

Gall Midge *Orseolia javanica* (Diptera: Cecidomyiidae), a Candidate Biological Control Agent of Cogongrass

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Acknowledgements

- Millie Burrell
- Patricia Kline
- Purnama Hidayat

**FWC, Bureau of Invasive
Plant Management**



Cogon grass
Imperata cylindrica
Photo by Ann Murray
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Outline

- Background on Cogongrass
- Potential for Biological Control
- Research on *Orseolia javanica*
- Cogongrass IPM Model
- Questions and Comments

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Cogongrass

- *Imperata cylindrica* (L.) Raeuschel (Poaceae)
- Federal Listed Noxious Weed
- Established in southeastern US as forage grass
- Invasive in Alabama, Mississippi, & Florida



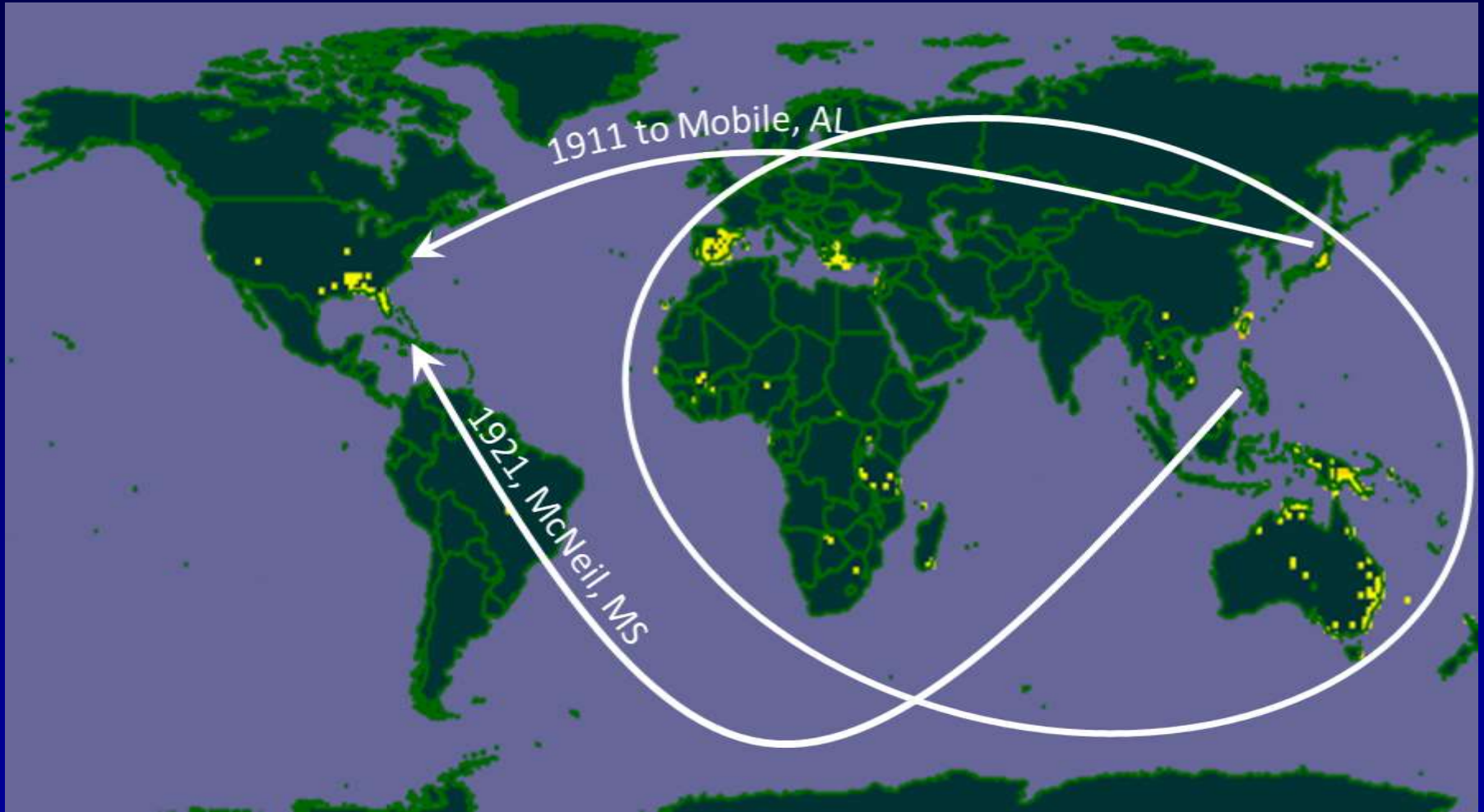
Cogongrass Impacts

- Displaces native/desirable vegetation
- Evidence of allelopathy
- Increases frequency and severity of fires
- Perennial; 4 clonal types
- Rhizotomous (60% of biomass in rhizome)
- C₄ photosynthesis



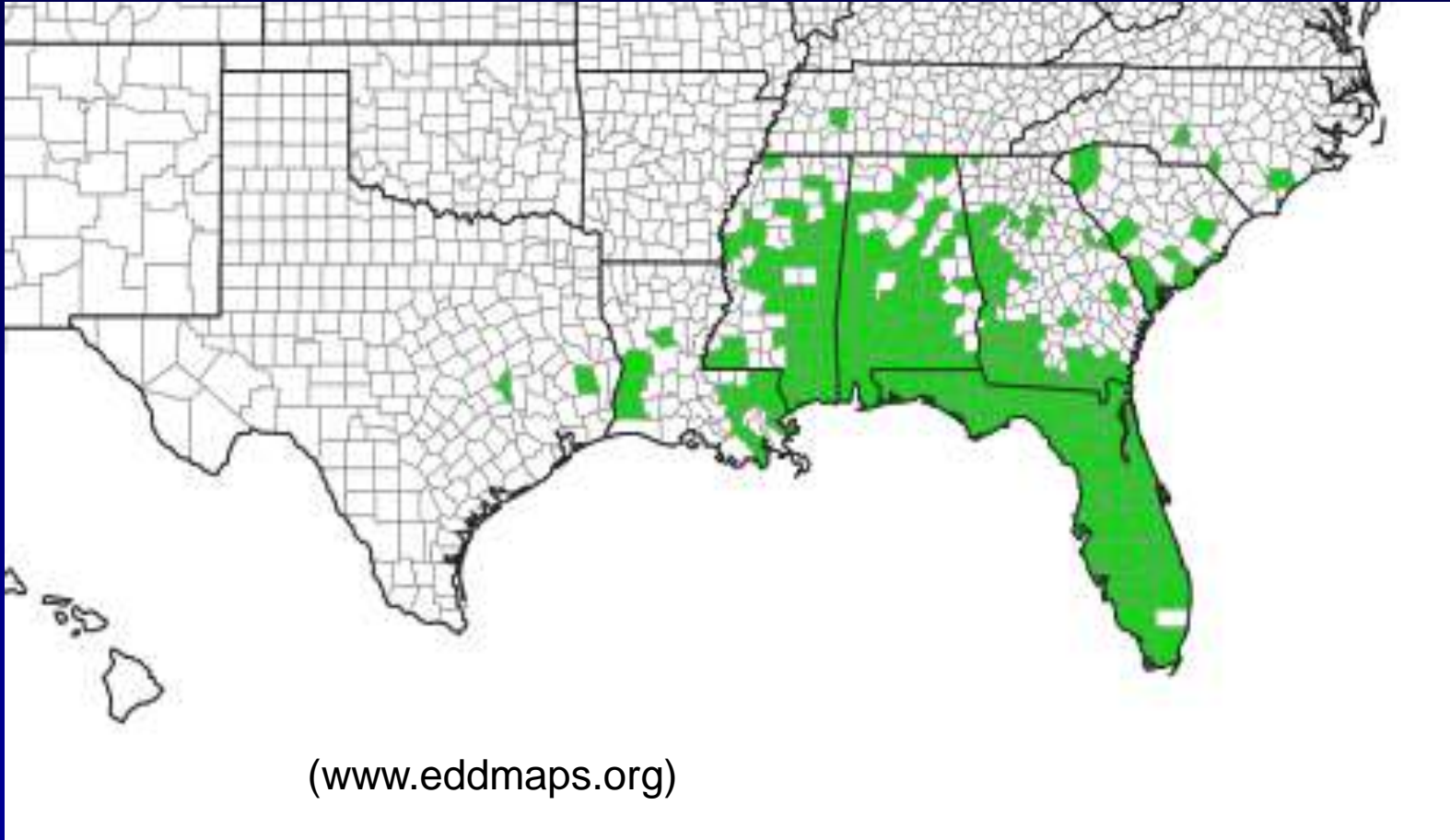
<http://bugwood.blogspot.com/2013/05/cogongrass-in-georgia-spring-2013-update.html>

