and Bryan French; Brookings, South Dakota.

6202-22000-029-00D

ECOLOGICALLY BASED MANAGEMENT OF BOLL WEEVILS AND OTHER ROW CROP PESTS UNDER TRANSITION TO BOLL WEEVIL ERADICATION IN TEMPERATE REGIONS – John K. Westbrook (P), Ronald Nachman, Charles Suh, and Gretchen Jones; College Station, Texas.

6217-22000-015-00D

BIOLOGICALLY BASED MANAGEMENT OF CEREAL APHIDS – Gary J. Puterka (P), Norman Elliott, and John Armstrong; Stillwater, Oklahoma.

6402-22000-062-00D

MASS PRODUCTION OF BIOLOGICAL CONTROL AGENTS – Juan A. Morales Ramos (P), Margaret Allen, Maria Rojas, Walker Jones, and Eric Riddick; Stoneville, Mississippi.

6402-22000-063-00D

INSECTICIDE RESISTANCE MANAGEMENT AND NEW CONTROL STRATEGIES FOR PESTS OF CORN, COTTON, SORGHUM, SOYBEAN, AND SWEET POTATO – Randall Luttrell (P), Ryan E. Jackson, Omaththage Perera, Yu Cheng Zhu, Maribel Portilla, Gordon Snodgrass, and Kerry Allen; Stoneville, Mississippi.

6402-22000-064-00D

CONTROL OF TARNISHED PLANT BUGS BY BIOCONTROL AND OTHER METHODS – Gordon L. Snodgrass (P), Maribel Portilla, and Randall Luttrell; Stoneville, Mississippi.

6402-22000-065-00D

EFFECT OF RESISTANCE ON INSECT PEST MANAGEMENT IN TRANSGENIC COTTON – Omaththage P. Perera (P), Kerry Allen, and Randall Luttrell; Stoneville, Mississippi.

6602-22000-041-00D

INSECT ECOLOGY AND SUSTAINABLE SYSTEMS FOR INSECT PEST MANAGEMENT IN THE SOUTHEASTERN REGION – Patricia G. Tillman (P), Brian Scully, and Dawn Olson; Tifton, Georgia.

6602-22000-042-00D

STERILE INSECT CONTROL OF INVASIVE PESTS, WITH A FOCUS ON MOTHS – James E. Carpenter (P) and Brian Scully; Tifton, Georgia.

6606-22000-022-00D

INTEGRATED PEST MANAGEMENT FOR KEY PESTS OF PECAN AND PEACH – David I. Shapiro Ilan (P) and Ted Cottrell; Byron, Georgia.

6615-22000-025-00D

BIOLOGICALLY-BASED TECHNOLOGIES FOR MANAGEMENT OF CROP INSECT PESTS IN LOCAL AND AREAWIDE PROGRAMS – Alfred M. Handler (P), John Sivinski, Stephen Hight, Sandra Allan, Robert Meagher Jr., Paul Shirk, Richard Mankin, and Rodney Nagoshi; Gainesville, Florida.

6615-22000-026-00D

BIOLOGICALLY BASED MANAGEMENT OF INVASIVE INSECT PESTS AND WEEDS – Stuart R. Reitz (P), Sandra Allan, Jesusa Legaspi, John Sivinski, and Stephen Hight; Gainesville, Florida.

6615-22000-027-00D

CHEMICAL BIOLOGY OF INSECT AND PLANT SIGNALING SYSTEMS – Eric A. Schmelz (P), Hans Alborn, and Peter Teal; Gainesville, Florida.

6618-22320-001-00D

IPM TECHNOLOGIES FOR INSECT PESTS OF ORCHARD CROPS – Stephen L. Lapointe (P); Fort Pierce, Florida.

6618-22320-002-00D

SUBTROPICAL INSECT PESTS OF VEGETABLES AND ORNAMENTAL PLANTS – Cindy L. McKenzie (P) and Robert Shatters; Fort Pierce, Florida.

6631-22000-005-00D

ALTERNATIVES TO METHYL BROMIDE: MITIGATION OF THE THREAT FROM EXOTIC TROPICAL AND SUBTROPICAL INSECT PESTS – Nancy Epsky (P), Paul Kendra, and Robert Mangan; Miami, Florida.

6659-22000-024-00D

BIOLOGICALLY BASED TECHNIQUES FOR MANAGEMENT OF VEGETABLE PESTS – D. Michael Jackson (P) and Alvin Simmons; Charleston, South Carolina.

WEEDS

0212-22000-025-00D

DISCOVERY AND EVALUATION OF CLASSICAL BIOLOGICAL CONTROL AGENTS FOR INVASIVE EURASIAN WEEDS AFFECTING AGRICULTURAL AND NATURAL AREAS – Livy H. Williams III (P) and Kim Hoelmer; Montpellier, France

1245-22000-165-00D

DEVELOPMENT OF MULTI-TACTIC WEED MANAGEMENT SYSTEMS FOR SUSTAINABLE CROP PRODUCTION – Steven B. Mirsky (P), Harry Schomberg, Clifford Rice, and Daniel Roberts; Beltsville, Maryland.

1907-22620-004-00D

BIOLOGICAL CONTROL OF SWALLOW-WORTS, INVASIVE WEEDS OF THE NORTHEASTERN UNITED STATES – Lindsey R. Milbrath (P) and Donna Gibson; Ithaca, New York.

1920-22000-039-00D

DISCOVERY AND CHARACTERIZATION OF PLANT PATHOGENS FOR BIOLOGICAL CONTROL OF INVASIVE WEEDS FROM THEIR NATIVE RANGE – Dana K. Berner (P), William Bruckart, and Douglas Luster; Fort Detrick, Maryland.

3611-12220-008-00D

ECOLOGY, MANAGEMENT AND ENVIRONMENTAL IMPACT OF WEEDY AND INVASIVE PLANT SPECIES IN A CHANGING CLIMATE – Adam Davis (P), Gerald K. Sims, Joanne Chee Sanford, and Martin Williams; Urbana, Illinois.

5325-22000-024-00D

LANDSCAPE-LEVEL ASSESSMENT AND MANAGEMENT OF INVASIVE WEEDS AND THEIR IMPACTS IN AGRICULTURAL AND NATURAL SYSTEMS – Raymond I. Carruthers (P), Brenda Grewell, David Spencer, and Lars Anderson; Albany, California.

5325-22000-025-00D

BIOLOGICAL CONTROL OF INVASIVE TERRESTRIAL AND RIPARIAN WEEDS IN THE FAR WESTERN UNITED STATES REGION, WITH EMPHASIS ON THISTLES, BROOMS AND CAPE-IVY – Lincoln Smith (P) and Patrick Morgan; Albany, California.

5325-22000-026-00D

AQUATIC AND RIPARIAN WEED MANAGEMENT TO PROTECT U.S. WATER RESOURCES IN THE FAR WEST UNITED STATES – Lars W.J. Anderson (P), David Spencer, Brenda Grewell, and Raymond I. Carruthers; Albany, California.

5360-22000-004-00D

DEVELOPMENT OF A DECISION-SUPPORT SYSTEM FOR THE ECOLOGICALLY-BASED MANAGEMENT OF CHEATGRASS- AND MEDUSAHEAD-INFESTED RANGELAND – Roger I. Sheley (P), Anthony Svejcar, and Jeremy James; Burns, Oregon.

5370-22000-023-00D

ECOLOGICAL INTERACTIONS IN INTEGRATED AND BIOLOGICALLY-BASED MANAGEMENT OF INVASIVE PLANT SPECIES IN WESTERN RANGELANDS – Keirith A. Snyder (P), Brian Rector, Sarah Swope, and William Longland; Reno, Nevada.

