United States Department Of Agriculture
Agricultural Research Service

Research Project:

Location: **Beneficial Insects Research**

ARS Project: (420353)

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2011 Annual Report

1a.Objectives (from AD-416)

The long-term objective of this project is to reduce the impact of invasive weeds in the Lower Rio Grande Basin (LRGB) and other southwestern watersheds. Over the next 5 years we will focus on the following objectives: Objective 1: Import, culture, and conduct biological studies and host range tests on candidate natural enemies for Arundo donax. Develop mass rearing and mass release methods for permitted agents. Evaluate impacts of biological control agents in the Rio Grande Basin and other watersheds of the Southwestern U.S. Subobjective 1A. Import and evaluate candidate natural enemies of Arundo donax in quarantine for safety and efficacy. Subobjective 1B. Evaluate (1) methods for mass release of biological control agents of Arundo donax and (2) related impacts of introduced natural enemies in the field. Objective 2: Evaluate impacts of tamarisk leaf beetles for biological control of Tamarix spp. saltcedars in the LRGB and in coastal Texas, and develop new agents. Subobjective 2A. Release and evaluate tamarisk leaf beetles (Diorhabda spp.) at sites in the LRGB that contain mainly T. ramosissima and T. chinensis saltcedar, and assess effects on exotic athel trees, Mexican Frankenia species, and native vegetation. Subobjective 2B. Release and evaluate Diorhabda tamarisk beetles for biological control of Tamarix canariensis/T. gallica at coastal sites. Subobjective 2C. Discover and evaluate new agents from the western Mediterranean for biological control of saltcedar. Objective 3: Begin initial foreign exploration and feasibility studies for biological control of guineagrass and elephant ear. Subobjective 3A. Begin initial foreign exploration and feasibility studies for biological control of guineagrass, and determine the distribution and impact of this plant in the LRGB and other watersheds. Subobjective 3B. Begin initial foreign exploration and feasibility studies for biological control of elephant ear, and determine the distribution of this plant in the LRGB and other southwestern watersheds.

1b.Approach (from AD-416)

Giant reed, saltcedar, guineagrass, and elephant ear are invasive, non-native weeds that compete for scarce water resources in arid regions facing critical water shortages for agricultural, municipal, and environmental uses and, in addition, cause many other ecological and economic problems in the Lower Rio Grande Basin (LRGB) of Texas and northern Mexico. The LRGB is the largest watershed in North America, and biological control of these important riparian and terrestrial weeds has not been developed. This project will discover, evaluate, and implement multiple biological control agents to control giant reed along the Rio Grande and throughout the LRGB. Remote sensing and land-based field studies will be used to measure the impact of a biological control program on vegetation change and water use. The project will also evaluate the field efficacy of tamarisk leaf beetles to control saltcedar in south Texas rangelands and coastal grasslands, areas not previously subjected to biological control, as well as evaluate potential non-target effects on related native plants that are relevant to future biological control of saltcedar in Mexico. In addition, the feasibility for biological control of guineagrass, an invasive, fire-promoting weed in LRGB agriculture and rangelands, and of elephant ear, a large, leafy plant that invades the edges of rivers and reservoirs, will be determined by compiling information on the distribution, impact, and uses of these weeds along with preliminary information from the literature and initial explorations for potential biological control agents. This research will produce environmental and economic benefits by conserving water resources associated with giant reed and saltcedar infestations of the LRGB, and by defining new weed targets to achieve further water savings in the future.

3.Progress Report

The arundo scale was released and is now established in Texas for biological control of arundo, a non-native invasive perennial grass that is impacting water resources and national security concerns in the arid Lower Rio Grande Basin and other areas of the southwestern U.S. Research in the scale's native range by collaborators at the European Biological Control Laboratory (EBCL), and Alicante University documented the scale's impact on above- and below-ground growth of A. donax. Large collections of the scale were shipped from Spain and France to U.S. quarantine facilities for isolation into pure cultures. Over 3 million first instar scale 'crawlers' were released on the Rio Grande River near Del Rio, TX, and into mass rearing facilities in Weslaco, TX. The arundo scale feeds on root and stem tissues, complementing the stem galling arundo wasp. More than 400,000 arundo wasps were mass-reared and aerially released in 2010-2011 on the Rio Grande Basin. Greenhouse studies confirmed the impact of arundo scale and wasp on growth of arundo and demonstrated the utility of nitrogen fertilization to increase scale and wasp reproduction for mass rearing. Field plots were established in Del Rio to examine long-term impacts on A. donax. In addition, long-term plots have been established in Amarillo, Austin, Del Rio, Weslaco, and in Cuernavaca, Mexico, to determine the effect of climate on three invasive genotypes of A. donax. Research is continuing on a third candidate agent, the arundo leafminer. The leafminer is capable of defoliating large stands of A. donax and could complement attack by the arundo wasp and scale. The leafminer was reared for three generations in quarantine, and the conditions for colony production were clarified. In collaborative field work with ARS researchers from Kerrville and Edinburg, TX, it was shown that along the Rio Grande River, the cattle fever tick