Worldwide Distribution



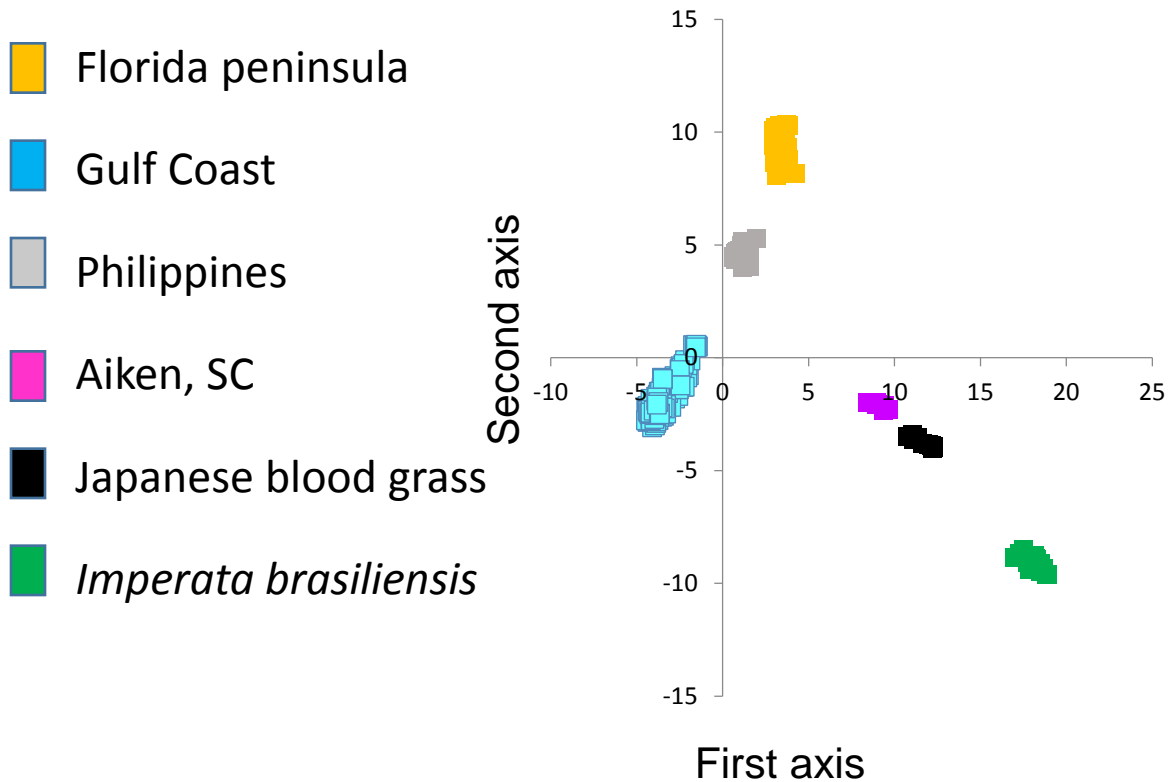
World distribution of *Imperata cylindrica* based on the Global Biodiversity Information Facility (www.gbif.org).