5436-22000-017-00D

REDUCING THE IMPACT OF INVASIVE WEEDS IN NORTHERN GREAT PLAINS RANGELANDS THROUGH BIOLOGICAL CONTROL AND COMMUNITY RESTORATION – Anthony J. Caesar (P), Erin Espeland, and John Gaskin; Sidney, Montana.

5442-21220-026-00D

NOVEL WEED MANAGEMENT SOLUTIONS: A BASIS IN UNDERSTANDING BUD AND SEED DORMANCY – James Anderson (P), Michael E. Foley, Wun Chao, and David Horvath; Fargo, North Dakota.

6402-21000-050-00D

CHARACTERIZATION AND MITIGATION OF HERBICIDE-RESISTANT AND RECALCITRANT WEEDS – Robert E. Hoagland (P), Vijay Nandula, Krishna Reddy, and William Molin; Stoneville, Mississippi.

6402-22000-073-00D

IMPROVEMENT OF BIOHERBICIDE STRATEGIES FOR INVASIVE WEEDS IN SOUTHERN CROPPING SYSTEMS – Clyde D. Boyette (P); Stoneville, Mississippi.

6408-21410-010-00D

DISCOVERY AND DEVELOPMENT OF NATURAL PRODUCT-BASED WEED MANAGEMENT METHODS – Stephen O. Duke (P), Pan Zhiqiang, Scott Baerson, and Franck Dayan; University/Oxford, Mississippi.

6602-22000-040-00D

INTEGRATED WEED MANAGEMENT SYSTEMS FOR ORGANIC AND CONVENTIONAL CROPS OF THE SOUTHEASTERN COASTAL PLAIN – Theodore M. Webster (P) and Wiley Johnson; Tifton, Georgia.

6629-22000-011-00D

DEVELOPMENT AND EVALUATION OF BIOLOGICAL CONTROL AGENTS FOR INVASIVE SPECIES THREATENING THE EVERGLADES AND OTHER NATURAL AND MANAGED SYSTEMS – Philip Tipping (P), Ted Douglas Center, Min Rayamajhi, Paul Pratt, and Gregory Wheeler; Fort Lauderdale, Florida.

6659-22000-023-00D

UTILIZING HERBICIDE TOLERANT AND COMPETITIVE CULTIVARS AND INNOVATIVE CULTURAL PRACTICES TO ENHANCE WEED MANAGEMENT IN VEGETABLE CROPS – Howard F. Harrison Jr. (P); Charleston, South Carolina.

INSECTS AND WEEDS

0201-22000-004-00D

BIOLOGICAL CONTROL ORGANISM DATABASES AND ASSESSMENTS – Glenn W. Hanes (P); Beltsville, Maryland.

0206-22000-002-00D

DISCOVERY AND DEVELOPMENT OF BIOLOGICAL CONTROL AGENTS FOR WEEDS/INSECT PESTS...INVASIVE IN THE UNITED STATES. NATIVE TO AUSTRALIA AND SOUTHEAST ASIA – Daniel A. Strickman (P); Beltsville, Maryland.

0206-22000-007-00D

DISCOVERY, IDENTIFICATION AND RISK-ASSESSMENT OF BIOCONTROL AGENTS FOR SUPPRESSION OF SOUTH AMERICAN INVASIVE WEEDS AND INSECTS IN THE UNITED STATES – Daniel A. Strickman (P); Beltsville, Maryland.

6410-22000-015-00D

DEVELOPING INTEGRATED WEED AND INSECT MANAGEMENT SYSTEMS FOR EFFICIENT AND SUSTAINABLE SUGARCANE PRODUCTION – William H. White (P) and Michael Grisham; Houma, Louisiana.

APPENDIX 2

National Program 304 – Crop Protection and Quarantine

ACCOMPLISHMENT REPORT 2007 – 2012

Publications by Research Project*

0206-22000-007-00D

DISCOVERY, IDENTIFICATION AND RISK-ASSESSMENT OF BIOCONTROL AGENTS FOR SUPPRESSION OF SOUTH AMERICAN INVASIVE WEEDS AND INSECTS IN THE U.S. - DANIEL STRICKMAN (P); BELTSVILLE, MARYLAND.

- Briano, J., Calcaterra, L., Varone, L. 2012. Fire ants (*Solenopsis* spp.) and their natural enemies in southern South America. *Psyche*. DOI:10.1155/2012/198084.
- Briano, J., Varone, L., Logarzo, G., Villamil, C. 2012. Extended geographical distribution and host range of the cactus moth *Cactoblastis cactorum* (Lepidoptera Pyralidae) in Argentina. *Florida Entomologist*. 95(1):233-237.
- Brooks, C.P., Ervin, G.N., Varone, L., Logarzo, G. 2012. Native ecotypic variation and the role of host identity in the spread of an invasive herbivore *Cactoblastis cactorum* (Berg). *Ecology* 93(2):402-410.
- Cabrera Walsh, G. 2012. Chrysomelids American diabroticines Hosts and natural enemies. Biology-feasibility for control of pest species (Crisomelidos Diabroticinos americanos Hospederos y enemigos naturales Biología y factibili manejo especies plagas. Chrysomelids American Diabroticines: Hosts and natural enemies. Spain: Editorial Academica Espanola p.1-143.
- Cabrera Walsh, G., Briano, J., Briano, A. 2012. El control biologico de plagas (Biological control of pests). *Ciencia Hoy*. 22(128):57-64.
- Calcaterra, L., Coulin, C., Briano, J., Follett, P.A. 2012. Acute exposure to low dose radiation disrupts reproduction and shortens survival of *Wasmannia auropunctata* (Hymenoptera Formicidae) queens. *Journal of Economic Entomology*. 105(3):817-822.
- Julien, M., Sosa, A., Chan, R., Schooler, S., Traversa, G. 2012. *Alternanthera philoxeroides* (Martius) Grisebach - alligator weed. Book Chapter. In: Julien, M.; McFadyen, R.; Cullen, J., editors. *Biological Control of Weeds in Australia*. Australia: CSIRO Publishing. p.43-51.
- Julien, M., Sosa, A.J., Traversa, G., Van Klinken, R. 2012. *Phyla canescens* (Kunth) Greene-lippia. Book Chapter. In: Julien, M.; McFadyen, R.; Cullen, J. editors. *Biological Control of Weeds in Australia*. Australia: CSIRO Publishing. p.463-471.
- Logarzo, G.A., Zamar, M., Richman, D., Bruzone, O. 2012. Structure and composition of a thrips community in the Chihuahuan Desert, New Mexico, U.S.. *Florida Entomologist*. 95(1):35-42.
- Mc Kay, F., Gandolfo, D., Witt, A. 2012. Biology and host specificity of *Coeloccephalopion gandolfoi* Kissinger (Brentidae) a promising candidate for the biological control of invasive *Prosopis* species (Leguminosae) in South Africa. *African Entomology*. 20(2):281-291.
- Mc Kay, F., Oleiro, M.I., Diniz Vitorino, M., Wheeler, G.S. 2012. The leafmining *Leurocephala schinusae* (Lepidoptera Gracillariidae): Not suitable for the biological control of *Schinus terebinthifolius* (Sapindales Anacardiaceae) in continental USA. *Biocontrol Science and Technology*. 22(4):477-489. DOI: 10.1080/09583157.2012.664618.
- Olivier, R., Estoup, A., Vonshak, M., Loiseau, A., Blanchet, S., Rossi, J., Kergoat, G.J., Foucaud, J., Orivel, J., Calcaterra, L., Chifflet, L., Courtoisier, P., Leponce, M., Schultz, T., Facon, B. 2012. Where do adaptive shifts occur during invasion? A multidisciplinary approach to unravel cold adaptation in a tropical ant species invading the Mediterranean zone. *Ecology Letters*. DOI:10.1111/j.1461-0248.2012.01849.x.

