Field Release of the Arundo Wasp, *Tetramesa romana* (Hymenoptera: Eurytomidae), an Insect for Biological Control of *Arundo donax* (Poaceae), in the Continental United States

Environmental Assessment, April 2009

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I. Purpose and Need for the Proposed Action

Background

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Permit Unit is proposing to issue permits for release of a wasp, *Tetramesa romana* Walker (Hymenoptera: Eurytomidae). The agent would be used by the applicant for the biological control of *Arundo donax* L. (giant reed, carrizo cane) in the continental United States. Before permits are issued for release of *T. romana*, APHIS must analyze the potential impacts of the release of this agent into the continental United States.

This environmental assessment[1] (EA) has been prepared, consistent with USDA, APHIS' National Environmental Policy Act (NEPA) implementing procedures (Title 7 of the Code of Federal Regulations (CFR), part 372). It examines the potential effects on the quality of the human environment that may be associated with the release of *T. romana* to control infestations of *A. donax* within the continental United States. This EA considers the potential effects of the proposed action and its alternatives, including no action.

The applicant's purpose for releasing *T. romana* is to reduce the severity of infestations of *A. donax* in the United States. It is an extremely invasive weed of riparian habitats and irrigation canals of the Rio Grande River Basin and the southwestern United States *A. donax* is native to the Old World from the Iberian Peninsula of Europe to south Asia, including North Africa and the Arabian Peninsula. It has been cultivated in the Old World for thousands of years and has been widely introduced around the world as an ornamental and for its fiber uses. It was introduced into North America in the early 1500s by the Spanish for its fiber uses and quickly became naturalized. It is now found throughout the southern half of the United States from Maryland to California, but it is most invasive along muddy banks of creeks and rivers in the southwestern United States.

A. donax infestations in riparian habitats lead to: loss of biodiversity; stream bank erosion; altered channel morphology; damage to bridges; increased costs for chemical and mechanical control along transportation

[1] Regulations implementing the National Environmental Policy Act of 1969 (42 United States Code 4321 *et seq.*) provide that an environmental assessment "shall include brief discussions of the need for the proposal, of alternatives as required by section 102(2)(E), of the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted." 40 CFR § 1508.9.

corridors, and impediment of law enforcement activities on the international border. Additionally, this invasive weed competes for water resources in an arid region where these resources are critical to the environment, agriculture and municipal users. *A. donax* is a severe threat to riparian areas where it displaces native plants and animals by forming massive stands that pose a wildfire threat (Frandsen and Jackson, 1994). It may reduce stream navigability (Dudley, 2000). It consumes excessive amounts of water and competes for water resources in an arid region prone to perennial droughts (Goolsby et al., 2008). Under optimum conditions it can attain growth rates of 0.7 meters (m) per week or 10 centimeters (cm) per day, putting it among the fastest growing plants (Perdue, 1958; Bell, 1997). Under ideal growth conditions *A. donax* can produce more than 20 metric tons of above-ground dry mass per hectare (Perdue, 1958).

Existing *A. donax* management options are ineffective, expensive, temporary, and have nontarget impacts. For these reasons, there is a need to identify an effective, host specific biological control organism and release it into the environment for the control of *A. donax*.

Public involvement

Notice of this EA was made available in the Federal Register on March 6, 2009 for a 30-day public comment period. Ten comments were received on the EA. All comments received have been addressed in Appendix 3 of this document. In addition, in the Laredo, Texas area where initial releases of *T. romana* may occur, the permit applicant has provided information about *T. romana* and has met with officials from the City of Laredo, including City Management, the Environmental Services Department, and the Department of Public Health, as well as Rio Grande Regional Water Authority, Lower Rio Grande Valley Development Council, and Laredo Community College. Newspaper articles about the agent have been published in the Laredo Morning Times and the Rio Grande Valley newspaper, The Monitor.

II. Alternatives

This section will explain the two alternatives available to the APHIS Permit Unit: no action and issue permits for environmental release of *T. romana*. Although the APHIS Permit Unit's alternatives are limited to a decision on whether to issue permits for release of *T. romana*, other methods available for control of *A. donax* are also described. These control methods are not decisions to be made by the APHIS Permit Unit and their use is likely to continue whether or not permits are issued for environmental release of *T. romana*. These are methods presently being used to control *A. donax* by public and private concerns.

A third alternative was considered, but will not be analyzed further. Under this third alternative, the APHIS Permit Unit would have issued permits for the field release of *T. romana* but the permits would contain special provisions or requirements concerning release procedures or mitigating measures. No issues have been raised that would indicate that special provisions or requirements are necessary.

A. No action

Under the no action alternative, the APHIS Permit Unit would not issue permits for the field release of *T. romana* for the control of *A. donax*. The release of this biological control agent would not take place. The following methods are presently being used to control *A. donax* and these methods will continue under the "No Action" alternative and will likely continue even if permits are issued for release of *T. romana*.

1. Chemical control

A. donax may be controlled using herbicides. Until a few years ago there was only one herbicide labeled for wetlands use by the EPA: Rodeo®, a glyphosate-based herbicide. Glyphosate is a broad-spectrum herbicide that is commonly used on a variety of wetland and aquatic plants such as water hyacinth (*Eichhornia crassipes*), giant salvinia (*Salvinia molesta*), saltcedar (*Tamarix ramosissima*), and others, including *A. donax*. Glyphosate has proven to be effective against *A. donax* (Finn and Minnesang, 1990; Jackson, 1994; USDA Forest Service, 1993). One of the reasons for its effectiveness is that glyphosate is a systemic herbicide and when used at appropriate times it is translocated to the roots, killing the entire plant. A number of techniques were developed for its use. These included 1) use as a foliar spray, 2) cutting plant stems and spraying, or painting the herbicide on the surface of the cut, and 3) cutting stems, letting plants re-sprout, and treating the re-sprouts with herbicide.

Currently, a number of management options are available in addition to the use of Rodeo®. A variety of other trade names have appeared on the market with glyphosate-based formulations. Additionally, an herbicide (Habitat®) with another active ingredient, imazapyr, has been developed and registered for use on *A. donax*. In general, Habitat® requires one to two applications and control may be achieved for several years. Biomass removal may be necessary if stem densities are great enough to inhibit recovery by native vegetation after treatment.

2. Mechanical control

Mechanical methods of *A. donax* control include use of prescribed fire, heavy machinery (e.g. bulldozers), hand-cutting, Hydro-axe, chipper, etc. Biomass removal may be necessary if there is a possibility that cut vegetation might create a flood hazard during high water events or if biomass density is great enough to inhibit recovery of native vegetation. Burning is a cost-effective way of removing biomass if it does not threaten native vegetation. Another, but more costly, means of removal is chipping. Equipment and labor are expensive relative to other forms of removal, but the small dry chips that are produced pose little threat in terms of regeneration, and they do not form debris dams. Biomass removal by vehicle is expensive, and generally not preferred due to its lack of cost-effectiveness. The use of heavy machinery such as the Hydro-axe is extremely expensive and slow, cutting only about 3-4 acres per day (Bell, 1997).

3. Biological control

Besides *T. romana*, two other biological control organisms are being tested for potential release for biological control of *A. donax*. These include the arundo scale, *Rhizaspidiotus donacis*, and the arundo fly, *Cryptonevra* sp. No biological control agents of *A. donax* have been purposely released in the United States, although two populations of *T. romana* have been recently discovered near Santa Barbara, California and Austin, Texas. Origin of this insect and impact on *A. donax* at these locations are unknown. Researchers at University of California are currently studying the impact of this insect on *A. donax*.

B. Issue permits for environmental release of *T. romana*

Under this alternative, the APHIS Permit Unit would issue permits for the field release of *T. romana* for the control of *A. donax*. These permits would contain no special provisions or requirements concerning release procedures or mitigating measures.

1. Biological control agent information

a. Description of *T. romana*

T. romana is a 5-millimeter (mm) long, stem-boring joint worm wasp, in the insect family Eurytomidae (Fig. 1). It appears to feed only on species in the genus *Arundo* (Goolsby, 2008). Female wasps have a black body (appendages excluded), with the sides of the pronotum partly yellowish.

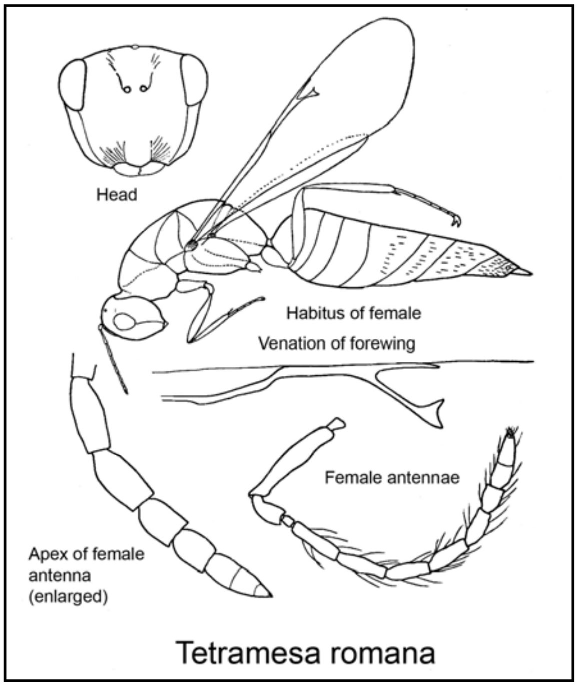

Fig 1. *Tetramesa romana*

b. Distribution of *T. romana*

T. romana distribution shows a very widespread presence around the Mediterranean Basin, from Turkey to Spain and Morocco, but not in the Canary Islands, Tunisia, or Egypt. *T. romana* was also found at one site in southern Africa and one site in China, but not in India, Nepal, Australia, Namibia, or Kenya. It was not found anywhere on *Phragmites* but was found on *Arundo plinii* in Sicily and Spain. Two populations of *T. romana* have been recently discovered near Santa Barbara, California and in Austin, Texas. In Texas, populations appear to be recently established.