US Distribution



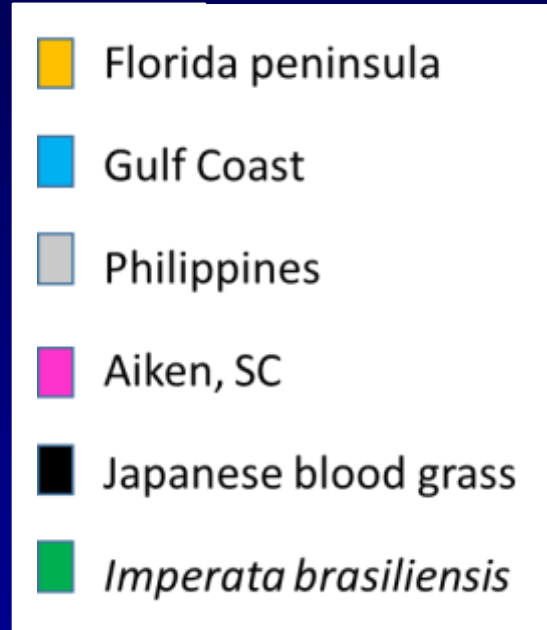
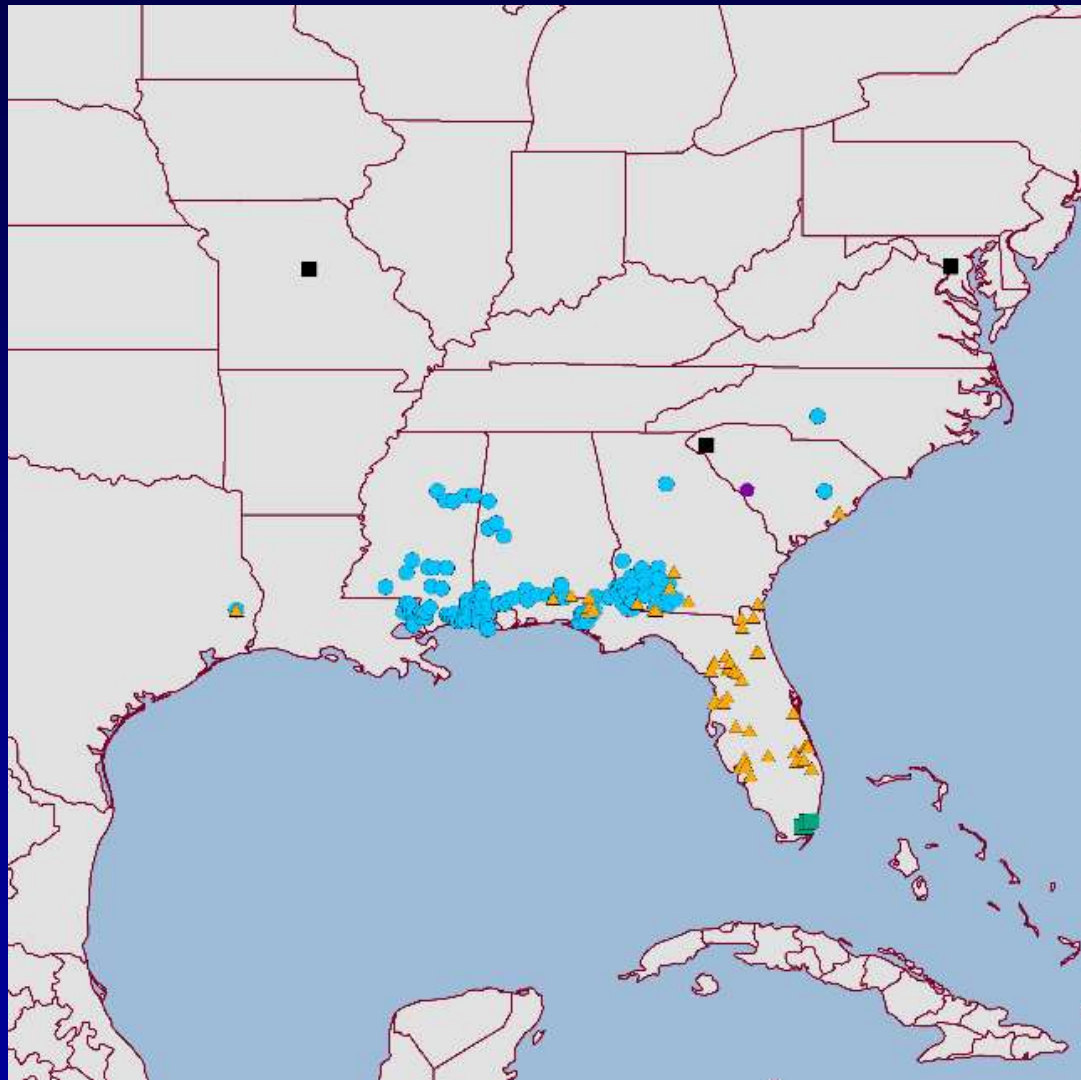
(www.eddmaps.org)