survives best in stands of arundo as compared to native riverine forests. This is the first demonstrated link between an invasive weed and a veterinary pest. Vegetation surveys at field sites in south Texas determined that the diversity of plants subject to invasion by saltcedar is highest along creeks feeding the Rio Grande. In the Big Bend region, tamarisk beetles released by collaborators to control saltcedar removed all of the foliage from exotic athel trees, which are invasive, but which have some value as shade trees. The trees recovered their foliage within two months. In balance, tamarisk beetles caused transient damage to the athel trees as compared to significant and on-going damage to the target saltcedar. Collaborators at EBCL in France determined that Texas guineagrass was actually a new species and was limited to Kenya and Ethiopia in east Africa. New collaborations were developed for exploration in eastern Africa for natural enemies of Texas guineagrass. A lab study showed that guineagrass seed viability is low but production prolific, demonstrating one mechanism of invasion.

4.Accomplishments

1. Arundo armored scale released for biological control of Arundo donax. Non-native, invasive A. donax is a giant reed grass that has invaded at least 100,000 acres in the arid Lower Rio Grande Basin. It consumes water supplies and reduces access to the international border which is critical for national security. Biological control of this weed is critically needed, because other control methods are not economical or environmentally feasible. In 2011, ARS researchers in Weslaco, Texas, released over 3 million arundo scales on the Rio Grande River, and establishment has been documented at all release sites. This research and the resulting biological control program address the national research priority to protect scarce water resources for agriculture in the context of climate change, which is expected to increase drought length and severity in the Lower Rio Grande Basin. Information on the field biology of the scale is useful for researchers and land managers in other areas where arundo is invasive, especially California and Arizona.

2. Impact of biocontrol on saltcedar and closely related shade tree. Exotic, invasive saltcedar occupies over 500 river-miles along the Rio Grande Basin, degrading natural habitats and impeding ranching and recreational use of the river. Biological control was successfully implemented in 2009-2010 by collaborators using the tamarisk leaf-feeding beetle. However, the beetles removed all of the foliage from athel trees, a close, exotic relative of saltcedar that is itself invasive, but which also has some use as a shade and windbreak tree in Mexico. ARS researchers in Weslaco characterized the damage to athel trees in Big Bend National Park and other sites, and documented full recovery of the foliage on athel trees late in 2010. A freeze killed all of the athel foliage in February 2011. The trees recovered 10-20% of the freeze-damaged foliage in the spring and summer, and did not sustain substantial new damage by tamarisk beetles. Information on the impact of tamarisk biological control on athel is essential to inform binational dialogue with Mexico regarding this biological control program.

Review Publications

Goolsby, J., Mangan, R.L. 2010. Use of Spinosad bait (BF-120) for management of Chaetopsis massyla in shadehouse grown Arundo donax. Southwestern Entomologist. 35(4):573-574.

Cortes, E., Goolsby, J., Moran, P.J., Marcos-Garcia, M.A. 2011. The effect of the armored scale, Rhizaspidiotus donacis (Hemiptera: Diaspididae) on shoot growth of the invasive plant Arundo donax (Arundinoideae). Biocontrol Science and Technology. 21:535-545.

Gowda, P., Goolsby, J., Yang, C., Basu, S., Racelis, A.E., Howell, T.A. 2011. Estimating water use by giant reed along the Rio Grande River using a large aperture scintillometer. Subtropical Plant Science. 63:1-6.

Boughton, A.J., Buckingham, G.R., Bennett, C., Zonneveld, R., Goolsby, J., Pemberton, R.W., Center, T.D. 2011. Laboratory host range of Austromusotima camptozonale (Lepidoptera: Crambidae), a potential biological control agent of Old World climbing fern, Lygodium microphyllum (Lygodiaceae). Biocontrol Science and Technology. 21(6):643-676

Moore, G.W., Watts, D.A., Goolsby, J. 2010. Ecophysiological responses of giant reed (Arundo donax) to herbivory. Journal of Invasive Plant Science and Management. 3:521-529.

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