A. donax is limited to Mediterranean climates in Europe, whereas in North America, it grows much further north into the cool temperate regions of the eastern United States. It is not known whether *T. romana* will be able to establish throughout the entire range of *A. donax*, but it is expected to do so (Goolsby, 2008). Establishment of *T. romana* in Austin, Texas indicates that the wasp has a moderate level of cold hardiness.

c. Life history of *T. romana*

The eggs of *T. romana* are white and have a hook-like pedicel on one end and a short hair on the other. The eggs without the pedicel average 0.39 mm long, and the total egg length with pedicel is approximately 1.26 mm long. A few days after eggs are laid, gall tissue begins to develop inside the shoot cavity, always within 2 nodes of the shoot tip. Galls are abnormal outgrowths of plant tissues and can be caused by various parasites, including insects. Over time the gall expands, causing exterior shoot distension within 12 days of oviposition (egg-laying). However, on main shoots greater than about 1 cm in diameter, and on lateral tiller bases, gall formation often occurs with little or no visible stem distension. The larvae feed on the expanding gall tissue. The larvae are creamy white. Larval instars 1, 2, 3, and 4 last approximately 4, 6, 5, and 8 days, respectively, and larval development is complete by the 27th day after oviposition (Goolsby, 2008).

Pupae or pre-pupae can be found as early as the 20th day after oviposition, but most were found on the 27th day or later (Goolsby, 2008). Mature pupae are black and by this time the gall tissue has hardened and dried. The average total time from the day of adult oviposition to emergence of new adults from galls is approximately 33 days, suggesting a pupal development time of approximately 5 days. However, generation time varies over a broad range (26−48 days). Adult wasps are about 5.38 mm long without antennae and about 7 mm long with antennae. Adult wasps live an average of approximately 4 days. The average number of wasps produced over the lifetime of each female (both reproductive and non-reproductive) is 6−12. Daily reproduction by adult wasps varies with age. Wasps exposed to *A. donax* shoots 0, 1, and 2 days after emergence are the most productive and are most likely to reproduce. Female wasps that are more than four days past emergence do not produce enough offspring to replace themselves, and only 10−15 percent of wasps of this age or older produce any offspring, suggesting that younger wasps are much more suitable for field releases (Goolsby, 2008).

Studies with pest species of *Tetramesa* in North America (*T. tritici*, *T. grandis*, *T. secale*) suggest that penultimate instar larvae or pupae overwinter inside galls and can survive extremely cold conditions (Davis, 1918; Salt, 1971), but in the areas of the most severe invasions of *A donax* in the Rio Grande Basin, daytime winter temperatures may be high enough to permit year-round wasp activity. The wasps will be capable of dispersing between isolated patches of *A. donax* during initial establishment and as patches are controlled (Dubbert et al., 1998).

III. Affected Environment

A. donax is a bamboo-like perennial that grows to 8 meters tall, with thick, well-developed rhizomes (a horizontal plant stem with shoots above and roots below serving as a reproductive structure). Plants are typically terrestrial, but tolerate periodic flooding. In California, from the late 1700s to early 1800s, *A. donax* was often planted for erosion control in flood channels and as wind breaks. More recently, it has become problematic in riparian corridors throughout the southwestern United States and northern Mexico. Dense, impenetrable stands typically develop, which often displace native vegetation, diminish wildlife habitat, and increase flooding and siltation in natural areas. *A. donax* is also adapted to a periodic fire regime. The canes are readily flammable throughout much of the year, and the presence of *A. donax* increases the susceptibility of riparian corridors to fire. Large stands of *A. donax* can significantly increase water loss from underground aquifers in semi-arid regions due to a high evapotranspiration rate, which is estimated at roughly 3 times greater than that of the native riparian vegetation. *A. donax* is cultivated as an ornamental, for industrial cellulose, and to produce reeds for woodwind instruments. It is an alternate host for beet western yellows virus, sugarcane mosaic virus, and maize dwarf mosaic virus.

A. donax reproduces vegetatively from rhizomes and stem fragments. Fragments disperse with water, mud, and human activities. Under optimal conditions, plants grow and spread rapidly during the warm season. Intact rhizomes buried under about 1−3 meters of silt can develop new shoots. Under experimental conditions, rhizome fragments readily develop new shoots from a depth of 25 cm, whereas stem fragments mostly re-sprout from a depth less than 10 cm. Viable seed has not been observed in North America or in the native range (DiTomaso and Healy, 2003).

A. Areas affected by *A. donax*

1. Native and introduced range

A. donax is native to Europe from the central Atlantic coast of Portugal, inland along the major rivers of the Iberian Peninsula, along the Mediterranean coast from Spain to Greece, including the warmer parts of the Adriatic Coast. In north Africa along the Mediterranean, the populations are discontinuous from the Western Sahara, Morocco, Algeria, to the Arabian Peninsula. Remote populations are known from the Sahara in stable oases. Populations in China are not considered to be native. In addition to *A. donax*, other *Arundo* species are native to the Mediterranean including *A. plinii* Turra, *A. collina* Tenore, and *A. mediterranea* (Danin et al., 2002; Danin, 2004; Danin et al., 2006). The only other known *Arundo* species outside of the Mediterranean is *A. formosana* in Taiwan.

A. donax has a nearly worldwide distribution in tropical to warm-temperate regions. In the United States, it is invasive from northern California across the southwestern and southeastern United States to

Virginia. It is widely distributed in Mexico, and Central and South America. Most severe infestations are in Arizona, California, and Texas, especially the Santa Ana River Basin and Rio Grande Basin. It was introduced into the New World by Spanish colonizers perhaps as early as the 1500s.

2. Present and potential distribution in North America

A. donax is well established in North America, although it continues to spread into new areas. Figure 1 shows the areas that are climatically suitable based on CLIMEX parameters from Europe. While the predicted CLIMEX distribution broadly agrees with the actual distribution, *A. donax* has naturalized further north. It has been documented in South Bend, Indiana and Coeur'd'Alene, Idaho.

Some of the most severely infested areas are in the Rio Grande Basin and in the coastal rivers of Southern California. A continuous stand of *A. donax* occurs from just south of Laredo to Del Rio, Texas. The swath of *A. donax* is nearly 0.5 miles wide along this stretch of the Rio Grande River. Further upriver near Big Bend National Park, stands of *A. donax* are increasing in size and density. Heavy rains during the summer of 2007 stimulated new growth and flood waters distributed propagules downstream. Aerial surveys conducted by USDA researchers in the fall of 2007 revealed much more *A. donax* than had been previously seen in the 2002 surveys (Goolsby, 2008).

The spread of *A. donax* into new areas appears to be from earthmoving equipment and roadway mowers (Goolsby, 2008). Once established in a watershed, rhizomes and canes move downstream during flood events to establish new stands. The movement of *A. donax* for biofuel trials also presents another means of spread. The State of Florida evaluated a request to plant *A. donax* on a plantation south of Lake Okeechobee. Concerns presented by the Florida Exotic Pest Plant Council were that it could not be contained from entering the Everglades following high rainfall events such as major hurricanes (Florida Native Plant Society, 2006). This business venture is no longer planned for Florida, but instead is being considered for St. Augustine County in east Texas (Loder, 2007).

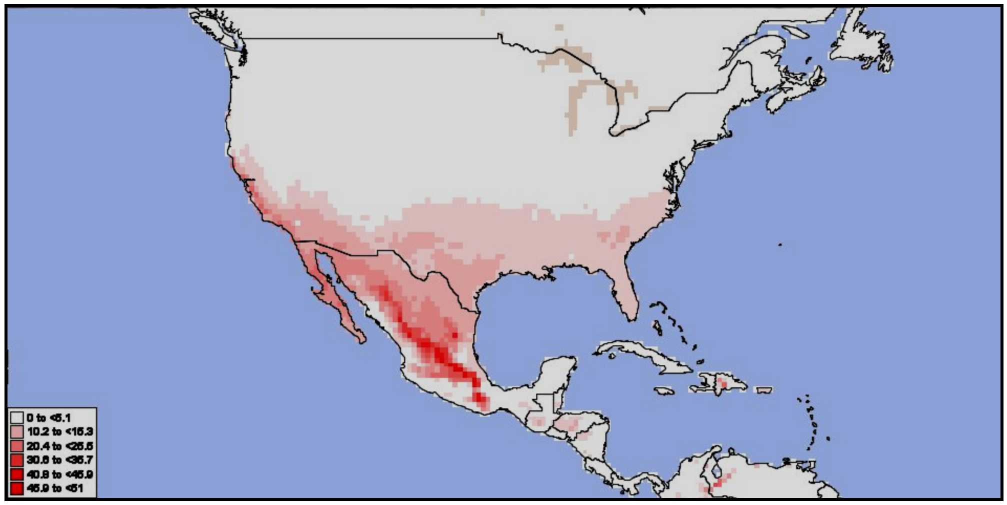

Fig 1. Areas in North America (red to pink) that are climatically suitable for *Arundo donax*.