Genetic Diversity of US Cogongrass



Burrell, M., A. E. Pepper, G. Hodnett, J. A. Goolsby, W. A. Overholt, A. E. Racelis, R. Diaz and P. E. Klein. 2015. Exploring origins, invasion history and genetic diversity of *Imperata cylindrica* (L.) P. Beauv. (Cogongrass) in the United States using genotyping by sequencing. *Molecular Ecology*. DOI: 10.1111/mec.13167.

US Distribution by Genotype



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Grasses as BioControl Targets

- Previously thought to have few specialized herbivores due to:
 - Simple architecture
 - Scarcity of secondary metabolites
 - Feeding deterrents (e.g. silica)
- Fear of non-target effects on crop grasses
 - 50% of human caloric intake from cereals (e.g., wheat, rice, corn, millet, etc.)

Natural Enemies of Grasses

GRASS	INSECT	REFERENCE
<i>Arundo donax</i>	<i>Tetramesa romana</i> (Eurytomidae)	Goolsby and Moran, 2009
“ “	<i>Rhizaspidiotus donacis</i> (Diaspididae)	Goolsby et al. 2009
<i>Spartina alterniflora</i>	<i>Prokelisia marginata</i> (Delphacidae)	Grevstad et al. 2003
<i>Phragmites australis</i>	66 monophagous species outside of North America	Tewksbury et al. 2002
<i>Hymenachne amplexicaulis</i>	<i>Ischnodemus variegatus</i> (Blissidae)	Diaz et al. 2010
<i>Imperata cylindrica</i>	<i>Acrapex</i> spp. (Noctuidae)	Le Ru et al. 2014
“ “	<i>Orseolia javanica</i> (Cecidomyiidae)	Mangoendihardjo (1980)

Why is Cogongrass Invasive?