* For the sake of consistency, projects are listed and organized in Appendixes 1 and 2 according to the ARS project number used to track projects in the Agency's internal database. A (P) after a scientist's name indicates the project's principal investigator.

- Varone, L., Mariana, M., Logarzo, G.A., Briano, J., Hight, S.D., Carpenter, J.E. 2012. Performance of *Cactoblastis cactorum* (Berg)(Lepidoptera:Pyralidae) on South and North American *Opuntia* species occurring in Argentina. *Florida Entomologist*. 95(4):1163-1173.
- Cabrera Walsh, G., Schooler, S., Julien, M. 2011. Biology and preliminary host range of *Hydrothimetes natans* Kolbe (Coleoptera:Curculionidae)a natural enemy candidate for biological control of *Cabomba caroliniana* Gray (Cabombaceae) in Australia. *Australian Journal of Entomology*. 50,200-206.
- Dellape, G., Logarzo, G.A., Virla, E., Paradell, S. 2011. New records on the geographical distribution of South American sharpshooters (Cicadellidae:Cicadellinae:Proconiini) and their potential as vectors of *Xylella fastidiosa*. *Florida Entomologist*. 94(2):364-366.
- Hernandez, M., Brentassi, M., Sosa, A.J., Sacco, J., Elsesser, G. 2011. Feeding behaviour and spatial distribution of two planthoppers *Megamelus scutellaris* (Delphacidae) and *Taosa longula* (Dictyopharidae) on water hyacinth. *Biocontrol Science and Technology*. 21(8):941-952.
- Hernandez, M., Sacco, J., Cabrera Walsh, G. 2011. Biology and host preference of the planthopper *Taosa longula* (Hemiptera: Dictyopharidae) a candidate for biological control of water hyacinth. *Biocontrol Science and Technology*. 21(9):1079-1090.
- Logarzo, G.A., Virla, E.G., Luft Albarracin, E., Triapitsyn, S., Jones, W.A., De Leon, J.H., Briano, J. 2011. Host range of *Gonatocerus* sp. near *tuberculifemur* Clade 1 in Argentina an egg parasitoid newly associated to the glassywinged sharpshooter *Homalodisca vitripennis* (Hemiptera:Cicadellidae)and candidate for its biocontrol. *Biocontrol*. Online.
- Mconnachie, A., Retief, E., Henderson, L., Mc Kay, F. 2011. The initiation of a biological control programme against pompom weed *Campuloclinium macrocephalum* (LESS.)DC (Asteraceae) in South Africa. *African Entomology*. 19(2):258-268.
- Oleiro, M., Mc Kay, F., Wheeler, G.S. 2011. Biology and host range of *Tecmessa elegans* (Lepidoptera:Notodontidae) a leaf-feeding moth evaluated as a potential biological control agent for *Schinus terebinthifolius* (Sapindales: Anacardiaceae) in the USA. *Environmental Entomology*. 40(3):605-613.
- Pan, X., Jia, X., Zeng, J., Sosa, A.J., Li, B., Chen, J. 2011. Stem tissue mass density is linked to growth and resistance to a stem-boring insect in *Alternanthera philoxeroides*. *Plant Species Biology*. 26:58-65.
- Telesnicki, M.C., Sosa, A.J., Greizerstein, E., Julien, M. 2011. Cytogenetic effect of *Alternanthera philoxeroides* (alligator weed) on *Agasicles hygrophila* (Coleoptera: Chrysomelidae) in its native range. *Biological Control*. Vol(57)138-142.
- Triapitsyn, S.V., Hernandez, M. 2011. Egg parasitoids of *Taosa* spp. (Hemiptera:Dictyopharidae)in Formosa Argentina with descriptions of new species. *Revista De La Sociedad Entomologica Argentina*. 70(1-2):55-61.
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DISCOVERY, BIOLOGY AND ECOLOGY OF NATURAL ENEMIES OF INSECT PESTS OF CROP AND URBAN AND NATURAL ECOSYSTEMS - Livy Williams (P) and Kim Hoelmer; Montpellier, France.

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1245-22000-165-00D*DEVELOPMENT OF MULTI-TACTIC WEED MANAGEMENT SYSTEMS FOR SUSTAINABLE CROP*

PRODUCTION - Steven Mirsky (P), Harry Schomberg, Clifford Rice, and Daniel Roberts; Beltsville, Maryland.

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SYSTEMATICS OF PARASITIC AND HERBIVOROUS WASPS OF AGRICULTURAL IMPORTANCE - Robert Kula (P), Matthew Buffington, and Michael W. Gates; Beltsville, Maryland.

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MITE SYSTEMATICS AND ARTHROPOD DIAGNOSTICS WITH EMPHASIS ON INVASIVE SPECIES - Ronald Ochoa (P); Beltsville, Maryland.

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SYSTEMATICS OF HEMIPTERA AND RELATED GROUPS: PLANT PESTS, PREDATORS, AND DISEASE VECTORS - Thomas Henry (P), Stuart H. McKamey, and Gary L. Miller; Beltsville, Maryland.

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DEVELOPMENT OF BIOLOGICAL CONTROL TECHNOLOGIES AND STRATEGIES FOR ARTHROPOD PESTS OF PERENNIAL TROPICAL CROPS IMPORTANT TO THE U.S., COFFEE - Fernando Vega (P); Beltsville, Maryland.

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INSECT MANAGEMENT SYSTEMS FOR URBAN SMALL FARMS AND GARDENS - Donald Weber (P), Susan D. Lawrence, Aijun Zhang, Phyllis A. Martin, Michael Blackburn, Robert Harrison, Kamlesh R. Chauhan, and Dawn Gundersen-Rindal; Beltsville, Maryland.

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SUSTAINABLE MANAGEMENT OF INVASIVE AND INDIGENOUS INSECTS OF URBAN LANDSCAPES -

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IPM-BASED STRATEGIES FOR INCORPORATING MICROBIAL BIOLOGICAL CONTROL FOR MANAGEMENT OF GREENHOUSE AND NURSERY CROP PESTS - John Vandenberg (P) and Stephen P. Wraight; Ithaca, New York

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DISCOVERY AND CHARACTERIZATION OF PLANT PATHOGENS FOR BIOLOGICAL CONTROL OF INVASIVE WEEDS FROM THEIR NATIVE RANGE - Dana K. Berner (P), William Bruckart, and Douglas Luster; Fort Detrick, Maryland.

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BIOCONTROL OF INVASIVE PESTS SUCH AS EMERALD ASH BORER AND QUARANTINE SERVICES - Jian Duan (P) and Douglas G. Luster; Newark, Delaware.

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GENETICS AND EVOLUTION OF HOST SPECIFICITY OF INSECT BIOLOGICAL CONTROL AGENTS, EMPHASIZING APHIDS AND MOTHS - Keith Hopper (P); Newark, Delaware.

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CLASSICAL BIOLOGICAL CONTROL OF INSECT PESTS OF CROPS, EMPHASIZING TARNISHED PLANT BUG, SOYBEAN APHID, AND BROWN MARMORATED STINK BUG - Kim Hoelmer (P) and Douglas G. Luster; Newark, Delaware.

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BIOCONTROL AND OTHER TECHNOLOGIES FOR CONTROL OF INVASIVE SPECIES, WITH EMPHASIS ON ASIAN LONGHORNED BEETLE AND RELATED SPECIES - Michael Smith (P) and Douglas G. Luster; Newark, Delaware.