4. Habitat

A. donax typically grows on sites with a low slope in riparian areas, floodplains, ditches, and irrigation canals. In the eastern United States, with average rainfall above 30 inches, it can grow in upland sites, such as windbreaks or in ornamental settings. *A. donax* occurs in a wide range of soils types, with variable fertility, but grows best in well-drained moist soils. Plants tolerate some salinity and extended periods of drought; however they do not survive in areas with prolonged or regular periods of freezing temperatures (DiTomaso and Healy, 2003).

B. Plants related to *A. donax* and their distribution

1. Taxonomically related plants

Plants for the host specificity test list were chosen based on the following criteria: *Arundo* spp. in North America, species in related genera in the Poaceae subfamily Arundinoidae; species in related subfamilies that are either native to the introduced range of *A. donax* and/or morphologically similar; species in related orders of monocots; economically important grasses; and habitat associates (Goolsby, 2008). See figure 2 for subfamilies of the plant family Poaceae.

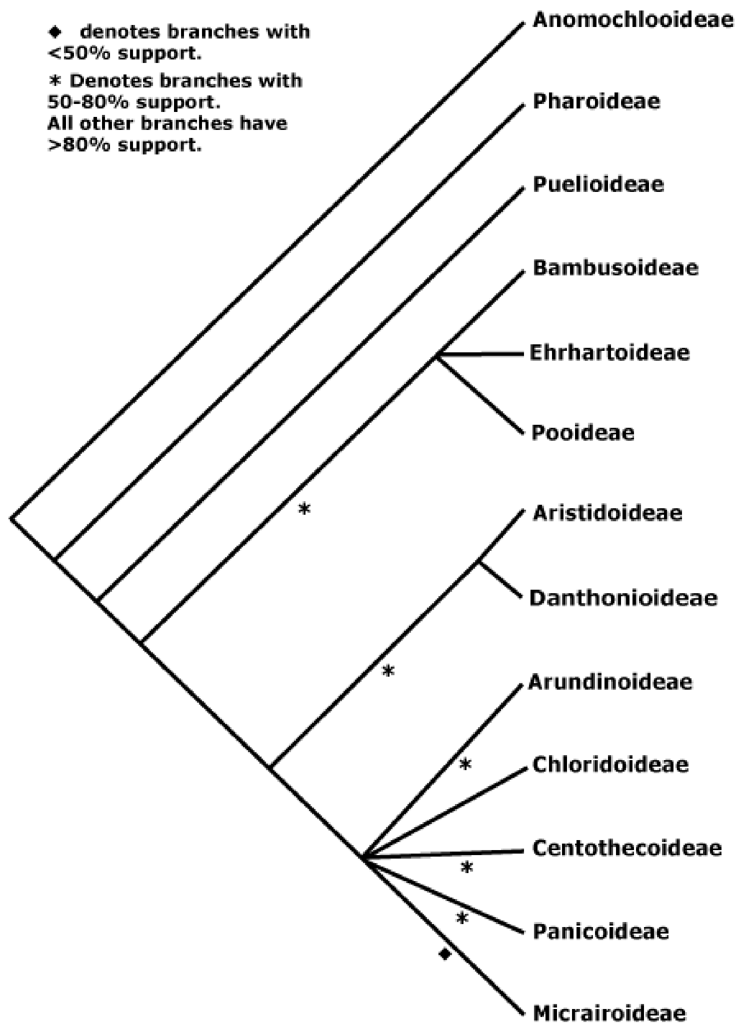

Fig 2. Phylogeny of the family Poaceae. Representatives of all these subfamilies were included in the host range testing except for Micrairoideae (from Goolsby, 2008).

Arundo formosana Hack. (fountain reed), a smaller relative of *A. donax*, is native to Taiwan, the Ryukyu Islands of Japan, and the Philippines. It is a very minor ornamental plant in northern California.

Phragmites australis (Cav.) Trin. ex Steud. (common reed) is similar in appearance and habitat to *A. donax. P. australis* is found nearly worldwide in temperate and tropical wet habitats. An introduced ecotype from Europe is invading northeastern North America. This exotic ecotype is the target of biological control program in the United States.

Molinia caerulea (L.) Moench (purple moor grass) is a perennial bunch grass native to temperate areas of Eurasia. It has been introduced as an ornamental to northeastern Canada and the United States where it has invaded damp areas.

Hakonechloa macra (Munro) Makino (Hakone grass) is endemic to Japan where it grows along rivers. It is grown as an ornamental in temperate areas of North America.

Aristida purpurea Nutt. var. *longiseta* (Steud.) Vasey (red threeawn) grows from western Canada to northern Mexico in well-drained soils.

Chasmanthium latifolium (Michx.) Yates (inland sea oats) grows from the middle Atlantic states of the United States west to Texas along waterways and in moist woods.

Cynodon dactylon (L.) Pers. (Bermuda grass) is a pasture and turf grass native to Africa that now grows worldwide except in the coldest and driest areas.

Spartina alterniflora Loisel. (smooth cordgrass) grows in muddy coastal marshes along the Gulf and Atlantic coasts of the United States, Canada, and South America and has invaded marshes along the Pacific coast of North America and in England, France, and China.
Spartina spartinae (Trin.) Merr. ex Hitchc. (Gulf cordgrass) is a bunch grass that grows mainly along the Atlantic Coast of Florida, the Gulf Coast of the United States and Mexico to Costa Rica. In South America it grows in Venezuela, Argentina, and Paraguay.

Uniola paniculata L. (sea oats) grows on sand dunes along the coast from Maryland to Veracruz, Mexico as well as in the Bahamas and Cuba.

Leptochloa panicea (A. Retzius) J. Ohwi subsp *brachiata* (=*L. filiformis*) (Mexican sprangletop) is native to the southern half of the United States and much of Mexico, the Caribbean, and Central and South America. It has naturalized in Africa and Australia.

Leptochloa fusca (L.) Kunth ssp. *uninervia* (J. Presl) N. Snow (=*L. uninervia*) (red sprangletop) is native to the southern half of the United States and much of Mexico, the Caribbean, and Central and South America.

Leptochloa virgata (L.) P. Beauv. (tropic sprangletop) is native to Texas and Florida in the United States and also to Tamaulipas and Veracruz, Mexico, as well as to much of Central and South America and the Caribbean.

Danthonia spicata (L.) P. Beauv. ex Roem. & Schult. (poverty oatgrass) grows throughout most of North America from the subarctic through central Mexico.

Cortaderia selloana (Schult. & Schult. f.) Asch. & Graebn. (pampas grass) is an ornamental grass native to Brazil and the southern part of South America. Pampas grass has been planted in the southeast and southwest of the United States and is invasive in some areas.

Panicum virgatum L. (switchgrass) grows mainly east of the Rocky Mountains from southern Canada through Central America and in Cuba.

Panicum hirsutum Sw. (hairy panicum) grows from southern Texas to Argentina and in the Caribbean.

Panicum amarum Elliot. (bitter panicgrass) grows along the Atlantic Coast from Connecticut to northeastern Mexico.

Sorghum bicolour (L.) Moench (sorghum) is a native of Africa that is grown through much of the world.

Zea mays L. (corn) is native to Mexico but is grown through much of the world.

Saccharum officinarum L. (sugarcane) is grown in the southeastern United States as well as in other tropical/subtropical regions throughout the world. It is native to tropical Asia and Oceania.

Triticum aestivum L. (wheat) originated in central and western Asia but is planted in many of the temperate areas of the world.

Distichlis spicata (L.) Greene (saltgrass) is native to much of North, Central, and South America and grows in saline soils.
Sporobolus wrightii Munro ex Scribn. (alkali sacaton) grows in Texas and Oklahoma and west to California and south to central Mexico.

Oryza sativa L. (rice) is of Asian origin and is grown in tropical, subtropical, and warm-temperate areas around the world.

Arundinaria gigantea (Walter) Muhl. (giant cane) is native to the southeastern United States.

Schoenoplectus maritimus (L.) Lye (alkali bulrush) grows from Canada into South America as well as in Africa, Eurasia, and Oceania. It may actually be native to Eurasia.

Juncus acutus L. (spiny rush) is native to California, Arizona, and northern Mexico as well as parts of Europe, Asia, and Africa.

Typha domingensis Pers. (narrowleaf cattail) grows through much of the tropics and warm-temperate areas.

Sabal mexicana Mart. is native to Texas, Mexico, and Central America.

Carya illinoinensis (Wangenh.) K. Koch (pecan) grows in the southeastern United States and south into central Mexico.

Salix exigua Nutt. (narrowleaf willow) grows from Alaska through the western third of Canada and the United States and into northern Mexico.

Baccharis neglecta Britton (dryland baccharis) is native to the southwestern United States and northern Mexico.

Fraxinus berlandieriana DC. (Rio Grande ash) grows in Mississippi, Louisiana, Texas, and Mexico.

