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Florida's Established Arthropod Weed Biological Control Agents and Their Targets[1]

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Nonnative invasive weeds are considered to be one of the most important threats to biodiversity, second only to habitat destruction (Randall 1996, Pimm and Gilpin 1989). They interfere with crop and pasture production in agroecosystems, or alter the composition, structure and function of natural ecosystems and waterways (Pimentel et al. 2000, 2005). The losses in productivity and associated costs of controlling invasive weeds are staggering. Pimentel et al. (2000, 2005) estimate the total cost of invasive weeds to the US economy is $34 billion annually.

Compared to the rest of the continental United States, Florida is more prone to the introduction, eventual establishment, and subsequent invasion of natural communities by invasive weeds because of its unique geographic and environmental characteristics (Simberloff 1997). South Florida's extensive tropical and aquatic habitats, for example, are conducive to the establishment of nonnative terrestrial and aquatic ornamental plants. The Florida peninsula, which is bounded on three sides by water and the fourth by frost, essentially is a subtropical “island” habitat that predisposes this region to nonnative plant invasions. Florida also is dominated by novel habitats created by intense human disturbance because of its popularity as a vacation destination. During FY 05-06, the state of Florida spent a total of $31.2 million to control aquatic and upland invasive plants on public lands (FWC 2008).

Approximately 900 out of an estimated 25,000 plant species (~ 4%) deliberately introduced into Florida for crop production and horticultural uses have invaded sensitive aquatic and terrestrial natural areas as well as improved pastures (Pimentel et al. 2005). One of the reasons these nonnative plants become invasive is they are introduced into an environment in which they did not evolve and therefore lack the natural enemies that limit their reproduction (Williams 1954). Biological control reunites these natural enemies (usually arthropods) with their host plants to selectively weaken and suppress the invasive weeds.

In Florida, arthropod biological control agents currently are established on seven invasive weeds: alligatorweed (*Alternanthera philoxeroides* (Mart.) Griseb.: Amaranthaceae), Brazilian peppertree (*Schinus terebinthifolius* Raddi: Anacardiaceae),

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hydrilla (*Hydrilla verticillata* (L. f.) Royle: Hydrocharitaceae), melaleuca (*Melaleuca quinquenervia* (Cav.) S.T. Blake: Myrtaceae), tropical soda apple (*Solanum viarum* Dunal: Solanaceae), waterhyacinth (*Eichhornia crassipes* (Mart.) Solms: Pontederiaceae), and waterlettuce (*Pistia stratiotes* L.: Araceae) (Table 1).

Various resources on Florida's weed biological control programs are available to county faculty. Extensive reviews have been published on the arthropods and biological control programs of the aforementioned invasive weeds (Buckingham 1994, Center 1994, Center et al. 2002, Van Driesche et al. 2002). Also, up-to-date information on Florida's weed biological control programs can be found on several Web sites: the aquatic weeds alligatorweed, hydrilla, waterhyacinth, waterlettuce (http://aquat1.ifas.ufl.edu/welcome. html), Brazilian peppertree (http://ipm.ifas.ufl. edu/pdf/BPmanagPlan.pdf , http://pesticide.ifas.ufl. edu/BrazilianPepper/index.shtml), melaleuca (http://tame.ifas.ufl. edu) and tropical soda apple (http://pesticide.ifas.ufl.edu/TropicalSodaApple/ index.shtml , http://ipm.ifas.ufl.edu/natural_areas/ weeds/terrestrial/TSA_Biocontrol/project.htm).

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Table 1. Established arthropod biological control agents of invasive weeds in Florida. For higher classification and authors of scientific names of the natural enemies, see Julien and Griffiths (1998), Cuda et al. (2006, 2007), and Frank and McCoy (2007).

Weed	Agent	Type	Origin	Date[1]
Alligatorweed	*Agasicles hygrophila*	Beetle	Argentina	1964
	Amynothrips andersoni	Thrips	Argentina	1967
	Arcola (= Vogtia) malloi	Moth	Argentina	1971
Brazilian peppertree	*Megastigmus transvaalensis*	Wasp	South Africa	Adventive
Hydrilla	*Hydrellia pakistanae*	Fly	India	1987
	Cricotopus lebetis	Midge	Louisiana	Adventive
Melaleuca	*Oxyops vitiosa*	Weevil	Australia	1997
	Boreioglycaspis melaleucae	Bug	Australia	2002
Tropical Soda Apple	*Gratiana boliviana*	Beetle	South America	2003
Waterhyacinth	*Neochetina bruchi*	Weevil	Argentina	1974
	Neochetina eichhorniae	Weevil	Argentina	1972
	Niphograpta albiguttalis	Moth	Argentina	1977
	Orthogalumna terebrantis	Mite	North & South America	Native
Waterlettuce	*Neohydronomus affnis*	Weevil	Brazil	1987

[1]Date of first release or discovery. Adventive means that the species arrived in Florida from somewhere else by any means. Others were introduced (deliberately).