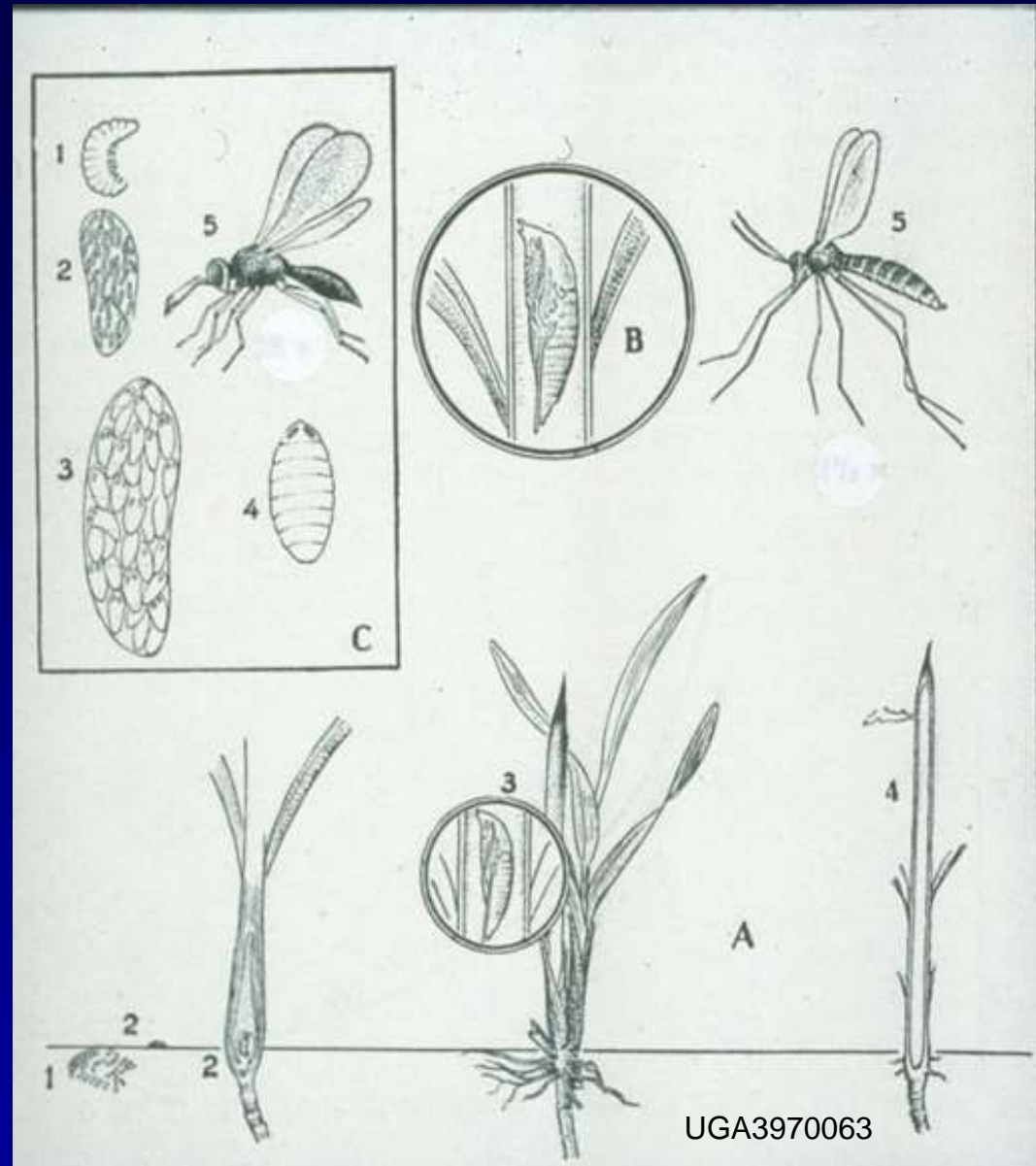
- Anecdotal evidence for supporting ‘Enemy Release’ hypothesis (Van Loan et al. 2002)
 - To date, biological control effort minimal
 - Preliminary testing of gall midge *Orseolia javanica* (Mangoendihardjo 1980)
 - Limited surveys in East Africa- Suspected center of origin for cogongrass (Evans 1991)
 - Discovery of potentially host specific natural enemies in Africa, Japan & Philippines (Overholt et al. 2016)

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O. javanica Life Cycle

- Adults crepuscular
- Females deposit 540 eggs on soil
- Neonates bore into leaf sheaths near apical meristem
- Induce formation of pink / white linear galls 2 days before adult emergence
- Development (egg-adult): 35 days



Mangoendihardjo (1980), Soerjani (1970)