IV. Environmental Consequences

A. No action

1. Impact of spread of *Arundo donax*

a. Beneficial uses:

A. donax is grown for woodwind reeds, although there is currently no commercial production in North America (Perdue, 1958; Obataya and Norimoto, 1995) . The highest quality reeds come from the native range in Europe. It is also used in basketry, for fishing rods, livestock fodder, and medicine. Currently, the most significant use of this plant is its proposed use as biofuel (Szabo et al., 1996). There are a few small-scale research plantings of *A. donax* in Texas and Georgia. Use of *A. donax* as a biofuel has sparked considerable controversy in Florida, which may have caused entrepreneurs to considering establishing their Arundo plantation in Texas (Florida Native Plant Society, 2006). The use of invasive species as biofuels is considered to be extremely risky. Raghu et al. (2005) presents the case that the long term environmental consequences of using invasive species will far outweigh the short term gains for energy use. USDA research on biofuels precludes the use of Federal dollars for research on invasive plants.

b. Nontarget plants

Nontarget plants growing in the riparian areas are severely impacted by *A. donax* throughout North America. *A. donax* grows in dense stands that prevent normal regeneration of native riparian vegetation. In many areas, *A. donax* is burned yearly to keep standing vegetation to a minimum. In other areas, accidental wildfires enter riparian zones infested with *A. donax* damaging riparian plants. In both cases native plants, especially trees that are not fire adapted, are killed by the hot fires. *A. donax* survives the wildfires due to its extensive below ground rhizomes. It re-grows quickly after fires, shading out emerging seedlings, thus increasing its dominance over native riparian vegetation.

c. Ecosystem function

Widespread effects of *A. donax* on ecosystems have been documented on several continents including Australia, North America, Oceania, and Africa. The Global Invasive Species Database lists *A. donax* as one of the worst 100 invaders http://www.issg.org/database/species/ecology.asp?si=112 (*last accessed* September 3, 2008). *A. donax* can increase sediment deposition in natural and man-made channels resulting in reduced channel depth and greater flooding (Frandsen and Jackson, 1994). In addition, during flooding, debris dams of *A. donax* may collect adjacent to flood control structures, bridges, and culverts, exacerbating flooding (Frandsen and Jackson, 1994). *A. donax* produces profuse quantities of biomass (Perdue, 1958; Sharma et al., 1998; Spencer et al., 2006) that are quite flammable at the end of the growing season. As a result, it has changed control of ecosystem processes in some Californian riparian zones from flood-regulated to fire-regulated (Rieger and Kreager, 1989).

d. Protected species

A. donax threatens most native plants and thereby native wildlife growing in the same habitat. The least Bell's vireo, southwestern willow flycatcher, and yellow-billed cuckoo, are negatively impacted by *A. donax* because it does not provide the structural habitat and food sources that native vegetation provides (Frandsen and Jackson, 1994; Dudley and Collins, 1995). In Sonoma Creek, California, *A. donax* was associated with about 50 percent of the total number and biomass of arthropods that were found on native vegetation (Herrera and Dudley, 2003). Protected aquatic species such as the arroyo toad, red-legged frog, western pond turtle, Santa Ana sucker, arroyo chub, unarmored three-spined stickleback, tidewater goby, and steelhead trout are negatively affected by *A. donax* because it provides little shade over streams and leads to increased water temperatures that are unsuitable for wildlife (Hoshovsky, 1988).

e. Human health

There are a few reports of allergies to *Arundo* pollen. It is listed on pollenlibrary.com (*last accessed* September 3, 2008) as a moderate allergen.

f. Water usage

Large stands of *A. donax* can increase water loss from underground aquifers in semi-arid regions due to a high evapotranspiration rate, which is estimated at roughly 3 times greater than that of the native riparian vegetation. *A. donax* consumes an estimated 56,200 acre-feet of water annually from the Santa Ana River alone (Zembal, 2007).

2. Impact from use of other control methods

The continued use of chemical herbicides and mechanical controls at current levels would be a result if the "no action" alternative is chosen.

a. Chemical control

The most common herbicide used for *A. donax* is Roundup® or Rodeo® (glyphosate), which may require continued application for 3−5 years for local control (Newhouser et al., 1999; Dudley, 2000). Habitat® (imazypyr) is also used for control along ditches and canals. However, chemical control methods are not feasible for large-scale infestations covering hundreds of river miles such as the infestation in the Bi-National Rio Grande Basin. Broadcast applications of herbicides could have adverse impacts on non-target vegetation if not carefully applied.

b. Mechanical control

Mechanical methods of *A. donax* control include use of prescribed fire, heavy machinery (e.g. bulldozers), hand-cutting, Hydro-axe, chipper, backhoe, etc. Biomass removal may be necessary if there is a possibility that cut vegetation might create a flood hazard during high water events. Chipping is a costly method of removal. Equipment and labor are expensive relative to other forms of removal, but the small dry chips that are produced pose little threat in terms of regeneration and they do not form debris dams. Biomass removal by vehicle is expensive, and generally not preferred due to its lack of cost-effectiveness. The use of heavy machinery such as the Hydro-axe is extremely expensive and slow, cutting only about 3−4 acres per day (Bell, 1997). Mechanical eradication with a backhoe has been ineffective because the rhizome fragments buried under the soil will readily resprout. Prescribed burning has not been successful because it cannot kill the rhizomes and generally promotes *A. donax* regeneration over native riparian species.

c. Biological control

Two populations of *T. romana* have been recently discovered near Santa Barbara, California and Austin, Texas. Origin of this insect and impact on *A. donax* at these locations are currently unknown. This (presumably) unintentionally released organism will likely spread and impact *A. donax.*

These environmental consequences may occur even with the implementation of the biological control alternative, depending on the efficacy of *T. romana* to reduce *A. donax* in the continental United States. It is not expected that *T. romana* alone will completely control *A. donax*. However, the stem galling of *A. donax* caused by *T. romana* results in shortened internodes, stunted stems, and sometimes death of the stems.

B. Issue permits for environmental release of *T. romana*

1. Impact of *T. romana* on nontarget plants

Host specificity of *T. romana* to *A. donax* has been demonstrated through scientific literature, field observations, and host specificity testing.

a. Scientific literature

T. romana has been reported from southern France (Steffan, 1956), Italy, and Egypt (Claridge, 1961). Claridge (1961) lists *Arundo* spp. as hosts, with *A. donax* as the only published host for France.
b. Field observations

Collections by researchers at the European Biological Control Laboratory, Montpellier, France, revealed that *T. romana* is common and abundant on *A. donax* in southern France, all of Spain, and elsewhere in the Mediterranean (Sicily, Turkey, Bulgaria, Crete, Morocco), as well as South Africa and China (presumed to have been introduced into these latter two countries). *T. romana* was absent from some of the areas where *A. donax* is native (e.g, India, Nepal, Croatia, Tunisia). *T. romana* was found on *Arundo plinii* L. in Spain and Sicily, but was never found on *Phragmites* spp. or other plants outside of the genus *Arundo*.

Observations in the areas in which *T. romana* has recently been discovered, near Austin, Texas found no *T. romana* galls or exit holes on

Indian woodoats (*Chasmanthium latifolium* (Michx.)) or pampas grass (*Cortaderia selloana* (Schult. & Schult. f.) Asch & Graebn.). Spot checks of 2-10 plants of each of the following mostly native grasses found no evidence of *T. romana*: Eastern gamagrass (*Tripsacum dactyloides* (L.) L.); johnsongrass (*Sorghum halepense* (L.) Pers.); Virginia wildrye (*Elymus virginicus* L.); southwestern bristlegrass (*Setaria scheelei* (Steud.) Hitchc.); sideoats grama (*Bouteloua cutipendula* (Michx.) Torr.); little bluestem (*Schizachyrium scoparium* (Michx.) Nash.) and *Sporobolus* sp. Observations in the Laredo area revealed no evidence of *T. romana* damage on big sacaton grass (*Sporobolus wrightii* Munro ex Scribn.) or *Phragmites australis.*

c. Host specificity testing

Site of quarantine and field studies

Field studies were conducted throughout Mediterranean Europe. Most studies were conducted near the European Biological Control Laboratory because *A. donax* and *T. romana* were native to the research grounds at the Campus Baillarguet Internacional. Laboratory studies were conducted at the USDA-APHIS Mission Biological Control Laboratory, Edinburg, Texas.

Test plant list

Representatives of most of the subfamilies of Poaceae were included in the host specificity testing. When selecting representative species for the host range tests, plants that were morphologically similar to *A. donax* or native to the southern United States were prioritized for testing. See Appendix 1 for a list of plants tested in quarantine.

Within the subfamily Arundinoideae are the following core genera: *Arundo, Dregeochloa, Hakonechloa, Molinia,* and *Phragmites*. Representatives from all of these genera were tested except *Dregochloa* which is endemic to southern Africa. Representatives of the genera *Hakenchoa* and *Molinia* were obtained, but are uncommon exotic, ornamental species in North America. Of these core genera, *Phragmites* is the most critical because it occurs with *A. donax* throughout a large part of its introduced range. There are no native *Arundo* species in North or South America. The only other *Arundo* species present in North America is *A. formosana*. This plant is native to Taiwan and is an uncommon, exotic ornamental in the San Francisco Bay Area. None of the other Mediterranean *Arundo* species (*A. plinii*, *A. collina,* or *A. mediterranea*) are known to be present in North America. To evaluate the genetic diversity of *A. donax*, the two dominant genotypes in the Rio Grande

Basin were collected from San Juan, Texas in the Lower Rio Grande Valley and Laredo, Texas, 150 miles upriver. The Laredo genotype is the dominant genotype in the Rio Grande Basin above Laredo and is representative of the vast biomass of the invasive population. *A. donax* var. *versicolor* was also included in host specificity testing because it is a widely distributed form in North America.