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MANAGEMENT OF INSECTS THAT ATTACK HORTICULTURAL, TURF, AND NURSERY CROPS - Michael Reding (P), Christopher Ranger, James E. Altland, and Charles R. Krause; Wooster, Ohio.

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ECOLOGY, MANAGEMENT AND ENVIRONMENTAL IMPACT OF WEEDY AND INVASIVE PLANT SPECIES IN A CHANGING CLIMATE - Adam Davis (P), Gerald K. Sims, Joanne Chee Sanford, and Martin Williams; Urbana, Illinois.

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PRODUCTION, STABILIZATION AND FORMULATION OF MICROBIAL AGENTS AND THEIR NATURAL PRODUCTS - Mark Jackson (P), Robert W. Behle, Christopher Dunlap, and Alejandro P. Rooney; Peoria, Illinois.

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PLANT RESISTANCE, BIOLOGY, AND RESISTANCE MANAGEMENT OF CORN PESTS, WITH EMPHASIS ON WESTERN CORN ROOTWORM - Bruce Hibbard (P) and Melvin J. Oliver; Columbia, Missouri.

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DEVELOPMENT OF HIGH QUALITY, COST-EFFECTIVE, MASS-REARED BIOCONTROL AGENTS FOR SMALL AND URBAN FARMS, ORGANIC FARMS AND GREENHOUSES - Holly Popham (P), Thomas A. Coudron, David W. Stanley, and Kent Shelby; Columbia, Missouri.

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EICOSANOID-MEDIATED AND MOLECULAR IMMUNE SIGNALING INHIBITORS IN PIERCING/SUCKING INSECT PESTS OF SMALL AND URBAN VEGETABLE FARMS - David Stanley (P), Thomas A. Coudron, Holly J. Popham, and Kent Shelby; Columbia, Missouri.

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ECOLOGICALLY-BASED MANAGEMENT OF INSECT PESTS OF CORN, WITH EMPHASIS ON CORN BORERS, ROOTWORMS, AND CUTWORMS - Richard Hellmich II (P) , Craig A. Abel, Thomas Sappington, Nicholas C. Lauter, and Brad S. Coates; Ames, Iowa.

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CHEMICAL ALTERNATIVES TO METHYL BROMIDE FOR QUARANTINE AND POST-HARVEST PESTS – David Obenland (P), Joseph L. Smilanick, Charles S. Burks, Joel P. Siegel, Lodewyk P.S. Kuenen, Spencer S. Walse, Victoria Y. Yokoyama, and Chang-Lin Xiao; Parlier, California.

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NON-CHEMICAL ALTERNATIVES FOR POST-HARVEST PESTS OF FRESH FRUITS, DRIED FRUITS, TREE NUTS, AND OTHER DURABLE COMMODITIES – Judy Johnson (P), David M. Obenland, Charles S. Burks, Joel P. Siegel, Lodewyk P.S. Kuenen, Victoria Y. Yokoyama, and Chang-Lin Xiao; Parlier, California.

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INTEGRATED MANAGEMENT OF COTTON PESTS: PLANT GENETICS, BIOLOGICAL CONTROL, AND NOVEL METHODS OF PEST ESTIMATION - Dale Spurgeon (P); Shafter, California.

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CHEMICAL ALTERNATIVES TO METHYL BROMIDE FOR POST-HARVEST PEST CONTROL ON PERISHABLE COMMODITIES – Yong Biao Liu (P); Salinas, California.

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BIOLOGY, CONTROL, AND AREA-WIDE MANAGEMENT OF FRUIT FLIES AND OTHER QUARANTINE PESTS - Roger Vargas (P), Eric B. Jang, Chiou Ling Chang, Grant T. McQuate, Scott M. Geib, and Nicholas Manoukis; Hilo, Hawaii.

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PRE AND POSTHARVEST TREATMENT OF TROPICAL AND OTHER COMMODITIES FOR QUARANTINE SECURITY, QUALITY MAINTENANCE, AND VALUE ENHANCEMENT - Marisa Wall (P), Eric B. Jang, Peter A. Follett, and Robert Hollingsworth; Hilo, Hawaii.

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BIOLOGICAL CONTROL OF INVASIVE TERRESTRIAL AND RIPARIAN WEEDS IN THE FAR WESTERN U.S. REGION, WITH EMPHASIS ON THISTLES, BROOMS AND CAPE-IVY - Lincoln Smith (P) and Patrick Morgan; Albany, California.

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DEVELOPMENT OF A DECISION-SUPPORT SYSTEM FOR THE ECOLOGICALLY-BASED MANAGEMENT OF CHEATGRASS- AND MEDUSAHEAD-INFESTED RANGELAND - Roger Sheley (P), Anthony Svejcar, and Jeremy James; Burns, Oregon.

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ECOLOGICAL INTERACTIONS IN INTEGRATED AND BIOLOGICALLY-BASED MANAGEMENT OF INVASIVE PLANT SPECIES IN WESTERN RANGELANDS - Keirith Snyder (P), Brian Rector, Sarah Swope, and William Longland; Reno, Nevada.

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ECOLOGY, GENOMICS, AND MANAGEMENT OF STORED PRODUCT INSECTS - Franklin Arthur (P), Guy Hallman, James Campbell, and Brenda Oppert; Manhattan, Kansas.

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ECOLOGY AND MANAGEMENT OF GRASSHOPPERS AND OTHER INSECT PESTS IN THE NORTHERN GREAT PLAINS - David Branson (P), Tatyana Rand, Robert Srygley, John Gaskin, and Stefan Jaronski; Sidney, Montana.

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REDUCING THE IMPACT OF INVASIVE WEEDS IN NORTHERN GREAT PLAINS RANGELANDS THROUGH BIOLOGICAL CONTROL AND COMMUNITY RESTORATION - Anthony Caesar (P), Erin Espeland, and John Gaskin; Sidney, Montana.

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NOVEL WEED MANAGEMENT SOLUTIONS: A BASIS IN UNDERSTANDING BUD AND SEED DORMANCY - James Anderson (P), Michael E. Foley, Wun Chao, and David Horvath; Fargo, North Dakota.

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INSECT CRYOPRESERVATION, DORMANCY, GENETICS AND BIOCHEMISTRY - William Kemp (P) , Richard Roehrdanz, Joseph Rinehart, and George Yocum; Fargo, North Dakota.

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ECOLOGICALLY BASED MANAGEMENT OF BOLL WEEVILS AND OTHER ROW CROP PESTS UNDER TRANSITION TO BOLL WEEVIL ERADICATION IN TEMPERATE REGIONS - John Westbrook (P) , Ronald Nachman, Charles Suh, and Gretchen Jones; College Station, Texas.

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BIOLOGICAL CONTROL STRATEGIES FOR INVASIVE WEEDS OF SOUTHWESTERN U.S. WATERSHEDS - John Goolsby (P); Weslaco, Texas.

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IPM STRATEGIES FOR MANAGING PESTS OF SUBTROPICAL ROW CROPS - Robert Pfannenstiel (P); Weslaco, Texas.

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BIOLOGICALLY BASED MANAGEMENT OF CEREAL APHIDS - Gary Puterka (P), Norman Elliott, and John Armstrong; Stillwater, Oklahoma.

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MASS PRODUCTION OF BIOLOGICAL CONTROL AGENTS - Juan Morales Ramos (P), Margaret Allen, Maria Rojas, Walker Jones, and Eric Riddick; Stoneville, Mississippi.

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INSECTICIDE RESISTANCE MANAGEMENT AND NEW CONTROL STRATEGIES FOR PESTS OF CORN, COTTON, SORGHUM, SOYBEAN, AND SWEET POTATO - Randall Luttrell (P), Ryan E. Jackson, Omaththage Perera, Yu Cheng Zhu, Maribel Portilla, Gordon Snodgrass, and Kerry Allen; Stoneville, Mississippi.