O. javanica Host Range

Test Plant	Gall Formation
Cultivated Rice, <i>Oryza sativa</i>	-
Wild Rice, <i>Oryza</i> sp. A	-
Wild Rice, <i>Oryza</i> sp. B	-
Corn, <i>Zea mays</i>	-
Sorghum, <i>Sorghum bicolor</i>	-
Native Grass, <i>Paspalum conjugatum</i>	-
Native Grass, <i>Penisetum polystachyon</i>	-
Cogongrass, <i>Imperata cylindrica</i>	+

Mangoendihardjo (1980)

Bogor Agricultural University West Java, Indonesia



Project Collaborators

Bogor University



Cianjur District

West Java, Indonesia



Orseolia javanica (Diptera: Cecidomyiidae)



Life stages of *Orseolia javanica*. 4th instar larva (far left), prepupa (left), pupa (center), adult male (right, top), female (right, bottom) (Photo credit: Purnama Hidayat).

Galled Stems of Cogongrass



Figure 1. Galled stems of *I. cylindrica* induced by *O. javanica* in Cianjur, West Java, Indonesia (Buhl and Hidayat 2016).

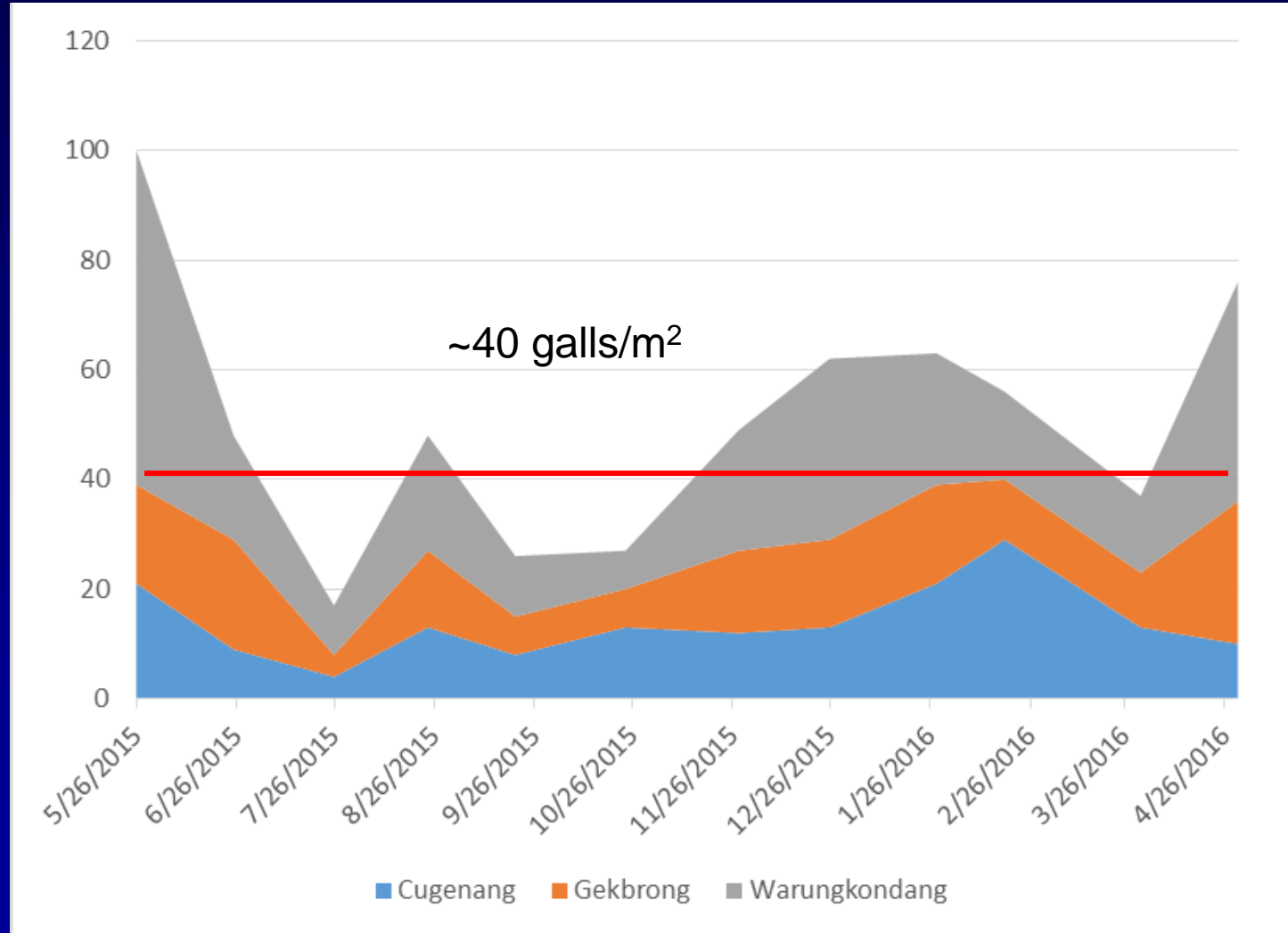
Galls w/ Emergence Holes



Photo credits: Ragil Irianto, Ministry of Forestry, Bogor, Indonesia

Orseolia Galls / m²

West Java, Indonesia



Parasitoid of *O. javanica*



Platygaster orseoliae Buhl
Hymenoptera: Platygasteridae

mtCO1 DNA Sequences of *Orseolia javanica* & *O. oryzae*

No	Spesies (No. Akses Genbank)	Homology (%)												
		1	2	3	4	5	6	7	8	9	10			
1	<i>O. javanica</i> Indonesia (Cianjur)	ID												
2	<i>O. oryzae</i> Indonesia (Bogor)	90.0	ID											
3	<i>O. oryzae</i> Indonesia (Cianjur)	90.0	99.5	ID										
4	<i>O. oryzae</i> India (KM888183.1)*	89.8	91.3	91.6	ID									
5	<i>Orseolia</i> sp. Kanada (KM862726.1)*	81.7	81.8	82.0	82.5	ID								