Considerable emphasis was placed on selection of *Phragmites* test plants. There is only one *Phragmites* species present in North America (*P. australis*), but there is a considerable body of knowledge associated with it because of its worldwide distribution and invasiveness in northeastern North America (Tewksbury et al., 2002). All of the North American ecotypes were obtained for host specificity testing. This included populations from Rhode Island, California, and Texas. Several populations of *P. australis* from the Lower Rio Grande Valley of Texas were collected and grown for host specificiy testing. One of the collections was made from a well-preserved native habitat (Bentsen State Park). Two collections were near the Gulf Coast (Los Fresnos and San Benito, Texas). An inland population was collected near Mercedes, Texas. All of these *Phragmites* populations represented the Gulf Coast ecotype. This native ecotype can become invasive along irrigation canals and drainage districts in Texas and is often the target of herbicide applications. From western North America, four populations of *P. australis* were collected in California. The Ventura, Santa Paula, and Colorado River populations are the same ecotype and overlap with some of the most invasive populations of *A. donax* in California. An uncommon desert ecotype was obtained from the Owens Valley of California.

Within the Poaceae, the main agricultural grasses, including corn, wheat, sorghum, and rice, were tested. Genetic material of these grasses was obtained from the USDA-Agricultural Research Service (ARS) Germplasm Repositories in Idaho, Georgia, and Colorado. Whole rice plants were obtained from the USDA-ARS laboratory in Beaumont, Texas. Wheat is the host of another known *Tetramesa* species.

Several habitat associates of *A. donax* were selected that represented species that the biological control agents may come in contact with in the Western or Gulf Coast areas of North America. All of the habitat associates are native non-economic species, except pecans, which are a native economic species, widely planted in the riparian habitats of North America.

<u>Discussion of Host Specificity Testing</u>

Based on host specificity testing, *T. romana* is specific to the *Arundo* genus (see Appendix 2 for host specificity test results). Development of *T.*

romana was recorded only on *A. donax* and *A. formosana,* an exotic ornamental native to Taiwan (Goolsby and Moran, 2009) There was a significant difference between the fecundity of *T. romana* females on *A. donax* and *A. formosana.* The mean number of offspring produced per female was low on *A. formosana* at approximately 2, compared to 9.5−18.8 per female on *A. donax*. The developmental time on *A. formosana* was more than two months, which is twice as long as development time on *A. donax*. This further indicates that *A. formosana* is a marginal host for *T. romana.*

Probing was recorded on nearly all the test plants with round green stems. There was a significant difference in number of probing events across plant species. More than 20 percent of all the non-target replicates had probing events, which shows that the non-target species were more than adequately challenged. Wasps spent significantly more time probing *A. donax* than other test plants. Each probe lasted several minutes as the female drilled with the ovipositor into the stem of the test plant. Plants such as willow, ash, pecan, and seep willow were not observed to have been probed, most likely because they contained woody stems. The researchers were not able to determine if every probe resulted in an oviposition (egg laying); however all test plants were held to allow for development of *T. romana* and development was only recorded on *Arundo*. The percentage of time on stems was significantly different, with most *T. romana* spending the most time on *A. donax* stems. This may be a precursor behavior to probing or oviposition. The percentage of time spent on leaves was significantly different; however, this behavior does not appear to be a good predictor of host range as *T. romana* spent the greatest percentage of time on *Fraxinus berlandieri*, Rio Grande ash. The percentage of time spent off the plant on the sleeve cage was significantly different, with the lowest percentage of time on the *A. donax* replicates. This indicates that wasps presented with their true host (*A. donax*) spent the greatest percentage of their time on the plant. When presented with non-hosts, most of their time was spent on the cage.

2. Impact of *T. romana* on *A. donax*

T. romana causes considerable damage to *A. donax* in the native range. The stem galling results in shortened internodes, stunted stems, and sometimes death of the stems. It is unclear what impact *T. romana* will have on *A. donax* in the United States. The insect attacks the stem apical meristems (growing tips) of *A. donax* and this will not necessarily reduce the reproductive capacity of *A. donax*.

3. Uncertainties regarding the environmental release of ***T. romana***

Once a biological control agent such as *T. romana* is released into the environment and becomes established, there is a slight possibility that it could move from the target plant (*A. donax*) to attack nontarget plants. Host shifts by introduced weed biological control agents to unrelated plants are rare (Pemberton, 2000). Native species that are closely related to the target species are the most likely to be attacked (Louda et al., 2003). If other plant species were to be attacked by *T. romana*, the resulting effects could be environmental impacts that may not be easily reversed. Biological control agents such as *T. romana* generally spread without intervention by man. In principle, therefore, release of this biological control agent at even one site must be considered equivalent to release over the entire area in which potential hosts occur and in which the climate is suitable for reproduction and survival.

In addition, this agent may not be successful in reducing *A. donax* populations in the continental United States. Worldwide, biological weed control programs have had an overall success rate of 33 percent; success rates have been considerably higher for programs in individual countries (Culliney, 2005). Actual impacts on *A. donax* by *T. romana* will not be known until after release occurs and post-release monitoring has been conducted. It is not expected that *T. romana* alone will control populations of *A. donax*, but will act in combination with other control methods or biological control agents that may be released in the future.

4. Human health

T. romana is a wasp but it does not sting or produce venom. It is a plant feeding wasp which poses no risk to humans or other animals.

5. Cumulative impacts

"Cumulative impacts are defined as the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agencies or person undertakes such other actions" (40 CFR 1508.7).

Many Federal and State agencies, as well as private entities, conduct programs to manage *A. donax* as well as other invasive weeds. Chemical and mechanical methods, as described previously in this document, are used in a wide range of habitats. Some of these control programs are listed below.

Dept. of Homeland Security, Customs and Border Protection: The Border

Patrol is planning to use mechanical and chemical methods to control *A. donax* along the United States and Mexican border in Webb County, Texas, to assist in law enforcement activities associated with illegal border crossings (DHS, 2008).

Dept. of State, International Boundary and Water Commission (IBWC), El Paso, Texas: The IBWC use annual mowing along the sections of the Rio Grande to manage access to the River.

U.S. Fish and Wildlife Service, International Services: Chemical control is used to stop the spread of *A. donax* at the Cuatro Cienegas nature preserve in Coahuila, Mexico

U.S. Dept. of Interior, National Park Service, Big Bend National Park, Texas: Park staff use a combination to fire and herbicides to manage *A. donax*.

Texas Dept. of Parks and Wildlife, Bentsen State Park, Mission, Texas: Park staff use herbicides to control *A. donax* and *Phragmites* growing in the alternate river channels.

Lower Rio Grande Valley Irrigation and Drainage Districts, Brownsville, Harlingen, Mercedes, McAllen, La Hoya, Texas: All of the irrigation districts report that they use mechanical control, shredders, and backhoes for control of *A. donax* along irrigation canals and drainage ditches.

Maverick Irrigation District, Eagle Pass, Texas: The district reports the use of mechanical and chemical control to manage *A. donax* along irrigation canals and drainage ditches.

Texas Dept. of Transportation (TXDot), Austin, Texas: The state vegetation coordinator reports that TXDot uses mechanical and chemical control to maintain populations of *A. donax* growing along roadsides. The problem is most severe south-central Texas near College Station.

Team Arundo Del Norte, California: A consortium of homeowner associations, municipalities. and the State of California combine their resources to use chemical control, mechanical removal, and revegetation to restore ecologically sensitive rivers and creeks in northern California.

Team Arundo Del Sur, California: A consortium of homeowner associations, municipalities and the State of California combine their resources to use chemical control, mechanical removal and revegetation to restore ecologically sensitive rivers and creeks in Southern California.

California Dept. of Transportation (CalDOT), Sacramento, California: CalDOT uses mechanical and chemical control to manage *A. donax* along highways and bridges in the state.

Private landowners throughout the southern tier of the United States use a variety of methods to control *A. donax* where it has become invasive on private land.

Santa Ana Watershed Association (SAWA), California: SAWA has removed over 2,000 acres of *A. donax* from the Santa Ana watershed to restore habitat for native species, including the southwestern willow flycatcher.

Release of *T. romana* is not expected to have any negative cumulative impacts in the continental United States because of its host specificity to *A. donax*. Effective biological control of *A. donax* will have beneficial effects for weed management programs, and may result in a long-term, non-damaging method to assist in the control of *A. donax*, and prevent its spread into other areas potentially at risk from invasion.

6. Endangered Species Act

Section 7 of the Endangered Species Act (ESA) and ESA's implementing regulations require Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of federally listed threatened endangered species or result in the destruction or adverse modification of critical habitat.

Thirteen species of Poaceae are federally-listed as threatened or endangered in the continental United States (*Alopecurus aequalis* var. *sonomensis*, *Neostapfia colusana*, *Orcuttia californica, Orcuttia inaequalis, Orcuttia pilosa, Orcuttia tenuis, Orcuttia viscida, Poa atropurpurea, Poa napensis, Swallenia alexandrae, Tuctoria greenei, Tuctoria mucronata,* and *Zizania texana.* Nine of these grass species have designated critical habitat. Three candidates for listing in Poaceae also occur in the continental United States (*Dichanthelium* (=*Panicum*) *hirstii, Digitaria pauciflora,* and *Festuca ligulata*).

APHIS has determined that based on the host specificity of *T. romana,* there will be no effect on any listed plant, candidate for listing, or designated critical habitat of these plants in the continental United States, based on literature, field observations, and host specificity testing. In host specificity testing, the biological control agent caused gall formation only on *A. donax* and to a lesser extent, *A. formosana* and appears to be specific to the *Arundo* genus.