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IMPROVEMENT OF BIOHERBICIDE STRATEGIES FOR INVASIVE WEEDS IN SOUTHERN CROPPING SYSTEMS - Clyde Boyette (P); Stoneville, Mississippi.

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DISCOVERY AND DEVELOPMENT OF NATURAL PRODUCT-BASED WEED MANAGEMENT METHODS - Stephen Duke (P), Pan Zhiqiang, Scott Baerson, and Franck Dayan; University, Mississippi.

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DEVELOPING INTEGRATED WEED AND INSECT MANAGEMENT SYSTEMS FOR EFFICIENT AND SUSTAINABLE SUGARCANE PRODUCTION - William White (P) and Michael Grisham; Houma, Louisiana.

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INTEGRATED WEED MANAGEMENT SYSTEMS FOR ORGANIC AND CONVENTIONAL CROPS OF THE SOUTHEASTERN COASTAL PLAIN - Theodore Webster (P) and Wiley Johnson; Tifton, Georgia.

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INSECT ECOLOGY AND SUSTAINABLE SYSTEMS FOR INSECT PEST MANAGEMENT IN THE SOUTHEASTERN REGION - Patricia Tillman (P), Brian Scully, and Dawn Olson; Tifton, Georgia.

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STERILE INSECT CONTROL OF INVASIVE PESTS, WITH A FOCUS ON MOTHS - James Carpenter (P) and Brian Scully; Tifton, Georgia.

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INTEGRATED PEST MANAGEMENT FOR KEY PESTS OF PECAN AND PEACH - David Shapiro Ilan (P) and Ted Cottrell; Byron, Georgia.

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BIOLOGICALLY-BASED TECHNOLOGIES FOR MANAGEMENT OF CROP INSECT PESTS IN LOCAL AND AREAWIDE PROGRAMS - Alfred Handler (P), John Sivinski, Stephen Hight, Sandra Allan, Robert Meagher Jr., Paul Shirk, Richard Mankin, and Rodney Nagoshi; Gainesville, Florida.

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ALTERNATIVES TO METHYL BROMIDE: MITIGATION OF THE THREAT FROM EXOTIC TROPICAL AND SUBTROPICAL INSECT PESTS – Nancy Epsky (P), Paul Kendra, and Robert Mangan; Miami, Florida.

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UTILIZING HERBICIDE TOLERANT AND COMPETITIVE CULTIVARS AND INNOVATIVE CULTURAL PRACTICES TO ENHANCE WEED MANAGEMENT IN VEGETABLE CROPS - Howard Harrison Jr (P); Charleston, South Carolina.

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APPENDIX 3

National Program 304 – Crop Protection and Quarantine

ACCOMPLISHMENT REPORT 2007 – 2012

Selected Supporting Information and Documentation for Accomplishments and Impact of NP 304 Research

RELATIONSHIP OF NATIONAL PROGRAM 304 TO THE ARS STRATEGIC PLAN:

Outputs of NP 304 research support the actionable strategies associated with the performance measures shown below from the *ARS Strategic Plan for 2006 - 2011*, Strategic Goal 4, Enhance Protection and Safety of the Nation's Agriculture and Food Supply; Objective 4.2: *Reduce the Number, Severity, and Distribution of Agricultural Pest and Disease Outbreaks*.

Performance Measure 4.2.3: Develop control strategies based on fundamental and applied research to reduce losses caused by plant diseases, nematodes, arthropods, and weeds that are effective and affordable while maintaining environmental quality. Develop technically and economically feasible alternatives to preplant and postharvest use of methyl bromide.

Target: Specific information and technology using methods cited above will be made available to producers and the research community to exclude, control, and/or better manage disease and pest outbreaks as they occur. Strategies and approaches will be made available to producers to identify and control and/or effectively manage over 10 new and emerging crop diseases and pests.

Performance Measure 4.2.4: Provide needed scientific information and technology that is environmentally acceptable to producers of agriculturally important plants in support of exclusion, early detection and eradication, control, and monitoring of invasive arthropods, weeds, nematodes, and pathogens; enhanced sustainability; and restoration of affected areas. Conduct biologically-based integrated and area-wide management of key invasive species.

Target: Improve knowledge and understanding of the ecology, physiology, epidemiology, and molecular biology and genomics of endemic and emerging diseases and pests. Incorporate this knowledge into at least 10 management strategies to minimize chemical inputs and increase production. Expand systematics of arthropods, fungi, and other biological collections' infrastructure.

Performance Measure 4.2.5: Provide environmentally sound fundamental and applied scientific information and technologies to action agencies, producers, exporters, and importers of commercially important plant and animal products in support of exclusion, early detection, and eradication of quarantine pests and pathogens that can impede foreign trade.

Target: Improved knowledge and understanding of quarantine pest and pathogen biology and epidemiology, leading to 30 new technologies implemented by industry, APHIS, or other action agencies to mitigate risk of pests and pathogens resulting in expanded export markets while protecting the safety and security of American agriculture.

PATENTS ISSUED TO ARS AND LICENSES NEGOTIATED WITH INDUSTRY 2007-2012:

ARS scientists filed eight patent applications with the U.S. Patent and Trademark Office, Washington, D.C., in both 2012 and 2013, all of which are pending approval. For the years 2007-2011, ARS scientists filed a total of 33 patent applications. Those that have been granted patents are listed below.

2013

- *Apparatus for packaging arthropods infected with entomopathogenic nematodes*; Juan Morales Ramos, W. Tedders, Carl Dean, David Shapiro Ilan, and Maria Rojas. U.S. Patent and Trademark Office, Patent Number 8,505,236, August 2013.
- *Genes encoding fatty acid desaturases from Sorghum bicolor*; Z. Pan, A.M. Rimando, and S.R. Baerson. U.S. Patent and Trademark Office, Patent Number 8,383,890, February 2013.
- *Novel cadherin receptor peptide for potentiating Bt biopesticides*; Brenda Oppert, Juan Jurat-Fuentes, Jeffrey Fabrick, and Cris Oppert. U.S. Patent and Trademark Office, Patent Number 8,354,371, January 2013.

2012

- *Methods for controlling weeds including kudzu*; W.T. Molin and M.E. Lyn. U.S. Patent and Trademark Office, Patent Number 8,338,333, December 2012.
- *System and Method for Production of Predatory Mites*; Juan Morales-Ramos, Maria Rojas, and D. Chan. U.S. Patent and Trademark Office, Patent Number 8,327,797 B1, December 2012.
- *Ascarosides as nematode sex pheromones*; Peter Teal, Hans Alborn, Paul Sternberg, Jagan Srinivasan, Fatma Kaplan, Ramazan Ajredini, Cherian Zacahriah, Arthur Edison, and Frank Schroeder. U.S. Patent and Trademark Office, Patent Number 8,318,146, November 2012.
- *Terrestrial arthropod trap*; Peter Teal, Adrian Duehl, Lee Cohnstaedt, and Richard Arbogast. U.S. Patent and Trademark Office, Patent Number 8,276,314, October 2012.
- *Compositions of keratin hydrolysates and microbes for pest control applications*; C.A. Dunlap, M.A. Jackson, and M.S. Wright. U.S. Patent and Trademark Office, Patent Number 8,263,526 B2, September 2012.
- *Indian meal moth attractant*; Peter Teal and Don Silhacek. U.S. Patent and Trademark Office, Patent Number 8,092,789, January 2012.