6	Cecidomyiidae Kanada (KR432674.1)*	83.2	81.3	81.5	81.2	90.4	ID							
7	Cecidomyiidae Kanada (KM868087.1)*	81.5	82.5	82.7	82.3	91.0	89.9	ID						
8	<i>O. oryzae</i> India (KC506565.1)*	71.8	73.2	73.5	78.0	72.1	70.0	70.8	ID					
9	<i>S. mosellana</i> Kanada (KM991223.1)*	83.4	80.8	81.1	81.9	90.4	91.0	91.3	70.6	ID				
10	<i>F. acarivora</i> Jepang (AB698995.1)*	84.6	84.3	84.6	84.9	88.0	85.7	88.0	73.9	86.6	ID			

*) DNA sequences from GenBank

Project Objectives

Bogor Agricultural University

- Assess performance of *Orseolia javanica* on two Florida cogongrass clones
- Develop laboratory rearing procedure for *O. javanica*
- Conduct field and laboratory impact studies

Project Objectives (cont'd)

University of Florida

- Establish laboratory colony of *O. javanica*
- Perform molecular characterization of *O. javanica* populations (Initiated)
- Demonstrate *O. javanica* is cogongrass specialist
 - Host range tests in Florida

Laboratory Rearing



Cages for rearing *Orseolia javanica* and conducting host range tests, BCRCL, Ft. Pierce, FL (Photo credit: Patricia Prade).

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Conclusions

- Cogongrass control difficult w/ only 1 tool
- Risk to native grasses from introduced cogongrass biocontrol agent(s) should be low
 - Only one native congener (*Imperata brevifolia*)
 - Gall midge *O. javanica* cogongrass specialist
- Incorporating biological control agents w/ conventional physical & chemical tools provides more complete & sustainable control of cogongrass

Thanx !



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