A. donax has been found to be used by some wildlife, although it provides little value for native wildlife in comparison to native vegetation, especially when it forms large, monotypic stands. Two endangered bird species, least Bell's vireo (*Vireo bellii pusillus*) and the southwestern willow flycatcher (*Empidonax traillii extimus*), have been found to use *A. donax* as a nest host (Pike et al., 2002; Kus, 2000). However, the recovery plan for the southwestern willow flycatcher indicates that it rarely nests in *A. donax* and also indicates that in California, *A. donax* is spreading rapidly, forming dense, monotypic stands unsuitable for flycatchers (FWS, 2002). Least Bell's vireos have been found nesting on *A. donax* along the Santa Clara River and the San Luis Rey River. In the U.S. Fish and Wildlife Service's 5-year review of the least Bell's vireo (FWS, 2006), habitat loss and invasion of riparian habitat by introduced exotic plant species (primarily *A. donax*) is listing factor 1 for the species. *T. romana* is already established in California where these bird species occur and is not expected to cause rapid, drastic reduction of *A. donax*, but could potentially decrease the reproductive capacity of *A. donax*. Thus, *A. donax* would not be rapidly removed from the environment, leaving nesting habitat for these species. Therefore, release of *T. romana* would have no effect on nesting by the least Bell's vireo or the southwestern willow flycatcher and may potentially benefit their designated critical habitat since *A.donax* does not provides suitable habitat for these birds.

In Texas, *A. donax* provides migratory habitat for the Gulf Coast jaguarundi (*Herpailurus* (=*Felis*) *yagouaroundi cacomitli*) and ocelot (*Leopardus* (=*Felis*) *pardalis*). However, *T. romana* is already established in Texas, and it is not expected to cause rapid, drastic reduction of *A. donax*, but could potentially decrease *Arundo's* reproductive capacity. Thus, *A. donax* would not be rapidly removed from the environment, leaving migratory cover for these species. Therefore, additional releases of *T. romana* would have no effect on the Gulf Coast jaguarundi or ocelot.

V. Other Issues

Consistent with Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," APHIS considered the potential for disproportionately high and adverse human health or environmental effects on any minority populations and low-income populations. There are no adverse environmental or human health effects from the field release of *T. romana* and will not have disproportionate adverse effects to any minority or low-income populations.

Consistent with EO 13045, "Protection of Children From Environmental Health Risks and Safety Risks," APHIS considered the potential for disproportionately high and adverse environmental health and safety risks to children. No circumstances that would trigger the need for special environmental reviews is involved in implementing the preferred alternative. Therefore, it is expected that no disproportionate effects on children are anticipated as a consequence of the field release of *T. romana*.

Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments," was issued to ensure that there would be "meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications…."

APHIS is consulting and collaborating with Indian tribal officials to ensure that they are well-informed and represented in policy and program decisions that may impact their agricultural interests in accordance with Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments."

VI. Agencies, Organizations, and Individuals Consulted

The Technical Advisory Group for the Biological Control Agents of Weeds (TAG) recommended the release of *T. romana* on August 6, 2008. TAG members that reviewed the release petition (Goolsby, 2008) included representatives from the U.S. Fish and Wildlife Service, Bureau of Indian Affairs, Cooperative State Research, Education, and Extension Service, U.S. Geological Survey, Environmental Protection Agency, U.S. Army Corps of Engineers, Bureau of Reclamation, Agriculture and Agri-Food Canada, Health Canada, and Mexico.

This EA was prepared and reviewed by APHIS. The addresses of participating APHIS units, cooperators, and consultants (as applicable) follow.

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Policy and Program Development
Environmental Services
4700 River Road, Unit 149
Riverdale, MD 20737

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Permits, Registrations, Imports, and Manuals
4700 River Road, Unit 133
Riverdale, MD 20737

U.S. Department of Agriculture
Kika de la Garza Subtropical Agricultural Research Center
Beneficial Insects Research Unit
2413 E. Hwy. 83
Weslaco, Texas 78596

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Appendix 1. Host plant test list for *Arundo donax* candidate biological control agents (Goolsby, 2008)

Order	Family	Sub-family	Scientific name	Common name	TAG Category	Indigenous to US	Indigenous to Mexico	Grain/ Forage	Orna-mental	Habitat Associate
Cyperales	Poaceae	Arundinoideae	*Arundo donax* L. Laredo, TX	Giant reed	1	No	No	No	Yes	-
"	"	"	*Arundo donax* L. San Juan, TX	Giant reed	1	No	No	No	Yes	-
"	"	"	*A. formosana* Hack.	Fountain reed	2	No	No	No	Yes	No
"	"	"	*Phragmites australis* Los Fresnos TX	Common Reed	3	Yes	Yes	No	No	Yes
"	"	"	*Phragmites australis* San Benito TX	Common Reed	3	Yes	Yes	No	No	No
"	"	"	*Phragmites australis* Bentsen S.P. TX	Common Reed	3	Yes	Yes	No	No	No
"	"	"	*Phragmites australis* Charlestown RI	Common Reed	3	No	No	No	No	No
"	"	"	*Phragmites australis* Santa Paula CA	Common Reed	3	Yes	Yes	No	No	No
"	"	"	*Phragmites australis* Colorado River CA	Common Reed	3	Yes	Yes	No	No	No
"	"	"	*Phragmites australis* Owens River CA	Common Reed	3	Yes	Yes	No	No	Yes
"	"	"	*Molinia caerulea* (L.) Moench	Moore Grass	3	No	No	No	Yes	No
"	"	"	*Hakonechloa macra* (Munro) Makino	Hakone Grass	3	No	No	No	Yes	No
"	"	Aristidoideae	*Aristida purpurea* Nutt. var. *longiseta* (Steud.) Vasey	Red Threeawn	3	Yes	Yes	No	No	No
"	"	Centothecoideae	*Chasmanthium latifolium* (Michx.) Yates	Inland Sea Oats	3	Yes	Yes	No	Yes	Yes
"	"	Chloridoideae	*Cynodon dactylon* (L.) Pers.	Bermuda grass	3	No	No	Yes	Yes	Yes
"	"		*Spartina spartinae* (Trin.) Merr. ex Hitchc.	Gulf Cordgrass	3	Yes	Yes	No	No	Yes
"	"		*Spartina alterniflora*	Smooth	3	Yes		No	No	Yes

			Loisel.	Cordgrass						
"	"	"	*Uniola paniculata* L.	Sea Oats	3	Yes	Yes	No	No	Yes
"	"		*Leptochloa panicea* (A. Retzius) J. Ohwi subsp *brachiata*	Red sprangletop	3	Yes	Yes	No	No	No
"	"		*Leptochloa fusca* (L.) Kunth ssp. *uninervia* (J. Presl) N. Snow	Mexican sprangletop	3	Yes	Yes	No	No	No
"	"		*Leptochloa virgata* (L.) P. Beauv.	Tropic sprangletop	3	Yes	Yes	No	No	No
"	"	Danthonioideae	*Danthonia spicata* (L.) P. Beauv. ex Roem. & Schult.	Poverty Oatgrass	3	Yes		Yes	No	No
"	"		*Cortaderia selloana* (Schult. & Schult. f.) Asch. & Graebn.	Pampas Grass	3	No	No	No	Yes	No
"	"	Panicoideae	*Panicum virgatum* L.	Switchgrass	3	Yes	Yes	Yes	Yes	No
"	"	"	*Panicum hirsutum* Sw.	Hairy panicum	3	Yes	Yes	No	No	Yes
"	"	"	*Panicum amarum* Elliot.	Bitter panicgrass	3	Yes		Yes	No	No
"	"	"	*Sorghum bicolour* (L.) Moench	Sorghum	3	No	No	Yes	No	No
"	"	"	*Zea mays* L.	Corn	3	No	No	Yes	No	No
"	"	"	*Saccharum officinarum* L.	Sugarcane	3	No	No	Yes*	No	No
"	"	Pooideae	*Triticum aestivum* L.	Wheat	3	No	No	Yes	No	No
"	"	"	*Distichlis spicata* (L.) Greene	Saltgrass	3	No	No	Yes	No	Yes
"	"		*Sporobolus wrightii* Munro ex Scribn.	Alkalai sacaton	3	Yes	Yes	Yes	No	Yes
"	"	Bambusoideae	*Oryza sativa* L.	Rice	3	No	No	Yes	No	No
"	"	"	*Arundinaria gigantea* (Walter) Muhl.	Giant cane	3	Yes	No	No	Yes	Yes
"	Cyperaceae	----	*Schoenoplectus maritimus* (L.) Lye	Alkali Bulrush	3	Yes		No	No	Yes

Juncales	Juncaceae	----	*Juncus acutus* L.	Spiny rush	5	Yes		No	No	Yes
Typhales	Typhaceae	----	*Typha domingensis* Pers.	Narrowleaf cattail	5	Yes	Yes	No	No	Yes
Arecales	Arecaceae	----	*Sabal mexicana* Mart.	Rio Grande palmetto	5	Yes	Yes	No	Yes	Yes
Juglandales	Juglandaceae	----	*Carya illinoinensis* (Wangenh.) K. Koch	Pecan	6	Yes	Yes	Yes*	Yes	Yes
Salicales	Salicaceae	----	*Salix exigua* Nutt.	Narrowleaf willow	6	Yes	Yes	No	No	Yes
Asterales	Asteraceae	----	*Baccharis neglecta* Britton	Dryland Baccharis	6	Yes	Yes	No	No	Yes
“	Oleaceae	----	*Fraxinus berlandieriana* DC.	Rio Grande Ash	6	Yes	Yes	No	Yes	Yes