2011

- *Compositions and methods to attract the Brown Marmorated Stink Bug, Halyomorpha halys*; A. Khimian, A. Zhang, T. Leskey, J. Aldrich, and D. Weber. U.S. Patent and Trademark Office, Provisional Patent D.N. 0154-11, December 2011.
- *Attractants and repellents for the tropical root weevil Diaprepes abbreviatus*; J.C. Dickens, F. Otalora-Luna, J.A. Hammock, S.L. Lapointe, and R.T. Alessandro. U.S. Patent and Trademark Office, Patent Number 8,066,979 B1, November 2011.
- *Attractant pheromone for the male pink hibiscus mealybug, Maconellicoccus hirsutus (Green) (Homoptera: Pseudococcidae)*; A. Zhang and J.E. Oliver. U.S. Patent and Trademark Office, Patent Number 8,062,651 B1, November 2011.
- *Solenopsis invicta viruses*; Steven Valles, Roberto Pereira, Wayne Hunter, David Oi, Phat Dang, David Williams, and Charles Strong. U.S. Patent and Trademark Office, Patent Number 8,034,333, October 2011.

- *Automated Insect Separation System*; Juan Morales-Ramos, Maria Rojas, David Shapiro Ilan, and W. Tedders. U.S. Patent and Trademark Office, Patent Number 8,025,027, September 2011
- *Female sex pheromone of the dogwood borer (DWB), Synanthedon scitula, and attraction inhibitor (antagonist)*; A. Zhang, T. Leskey, and C. Bergh. U.S. Patent and Trademark Office, Patent Number 7,943,159 B1, May 2011. **This technology has been licensed to an industry partner.**

2010

- *O-methyltransferase gene from sorghum. Cloning, expression, transformation and characterization*; S.R. Baerson, A.M. Rimando, F.E. Dayan, Z. Pan, and J.J. Polashock. U.S. Patent and Trademark Office, Patent Number 7,732,666, June 2010.
- *System for gene targeting and producing stable genomic transgene insertions*; C. Horn, and A.M. Handler. U.S. Patent and Trademark Office, Patent Number 7,700,356, April 2010.
- *Navel Orangeworm Pheromone Composition*; L.P.S. Kuenen, W.S. Leal, J.G. Millar, D.J. Pesak, A.L. Parra-Pedrazzoli, and F.G. Zalom. U.S. Patent and Trademark Office, Patent Number 7,655,253 B2, February 2010.

2008

- *Use of Paecilomyces spp. as pathogenic agents against subterranean termites*; M.S. Wright, W.J. Connick Jr., and M.A. Jackson., U.S. Patent and Trademark Office, Patent Number 7,390,480 B2, June 2008.

2007

- *Chromobacterium subtsugae sp. nov. and use for control of insect pests*; P.A.W. Martin, A. Shropshire, D. Gundersen-Rindal, and M.B. Blackburn. U.S. Patent and Trademark Office, Patent Number 7,244,607, July 2007. This technology has been licensed to an industry partner.

In addition, ARS has licensed the following patent application technologies to industry partners during the years 2007-2012.

- *Insect bait station method and apparatus*; R.R. Heath, P. Rendón, and N.D. Epsky. U.S. Patent and Trademark Office, Application Number 13/397,799, 2012.
- *Composition of entomopathogenic fungus and method of production and application for insect control*; Mark Jackson and Stefan Jaronski. U.S. Patent and Trademark Office, Application Number 12/909,943, 2011.
- *Identification and synthesis of a male-produced pheromone for the Neotropical root weevil Diaprepes abbreviatus (Coleoptera: Curculionidae)*; Stephen Lapointe, Ashot Khrimian, Joseph Dickens, and Peter Teal. U.S. Patent and Trademark Office, Application Number 13/745,509, 2010.
- *Method for encapsulation of microparticles*; Xixuan In and Dan Custis. U.S. Patent and Trademark Office, Application Number 12/797,087, 2009.

EXTERNAL AWARDS:

Peer-reviewed research grants and stakeholder awards are a useful indicator of the quality and value of the NP 304 program. From 2007 to 2012, NP 304 National Program scientists were awarded 588 grants and awards that complemented and enhanced the objectives of the NP 304 Action Plan. As you can see in the table below, the largest portion of the external funding sources were from industry (34 percent) – evidence that the research is valued by stakeholders. Industry grants were typically non-competitively awarded, usually for “upstream,” long-term research partnerships that industry was not

motivated to fund entirely on their own. State and local grants were the second largest number, demonstrating the region’s vested interest in the success of these projects. University grants were the third largest number, and usually involved cooperative research projects jointly conducted with university partners. ARS scientists were also successful in competing outright for grants from other Federal sources (133 in all).

External Grant Sources of Funding for National Program 304 Projects 2007-2012

UNIVERSITY	GOVERNMENT						INTERNATIONAL	INDUSTRY	MISC
	APHIS	FAS	FS	NIFA	OTHER FEDERAL	STATE/ LOCAL			
105	52	11	9	18	43	113	31	199	7

PLANNING AND COORDINATION – SELECTED NP 304 WORKSHOPS AND STAKEHOLDER GATHERINGS:

- National Invasive Weeds Awareness Week, North American Invasive Species Management Association (NAISMA), Washington, D.C.; February 25-March 2, 2007.
- Emerald ash borer/Asian long-horned beetle Workshop, Pittsburgh, PA; October 23-24, 2007.
- Pierce’s Disease Workshop, San Diego, CA; December 12-14, 2007.
- National Invasive Weeds Awareness Week, NAISMA, Washington, D.C.; February 24-29, 2008.
- ARS NP 304 Customer and Stakeholder Workshop, Miami, FL; May 21, 2008.
- Citrus Greening Workshop, Orlando, FL; December 1-5, 2008.
- National Invasive Weeds Awareness Week, NAISMA, Washington, D.C.; February 22-27, 2009.
- First National Agricultural Pollinator Forum, Native Pollinators in Agriculture Work Group, Crystal City, VA; February 24-25, 2009.
- ARS Biocontrol Customer/Stakeholder Workshop, Portland, OR; March 21-26, 2009.
- ARS National Grape and Wine Initiative Stakeholder Workshop, Beltsville, MD; April 27-28, 2009.
- Emerald Ash Borer Workshop, Pittsburgh, PA; October 20-21, 2009.
- Annual International Conference of the North American Pollinator Protection Campaign, Washington D.C.; December 9-11, 2009.
- National Invasive Species Awareness Week, Center for Invasive Species and Ecosystem Health, University of Georgia, Washington, D.C.; January 10-14, 2010.
- American Dry Peas and Lentils Workshop, Washington D.C.; March 29-31, 2010.
- Brown Marmorated Stink Bug Workshop, Shepherdstown, WV; June 15-16, 2010.
- Citrus Greening Workshop, Denver, CO; June 16-18, 2010.
- Pollinator Workshop, University Park, PA (Penn State); July 24-28, 2010.
- Arthropod Biocontrol Workshop, Amherst, MA; October 3-7, 2010.
- Pierce’s Disease Workshop, San Diego, CA; December 15-17, 2010.
- National Invasive Species Awareness Week, Center for Invasive Species and Ecosystem Health, University of Georgia, Washington D.C.; February 28-March 4, 2011.
- ARS Arthropod Genomics (i5K) Symposium and Stakeholder Workshop, Kansas City, MO; June 9-12, 2011.
- Citrus Greening Research Forum and Workshop, Denver, CO; October 4-6, 2011.
- ARS i5k-Arthropod Genomics Symposium & Stakeholder Workshop, Kansas City, MO; May 30-June 3, 2012.
- Colony Collapse Disorder, Crop Life America, Washington, D.C.; August 2, 2012.
- Citrus Greening Workshop, Fort Collins, CO; August 27-30, 2012.
- Colony Collapse Disorder and Bee Health Workshop, Washington, D.C.; October 15-17, 2012.
- Annual International Conference of the North American Pollinator Protection Campaign, Arlington, VA; October 17-19, 2012.

APPENDIX 4

National Program 304 – Crop Protection and Quarantine

ACCOMPLISHMENT REPORT 2007 – 2012

Research Accomplishments in Brief

Component	Problem Statement	Pages	Accomplishments
COMPONENT I: Systematics and Identification	PROBLEM STATEMENT IA: <i>Insects and Mites</i>. There is a need to examine and understand the genetic relationships among known arthropod species to provide a means to predict the potential pest status or beneficial control possibilities of other, related species.	12 – 19	<ul style="list-style-type: none"> • Hidden Neotropical diversity. • First molecular phylogeny of the family Tortricidae (leaf-roller moths). • Manual of the flies (Diptera) of Central America. • Identification tools assist in the early detection and exclusion of fruit fly pests. • Novel tools help to identify potential invasive longhorned woodboring beetles from Hispaniola. • New tools developed for the identification of the beetle genus <i>Diabrotica</i>. • Thirty-four new insect species described in Argentina. • New hope for endangered cycad forests and urban plantings of king sago palms. • New potential biological control agent against Brazilian peppertree leads to discovery of five additional new species. • Molecular taxonomic research supports use of dung beetle as a biological control agent. • Invasive vine mealybug in California originated in the Middle East. • Systematic study of the tomato fruit borer for quarantine purposes. • Methods for reliably separating adult apple maggot and snowberry maggot flies identified.

Component	Problem Statement	Pages	Accomplishments
COMPONENT I: Systematics and Identification	PROBLEM STATEMENT IB: Weeds. Information is needed on the proper identification of weeds, the evolutionary relationships of weeds to other plant species, and hybridization/introgression involving weed species, as well as the population structure of weed species and weed genotypes.	20 - 22	<ul style="list-style-type: none"> • Scholarly reviews of molecular methods for weed biological control. • Distinguishing characteristics of southeastern prickly nightshades. • Population genetics of Canada thistle. • Major plant invasion in the United States is actually a hybrid species.
COMPONENT I: Systematics and Identification	PROBLEM STATEMENT IC: Microbials. Rapid diagnostic tests designed to differentiate species and strains of pathogens need to be developed. New species and strains of agriculturally important microorganisms must be discovered, described, and accessed as potential biological control agents.	22 - 25	<ul style="list-style-type: none"> • Culture collection a globally essential resource for research on fungi from invertebrates. • Integration of molecular taxonomy and biological control. • Phylogenetics of entomopathogenic fungi. • Practical results from ARS worldwide collection of diverse <i>Bacillus thuringiensis</i> isolates. • Potential biopesticides against the coffee berry borer.
COMPONENT II: Protection of Agricultural and Horticultural Crops	PROBLEM STATEMENT IIA: Biology and Ecology of Pests and Natural Enemies. A thorough understanding of the biology and ecology of native and exotic arthropod and weed pests and the natural enemies (biological control agents) that may keep them in check is essential for the subsequent development of cost-effective and environmentally-safe management and control strategies of these pests.	27 - 33	<p>(Weeds)</p> <ul style="list-style-type: none"> • Genomics approaches help identify potential targets for manipulation of plant growth and development in perennial weeds. • Gene regulates seed dormancy and red grain color in weedy rice. • Mechanisms of weed-induced yield losses identified. • Transgenic modification of synthesis of the allelochemical sorgoleone in sorghum. • Insights into molecular interactions of regulatory protein and phytotoxins. • Technology solving herbicide sensitivity in sweet corn. • EPSPS gene amplification a key resistance mechanism. • First report of a target-site mutation in a glyphosate-resistant dicot weed. • Restoration using annual cover crops does not inhibit establishment of perennials.

Component	Problem Statement	Pages	Accomplishments
<p>COMPONENT II: Protection of Agricultural and Horticultural Crops</p>	<p>PROBLEM STATEMENT IIA: <i>Biology and Ecology of Pests and Natural Enemies.</i> A thorough understanding of the biology and ecology of native and exotic arthropod and weed pests and the natural enemies (biological control agents) that may keep them in check is essential for the subsequent development of cost-effective and environmentally-safe management and control strategies of these pests.</p>	<p>33 - 48</p>	<p>(Insects)</p> <ul style="list-style-type: none"> • Whitefly-host plant-virus relationships in sweet potato. • Improved methods for molecular analysis of arthropod predator-prey interactions. • Identification of functional aquaporins in guts of sucking insect pests. • New markers, genomic insights, host prediction information, and landscape-level dispersal and population dynamics models for Western tarnished plant bug. • Identification of pheromone receptors in Lepidoptera. • Influence of dietary trace metals on insect performance. • Fall armyworm as a model system to study effect of climate change on long-distance migration. • Chemical concentration learning in a parasitic wasp. • Crop and non-crop colonization of stink bug pests in farmscapes. • Induction of novel defense compounds in corn by European corn borer and pathogens. • A new class of insect compounds may elicit a defensive response in corn. • Discovery and inhibition of biochemical signaling in insect immunity. • Disrupting insect diapause to control pest insects. • Understanding Bt resistance in pink bollworm. • Genetic markers for studying insect dispersal and Bt resistance. • Host utilization patterns enhance risk assessments of Bt resistance. • Sequencing the western corn rootworm genome. • Development of western corn rootworm colonies with resistance to Bt-corn. • Potent new aphicides based on novel mode of action.

Component	Problem Statement	Pages	Accomplishments
<p>COMPONENT II: Protection of Agricultural and Horticultural Crops</p>	<p>PROBLEM STATEMENT IIB: Control. New and improved biological and cultural control and host plant resistance methods that are effective and environmentally sound need to be developed to reduce our reliance on synthetic pesticides. In addition, there is a need to evaluate new insecticides as they become available and determine optimum application rates.</p>	<p>48 - 53</p>	<p>(Weeds)</p> <ul style="list-style-type: none"> • Population-based weed management reduces need for herbicides. • Organic rotational no-till soybean production requires a multi-tactical weed management approach. • Better timing of fertilizer applications reduces need for herbicides in rice fields. • Discovering phytotoxins with new modes-of-action for weed management. • Prediction and mitigation of bioenergy crop invasion. • Manuka oil, a green weed management product with pre-emergence systemic herbicidal activity. • A fungal bioherbicide to control herbicide-resistant weeds. • Synergistic interaction of herbicides for kudzu control.
<p>COMPONENT II: Protection of Agricultural and Horticultural Crops</p>	<p>PROBLEM STATEMENT IIB: Control. New and improved biological and cultural control and host plant resistance methods that are effective and environmentally sound need to be developed to reduce our reliance on synthetic pesticides. In addition, there is a need to evaluate new insecticides as they become available and determine optimum application rates.</p>	<p>53 - 62</p>	<p>(Insects)</p> <ul style="list-style-type: none"> • Attractants for brown marmorated stink bug identified. • Pink hibiscus mealybug pheromone licensed. • Super lure for important insect predators and egg parasitoids developed for commercial production. • Dogwood borer pheromone discovered. • Chemical lure for trapping spotted wing drosophila. • Practical uses of pear ester to improve management of codling moth. • Pear psylla pheromone and lure. • Discovery and use of pheromones for control of major citrus pests. • Identification of female sex pheromone of the navel orangeworm. • Mating disruption for control of navel orangeworm. • New fruit fly dispenser deployed in California. • Methods to increase shelf life of fungus-based biopesticides developed. • Methodologies and strategies for control of ambrosia beetles with entomopathogenic fungi. • New biological control agents established against tarnished plant bug. • New methods to commercially produce fungi that kill insect pests and ticks. • New biocompatible foams deliver living microbial agents for insect pest control.