Appendix 2.. Host range testing results for *Tetramesa romana* (originating in France) (Goolsby, 2008)

Species	Reps	Reps w/ probing	Obs. T (hr)	Time Budget					Reps w/ reprod.	*Tetramesa* emerging	*Tetramesa* / reprod. female	*Tetramesa* / Rep ± SE	% Plants producing *Tetramesa*
				# Probes	% Probe	% Stem	% Leaf	% Cage					
Arundo donax Laredo, TX	17	14	228.1	168 [a]	10.5 [a]	12.6 [ab]	36.3 [ab]	40.6 [f]	10	188	18.8	11.1±3.6[a]	58.8
Arundo donax San Juan, TX	27	22	200.8	152 [b]	17.4 [a]	13.1 [a]	16.9 [abc]	52.7 [ef]	11	104	9.5	3.9±0.9[b]	40.7
Arundo formosana	10	4	112.3	19 [b]	2.1 [b]	3.3 [dce]	16.0 [cdef]	78.7 [abcd]	1	2	2.0	0.2±0.21[b]	11.1
Phragmites australis Los Fresnos TX	29	8	279.3	48 [ab]	2.7 [b]	5.1 [bcde]	7.9 [cdefg]	84.3 [abcde]	0	0	0.0	0.0	0.0
Phragmites australis San Benito TX	6	3	55.6	11 [b]	2.2 [b]	4.4 [dce]	4.3 [cdefg]	89.2 [abcd]	0	0	0.0	0.0	0.0
Phragmites australis Bentsen S.P. TX	6	2	58.7	17 [b]	7.3 [b]	8.7 [dce]	5.6 [cdef]	78.4 [abcd]	0	0	0.0	0.0	0.0
Phragmites australis Charlestown RI	10	1	133.1	6 [b]	0.5 [b]	0.5 [cbde]	7.0 [cdefg]	92.1 [abcde]	0	0	0.0	0.0	0.0
Phragmites australis Santa Paula CA	3	0	12.1	0 [b]	0.0 [b]	2.8 [abcde]	0.0 [bcde]	97.3 [bcde]	0	0	0.0	0.0	0.0
Phragmites australis Colorado River CA	6	0	48.6	0 [b]	0.0 [b]	3.1 [cde]	14.2 [efg]	82.8 [ab]	0	0	0.0	0.0	0.0
Phragmites australis Owens River CA	4	1	34.8	1 [b]	0.2 [b]	0.5 [bcde]	8.7 [defg]	90.6 [abcd]	0	0	0.0	0.0	0.0
Molinia caerulea	6	0	72.5	0 [b]	0.0 [b]	3.1 [cde]	0.1 [defg]	96.8 [ab]	0	0	0.0	0.0	0.0
Hakonechloa macra	4	1	23.2	5 [b]	4.2 [b]	9.3 [abcde]	6.5 [defg]	80.1 [abcd]	0	0	0.0	0.0	0.0

Aristida purpurea var. *longiseta*	6	0	75.8	0^{b}	0.0^{b}	0.1^{cde}	5.2^{defg}	94.7^{ab}	0	0	0.0	0.0	0.0
Chasmanthium latifolium	2	0	22.8	0^{b}	0.0^{b}	0.0^{cde}	0.0^{defg}	100.0^{ab}	0	0	0.0	0.0	0.0
Cynodon dactylon	6	0	64.1	0^{b}	0.0^{b}	0.0^{e}	0.0^{fg}	100.0^{a}	0	0	0.0	0.0	0.0
Spartina spartinae	8	1	82.3	3^{b}	0.8^{b}	0.7^{cde}	1.1^{defg}	97.4^{ab}	0	0	0.0	0.0	0.0
Spartina alterniflora	4	1	13.5	2^{b}	1.5^{b}	0.3^{cde}	0.3^{defg}	98.0^{ab}	0	0	0.0	0.0	0.0
Uniola paniculata	10	4	120.3	31^{b}	5.5^{b}	4.6^{bcde}	8.6^{cdefg}	81.4^{bcde}	0	0	0.0	0.0	0.0
Leptochloa panicea	6	1	62.1	6^{b}	1.9^{b}	5.6^{abcd}	7.0^{defg}	85.6^{abcde}	0	0	0.0	0.0	0.0
Leptochloa uninervia	6	0	73.7	0^{b}	0.0^{b}	0.1^{cde}	6.7^{defg}	93.2^{abc}	0	0	0.0	0.0	0.0
Leptochloa virgata	2	0	22.6	0^{b}	0.0^{b}	0.0^{cde}	9.6^{cdefg}	90.4^{abcd}	0	0	0.0	0.0	0.0
Danthonia spicata	2	0	18.2	0^{b}	0.0^{b}	0.0^{cde}	0.0^{defg}	100.0^{ab}	0	0	0.0	0.0	0.0
Cortaderia selloana	8	3	71.1	20^{b}	4.5^{b}	2.8^{cde}	9.1^{cde}	100.0^{abcd}	0	0	0.0	0.0	0.0
Panicum virgatum	11	5	109.9	23^{b}	3.2^{b}	7.4^{abcd}	10.0^{defg}	79.4^{bcde}	0	0	0.0	0.0	0.0
Panicum hirsutum	5	0	33.5	0^{b}	0.0^{b}	0.1^{cde}	20.6^{bcd}	79.3^{bcde}	0	0	0.0	0.0	0.0
Panicum amarum	2	0	18.8	0^{b}	0.0^{b}	0.0^{cde}	0.0^{defg}	100.0^{ab}	0	0	0.0	0.0	0.0
Sorghum bicolor	9	0	85.0	0^{b}	0.0^{b}	2.0^{cde}	16.6^{cdefg}	81.5^{abcd}	0	0	0.0	0.0	0.0
Zea mays	12	3	143.6	9^{b}	1.4^{b}	4.5^{cde}	20.3^{abc}	73.8^{de}	0	0	0.0	0.0	0.0
Saccharum officinarum	8	1	77.1	6^{b}	1.4^{b}	3.1^{cde}	17.8^{abc}	77.7^{cde}	0	0	0.0	0.0	0.0
Triticum aestivum	3	0	13.1	0^{b}	0.0^{b}	0.0^{cde}	10.2^{cdefg}	89.8^{abcd}	0	0	0.0	0.0	0.0
Distichlis spicata	3	0	20.5	0^{b}	0.0^{b}	0.5^{cde}	1.0^{defg}	98.5^{ab}	0	0	0.0	0.0	0.0
Sporobolus wrightii	6	1	31.4	1^{b}	1.1^{b}	3.7^{bcde}	13.3^{cde}	81.9^{abcde}	0	0	0.0	0.0	0.0
Oryza sativa	3	0	18.8	0^{b}	0.0^{b}	15.2^{abc}	2.7^{bcde}	82.2^{de}	0	0	0.0	0.0	0.0
Arundinaria	6	2	65.3	10^{b}	2.1^{b}	1.8^{cde}	8.3^{cde}	87.8^{abcd}	0	0	0.0	0.0	0.0

gigantea													
Schoenoplectus maritimus	5	0	74.3	0^{b}	0.0^{b}	0.0^{cde}	3.0^{defg}	97.0^{ab}	0	0	0.0	0.0	0.0
Juncus acutus	10	3	128.5	7^{b}	0.7^{b}	5.0^{cde}	0.0^{g}	94.3^{ab}	0	0	0.0	0.0	0.0
Typha latifolia	4	0	34.1	0^{b}	0.0^{b}	0.0^{de}	23.5^{abdc}	76.5^{abcde}	0	0	0.0	0.0	0.0
Sabal mexicana	3	0	22.4	0^{b}	0.0^{b}	0.0^{de}	0.0^{efg}	100.0^{ab}	0	0	0.0	0.0	0.0
Carya illinoinensis	3	0	35.3	0^{b}	0.0^{b}	0.0^{de}	9.1^{cdefg}	90.9^{abcd}	0	0	0.0	0.0	0.0
Salix exigua	3	0	33.1	0^{b}	0.0^{b}	0.1^{cde}	3.6^{cdefg}	96.3^{abcd}	0	0	0.0	0.0	0.0
Baccharis neglecta	4	0	43.6	0^{b}	0.0^{b}	0.2^{cde}	19.3^{bcde}	80.5^{abcde}	0	0	0.0	0.0	0.0
Fraxinus berlandieriana	4	0	30.3	0^{b}	0.0^{b}	5.0^{cde}	34.1^{a}	61.0^{ef}	0	0	0.0	0.0	0.0

Values in columns with different superscript letters are significantly different from each other ($P < 0.05$)

Appendix 3. Response to comments received on draft Environmental Assessment.

Notice of the EA was made available in the Federal Register on March 6, 2009 for a 30-day public comment period. Ten comments were received. Five of those comments were in support of the release of *T. romana.* One comment from a federal agency indicated no opinion on the release. Comments received from the four others are addressed below in a question and answer format.

1. What prior introductions of non-native species have been made and were they successful and/or did they have negative unplanned side effects?

Biological control has been used as a management tool in the control of alien plants for almost 150 years. In 1863, cochineal insects were first used, in India, for the biological control of a cactus weed. Since then biological control has become an accepted and common practice in nearly 100 countries around the world. Many species of alien weeds have been targeted and more than 700 species of plant feeding insects and pathogens have been tested and released.