Component	Problem Statement	Pages	Accomplishments
<p>COMPONENT II: Protection of Agricultural and Horticultural Crops</p>	<p>PROBLEM STATEMENT IIB: Control. New and improved biological and cultural control and host plant resistance methods that are effective and environmentally sound need to be developed to reduce our reliance on synthetic pesticides. In addition, there is a need to evaluate new insecticides as they become available and determine optimum application rates.</p>	<p>63 - 79</p>	<p>(Insects – continued)</p> <ul style="list-style-type: none"> • Black pecan aphid control using a plant bioregulator. • New species of biological control agents approved for field release against soybean aphid. • Integrated management of disease-vectoring thrips. • Novel application of environmentally friendly nematodes controls key peach pests. • Mass production methods of an environmentally friendly bio-pesticide. • Sweetpotato germplasm identified with multiple pest resistance. • Novel bacterium with activity against insects commercialized. • Baculoviruses with improved genetic characteristics selected for biocontrol. • Exploiting host-finding and flight behavior of ambrosia beetles in ornamental nurseries. • Managing exotic scarabs and root weevils with botanical extracts and reduced-risk insecticides. • Integrated pest management of the sweetpotato whitefly. • Stage- and age-dependent injury to cotton by the western tarnished plant bug. • Spotted wing drosophila management. • Black vine weevil management. • Suppression of tarnished plant bug with a Mississippi native strain of <i>Beauveria bassiana</i>. • IPM programs in sweetpotato builds opportunities for small-scale farms in the Mississippi Delta. • Wild rose habitat enhances biological control of apple leafrollers. • IPM tactics for the Asian citrus psyllid. • Development of banker plant systems for biological control of greenhouse pests. • Genetic markers developed for rapid optimization of insect artificial diets. • Complex molecular interactions between aphid salivary proteins and their plant hosts. • How new biotypes of cereal aphids evolve and overcome aphid resistance genes in wheat. • Decision support systems to efficiently manage key insect pests of wheat and sorghum. • Multispectral remote sensing for area-wide monitoring of insect pests in wheat. • New species of biological control agents against olive fruit fly discovered, released, and established.

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<p>COMPONENT II: Protection of Agricultural and Horticultural Crops</p>	<p>PROBLEM STATEMENT IIB: Control. New and improved biological and cultural control and host plant resistance methods that are effective and environmentally sound need to be developed to reduce our reliance on synthetic pesticides. In addition, there is a need to evaluate new insecticides as they become available and determine optimum application rates.</p>	<p>80 - 90</p>	<p>(Insects – continued)</p> <ul style="list-style-type: none"> • Nutritional deficiencies motivate migratory activity in Mormon crickets. • Breeding solid stem wheat for resistance to sawfly generally disrupts biological control. • Managing the insect vector of zebra chip disease of potato. • Area-wide control of fruit flies in Hawaii. • Bacterial and fungal pathogens in stink bugs associated with boll rot of cotton. • Mass production of biological control agents. • Area-wide control of European corn borer. • Management of Bt crops. • Managing insecticide-resistant tarnished plant bug. • Benchmarks for insect resistance to Bt-cotton and Bt-corn. • Federal Section 18 Crisis Exemptions: <ul style="list-style-type: none"> - Imidicloprid to control West Indian canefly. - Pesticides to control brown marmorated stink bug. • IR-4 Projects: <ul style="list-style-type: none"> - Data to support the registration of pesticides for minor use and specialty food crops. - Expanding EPA crop grouping scheme to assist pest control for minor crops.
<p>COMPONENT III: Protection of Natural Ecosystems</p>	<p>PROBLEM STATEMENT IIIA: Insects. Safe, effective, biologically-based management strategies and controls are needed to mitigate threats of invasive pest insects.</p>	<p>91 - 95</p>	<ul style="list-style-type: none"> • Successful development of classical biological control to manage the emerald ash borer. • New chemical attractants for the detection, monitoring, and control of the emerald ash borer. • Improved detection and cultural management of emerald ash borer infestations. • New tools for early detection of Asian longhorned beetle. • Advanced polydnavirus-based strategies for disruption of caterpillar pest immune systems. • Development of area-wide management technology against the invasive cactus moth.

Component	Problem Statement	Pages	Accomplishments
<p>COMPONENT III: Protection of Natural Ecosystems</p>	<p>PROBLEM STATEMENT IIIB: <i>Terrestrial, Aquatic, and Wetland Weeds.</i> Environmentally sound methods are needed to control, manage, or eradicate invasive terrestrial and aquatic weeds.</p>	<p>96 - 113</p>	<ul style="list-style-type: none"> • Biological control of the paperbark tree in Florida. • Biological control of Old World climbing fern. • An instrumented watershed approach for sustainable grazing and sage grouse habitat. • Invasive spread of swallow-worts revealed. • Discovery, field release, and establishment of new natural enemies of giant reed in Texas. • Invasive guineagrass in the United States is of hybrid origin. • Discovery of genetic diversity in flea beetles used in leafy spurge biocontrol. • Production of the bioherbicide <i>Mycleptodiscus terrestris</i> for managing aquatic weed infestations. • Integrated management of invasive <i>Ludwigia hexapetala</i>. • Perennial pepperweed control for endangered species recovery. • Saltcedar biological control developed along the Rio Grande and other Texas rivers. • Elucidating the ecosystem effects of insect biological control. • New biological agents and strategies for control of waterway weeds. • Interactions of native parasitoids and insect biological control agents selected for weed control. • Molecular genetics used to assist evaluation of host plant specificity for biological control. • Managing phosphorus to control algal blooms in rice fields. • Biological control combined with burning or mowing for management of Scotch broom. • New approach to improve safety assessments of weed biological control pathogens. • Ecosystem-based approach to invasive annual grass management. • Biological control of air potato. • Chinese tallow biological control. • Biological control of the tropical soda apple.

Component	Problem Statement	Pages	Accomplishments
<p>COMPONENT IV: Protection of Post-Harvest Commodities and Quarantine</p>	<p>PROBLEM STATEMENT IVA: <i>Insect Pests of Fresh Commodities.</i> There is a critical need for new and sensitive tools that effectively detect infestations of exotic pest insects in fresh commodities. Environmentally sound, and economically feasible systems that suppress or eradicate populations of invasive species are needed, which will require information on the basic biology and ecology of these pests. Finally, the post-harvest management of diseases that cause spoilage and reduce shelf life needs to be addressed.</p>	<p>115 - 119</p>	<ul style="list-style-type: none"> • Systems for gene targeting and producing stable genomic transgene insertions. • Transgenic tephritid fruit fly strains for the sterile insect technique. • Diet and juvenile hormone interactions in the fruit fly SIT. • Acoustic detection of hidden pest insects in trees and reductions in instrument costs. • Bait station for control of tephritid fruit flies. • Identification of attractants for detection of the redbay ambrosia beetle.
<p>COMPONENT IV: Protection of Post-Harvest Commodities and Quarantine</p>	<p>PROBLEM STATEMENT IVB: <i>Insect Pests of Durable (Stored and Processed) Commodities.</i> Sensitive methods are needed for detecting insects in grain before the grain is placed into storage and in marketing channels. Also, there is an urgent need to develop management and control programs for insect pests of these commodities that are practical, cost-effective, and environmentally sound.</p>	<p>120 - 124</p>	<ul style="list-style-type: none"> • Methyl bromide alternative for insect control for export of table grapes and sweet cherries. • Control of Indianmeal moth with mating disruption. • Development of radio frequency treatments against the cowpea weevil. • <i>Tribolium</i> genome sequenced. • Selfish gene discovered. • New genomic tools developed.