There are many examples from around the world where biological control agents, acting on their own (i.e. without any further management or financial inputs), have successfully suppressed and controlled populations of the target weeds. The agents may sustain these benefits for decades. At least 40 species of alien invasive plants have been completely controlled, in various countries across the world, using introduced biological control agents.

There are also many examples where the agents have contributed significantly to the management of the weeds by putting additional pressure on their target plants, reducing their density or rate of spread, thus successfully supplementing other methods of management and control. Although there are many examples of successful weed biological control, it is true that in some instances, biological control agents become established on their target weeds, inflict damage on the plants, but contribute little to the reduction of the weed populations. And in other cases, of course, biological control attempts fail because, for many reasons, the agents do not become established in their country of introduction.

2. What is the problem of *A. donax*?

This is discussed on pages 4 and 5 of the EA.

3. Where geographically is *A. donax* a problem?

In the United States, it is invasive from northern California across the southwestern and southeastern United States to Virginia. It is widely distributed in Mexico, and Central and South America. Most severe infestations are in Arizona, California, and Texas, especially the Santa Ana River Basin and Rio Grande Basin. In the world, *A. donax* is known to be problematic in South Africa, Australia, and Mexico.

4. What threats to humans and animals does this wasp present?

T. romana is a wasp but it does not sting or produce venom. It is a plant feeding wasp which poses

no risk to humans or other animals. This is discussed on page 23 of the EA.
5. The EA does not explain how harvesting, if any, of dead cane might be undertaken to prevent potential rapid decomposition (which could lead to low dissolved oxygen levels and perhaps high nutrient loading), leading to decreased water quality.

Harvesting will not be part of the biological control program. *Arundo donax* is not expected to rapidly decompose following release of *T. romana*. Feeding by the wasp causes stunting of new growth, which limits growth of new canes and side shoots. It does not lay eggs into mature canes. Currently, dead *A. donax* canes will stand in the field for 1-2 years before decomposition. In Europe, the same processes have been observed even with the full suite of herbivores. Therefore, rapid decomposition leading to decreased water quality is not expected.

6. The EA does not seem to rule out negative impacts on native species. It seems to discuss potential impacts to other plant species but neglects impacts on invertebrate species; this is especially important in arid environments such as the Chihuahuan desert, with endemic species with low abundance and localized distribution. The wasp as a taxon is a generalist—that is, it has broader, less specialized niche requirements, able to use a variety of potential food and habitat resources— but impacts, if any, on resources used by similar species are not discussed.

Many wasp species in the insect suborder Apocrita are predators and some species like yellow jackets in the family Vespidae fit the description above. However, *T. romana* belongs to a group of primitive, plant-feeding wasps in the family Eurtyomidae. *Tetramesa romana* are extreme specialists and can only feed and develop on plants in the genus *Arundo*. They do not possess the biology or mouthparts to attack or consume other insects.

7. The impacts of adult wasps, especially on what they feed, are not stated in the EA. Specifically, the EA does not describe the food habits of the adult wasp nor potential impacts on other invertebrates.

See comment above. Adult *T. romana* wasps feed only on nectar and water droplets. Adults do not feed on other insects or other invertebrates.

8. It is not clear that the implications of range expansion have been evaluated, given the cold-tolerance allowing persistence in Texas.

Tetramesa romana should be expected to live anywhere in North America that is suitable for growth of *A. donax*. This species is native to Mediterranean Europe where moderately cold winters are common. Therefore, because *T. romana* is a specialist insect, its range will mirror the range of *A. donax*.

9. The EA does not address future, long-term effects of the wasp—for example, what happens after *A. donax* is extirpated: would the wasp die out or would it adapt to other plants?

Successful biological control of weeds using insect agents reduce and maintain the target plants at low densities where they are no longer a problem. Over the years, the numbers of the target plant and the agent will fluctuate, but the target plant is never eradicated. In the very unlikely chance that the target host plant were to be eradicated, the introduced biological agents would likely die out with it.

10. The test plot in Austin showed that species probed various plant species looking for a place to lay eggs. The EA did not address how the piercing of plants, whether to lay eggs or not, will have an adverse impact on non-host plants by providing a point of entry for plant diseases, fungi, etc.

No damage to non-target plants was observed from the laboratory testing. Research shows that egg-laying behavior on non-target grasses occurs only under confined cage conditions and only infrequently. In Austin, where a population of the wasp is not established, no damage to non-target grass or plant species was observed.

11. With the recent issues associated with the proposed use of imazapyr by the Department of Homeland Security on *A. donax* along the Rio Grande, especially after local, state and federal agencies in Mexico became aware of the proposed aerial spraying, the EA is silent on the implications for the dispersal of the wasps to Mexico. The title references “continental United States” but clearly a release of the wasp along the Rio Grande would have consequences for Mexico.

Canada, the United States, and Mexico review potential releases of weed biological control agents prior to release. This process takes place as part of the Technical Advisory Group for Biological Control of Weeds, administered by USDA-APHIS. In the case of *T. romana*, Mexico recommended release of *T. romana* in North America and also permitted its release in Mexico. Researchers in Cuernavaca, Mexico at the Instituto Mexicano de Tecnologia del Aguas are currently rearing *T. romana* for release on the Mexican side of the Rio Grande and other impacted areas in Mexico, such as the Morelos Valley.

12. Discuss any recent information collected regarding the environmental effects of the existing occurrences of arundo wasps in Santa Barbara and Austin.

The adventive population (existing occurrence) of *T. romana* has become naturalized in Austin, San Antonio, Laredo, and Eagle Pass Texas and Ventura and Yorba Linda, CA. It appears that the *Arundo* wasp has only been established for a few years in Texas. The population in Laredo has expanded up and down the Rio Grande an additional 25 miles from February 2008 to February 2009. This shows that populations of the adventive Arundo wasp are only localized and not widespread. The impact of the adventive Arundo wasp on *A. donax* at this point in time is minimal. The wasp causes large galls to form on *A. donax* which diverts resources from growth. It also changes the growth of new cane by stunting stem elongation and causing early production of side shoots. This impact on *A. donax* weakens the plant making the existing native vegetation more competitive.

13. The Office of Border Patrol, Laredo Sector is about to undertake a cane eradication pilot effort.

The permit applicant is working closely with the Department of Homeland Security (DHS) Customs and Border Protection (CBP) and the Science and Technology Directorate. In addition, these agencies have provided supplemental funding to USDA for the biological control program of *A. donax*. The insect will likely be used by CBP in their program to control *A. donax* on the Texas/Mexico border.

Decision and Finding of No Significant Impact
for
Field Release of the Arundo Wasp, *Tetramesa romana* (Hymenoptera: Eurytomidae), an Insect for Biological Control of *Arundo donax* (Poaceae), in the Continental United States
April 2009

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ) Permit Unit, is proposing to issue permits for release of a wasp, *Tetramesa romana* Walker (Hymenoptera: Eurytomidae) in the continental United States. The agent would be used by the applicant for the biological control of *Arundo donax* L. (giant reed, carrizo cane). Before permits are issued for release of *T. romana*, APHIS must analyze the potential impacts of the release of this organism into the continental United States. APHIS has prepared an environmental assessment (EA) that analyzes the potential environmental consequences of this action. The EA is available from:

U.S. Department of Agriculture
Animal and Plant Health inspection Service
Plant Protection and Quarantine
Registrations, Identification, Permits, and Plant Safeguarding
4700 River Road, Unit 133
Riverdale, MD 20737
http://www.aphis.usda.gov/plant_health/ea/biocontrol_weeds.shtml

The EA analyzed the following two alternatives in response to the need to control *A. donax* and contain infestations: (1) no action, and (2) issue permits for the release of *T. romana* for biological control of *A. donax*. A third alternative, to issue permits with special provisions or requirements concerning release procedures or mitigating measures, was considered. However, this alternative was dismissed because no issues were raised that indicated that special provisions or requirements were necessary. The No Action alternative, as described in the EA, would likely result in the continued use at the current level of chemical, mechanical, and biological control methods for the management of *A. donax*. These control methods described are not alternatives for decisions to be made by APHIS, but are presently being used to control *A. donax* in the United States and may continue regardless of permit issuance for field release of *T. romana.* Notice of the EA was made available in the Federal Register on March 6, 2009 for a 30-day public comment period. Ten comments were received on the EA. The final EA contains written responses to all comments received on the draft EA in appendix 3.

I have decided to authorize the APHIS PPQ Permit Unit to issue permits for the environmental release of *T. romana.* The reasons for my decision are:

- This biological control agent is sufficiently host specific and poses little, if any, threat to the biological resources of the continental United States.

- The release will have no effect on federally listed threatened and endangered species or their habitats in the continental United States.

- *T. romana* poses no threat to the health of humans or wild or domestic animals.

- No negative cumulative impacts are expected from release of *T. romana.*

- There are no disproportionate adverse effects to minorities, low-income populations, or children in accordance with Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations" and Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks."

- While there is not total assurance that the release of *T. romana* into the environment will be reversible, there is no evidence that this organism will cause any adverse environmental effects.

An environmental impact statement (EIS) must be prepared if implementation of the proposed action may significantly affect the quality of the human environment. I have determined that there would be no significant impact to the human environment from the implementation of any of the action alternatives and, therefore, no EIS needs to be prepared.

M. J. Firko — 04/10/2009

Dr. Michael J. Firko — Date
Director
Registrations, Identification, Permits, and Plant Safeguarding
APHIS Plant Health Programs
Plant Protection and Quarantine