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# Field Release of the Biological Control Agent *Lophodiplosis trifida* Gagné (Diptera: Cecidomyiidae) for the Control of *Melaleuca quinquenervia* (Cav.) S.T. Blake (Myrtales: Myrtaceae) in the Continental United States

## Environmental Assessment
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# I. Purpose and Need for the Proposed Action

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), is proposing to issue a permit to the USDA Agricultural Research Service, Invasive Plant Research Laboratory, for the environmental release of the melaleuca stem-gall fly, *Lophodiplosis trifida* Gagné (Diptera: Cecidomyiidae). The agent would be used by the applicant for the biological control of melaleuca (Australian broad-leaved paperbark), *Melaleuca quinquenervia* (Cav.) S.T. Blake (Myrtales: Myrtaceae: Leptospermoideae) in Florida. Before permits are issued for release of *L. trifida*, APHIS must analyze the potential impacts of the release of this agent into the environment of 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 *L. trifida* to control infestations of *Melaleuca quinquenervia* (melaleuca) in Florida. This EA considers the potential effects of the proposed action and its alternatives, including no action.

The applicant's purpose for releasing *L. trifida* is to reduce the severity of infestations of melaleuca in Florida. Melaleuca is a large tree of Australian origin that has invaded large expanses of wetlands in south Florida. It was intentionally introduced into Florida for ornamental, soil stabilization, and agroforestry purposes prior to 1906. It was widely planted in wetlands as an inexpensive production for the nursery trade and in an attempt to produce a harvestable commodity. As a result, this exotic tree naturalized and over time displaced much of the native vegetation in the swamp forests and sawgrass-dominated wetlands that constitute the Florida Everglades (Turner *et al.,* 1998).

The invasion success of melaleuca relates primarily to its ability to produce large quantities of seed. Individual trees bear up to 100 million seeds. About 2.5 billion seeds per hectare are stored in the canopies of melaleuca forests typical to south Florida. Massive simultaneous seed

[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.

releases occur following fire, herbicide treatments, or any event that causes the capsules that contain the seed to dry out. However, a steady seed rain is produced year round even without these stimuli.

Melaleuca has invaded more than a half-million acres of agricultural, riparian, and wetland systems in south Florida, and over $25 million has been spent over the past decade to manage it. Yet it continues to thrive and spread, specifically on unmanaged private lands.

There is a need to release a host-specific biological control agent to reduce infestations of melaleuca because chemical treatments and controlled burns induce the release of billions of seeds which produce thickets of saplings where only a few trees existed prior to treatment. These infestations are often in sensitive habitats that are difficult to access and hazardous in which to work. Moreover, multiple follow-up site visits are necessary to hand-remove seedlings and thereby prevent regeneration.

Because it is host specific, *L. trifida* is expected to affect directly only the target weed, melaleuca, in Florida. The primary aim of the release of this agent ( in combination with previously released melaleuca biological control agents) is to debilitate melaleuca trees, hindering spread to new sites, while hampering regeneration at cleared sites by precluding seed production and minimizing survival of seedlings and saplings.

# II. Alternatives

This section will explain the two alternatives available to APHIS; no action and to issue permits for release of *L. trifida*. Although APHIS' alternatives are limited to a decision on whether to issue permits for release of *L. trifida*, other methods available for control of melaleuca are also described. These control methods are not decisions to be made by APHIS and are likely to continue whether or not permits are issued for environmental release of *L. trifida.* These are methods presently being used to control melaleuca by public and private concerns.

A third alternative was considered, but will not be analyzed further. Under this third alternative, APHIS would have issued permits for the field release of *L. trifida* but they 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, APHIS would not issue permits for the field release of *L. trifida* for the control of melaleuca. The release of this biological control agent would not take place. The following methods are presently being used to control melaleuca in Florida and these methods will continue under the "No Action" alternative and will likely continue to some extent even if permits are issued for release of *L. trifida*.

### 1. Chemical Control

The primary method used to remove large melaleuca trees involves cutting into the trunks then squirting herbicide into the wounds. The cuts can either girdle the bark on large trees or completely sever the trunk of small trees. Herbicides, such as imazapyr or imazapyr combined with glyphosate, are applied by hand directly onto the exposed cambial layer. Fairly low concentrations of triclopyr products also work on cut stumps and greatly reduce non-target damage (Center, 2007).

### 2. Mechanical Control

Trees are removed with heavy equipment in accessible areas, such as along canals, utility rights-of-way, and in new developments. Seedlings and small saplings may be hand pulled, especially after the older trees are killed or removed.

### 3. Biological control

The Australian weevil, *Oxyops vitiosa* Pascoe was released during April, 1997 (Center *et al*., 2000). It established throughout south Florida (Pratt *et al.*, 2003) except at long-hydroperiod sites (i.e., Loxahatchee National Wildlife Refuge) where the subterranean pupae cannot survive prolonged submergence under water. The melaleuca psyllid, *Boreioglycaspis melaleucae* Moore, was released in February, 2002 (Center *et al.*, 2006). It has established in at least 9 south Florida counties and is rapidly expanding its range, causing extensive defoliation of melaleuca trees (Morath *et al.*, 2006) and mortality of seedlings (Franks *et al.*, 2006). It performs best during the dry season and persists at wet sites but does not thrive during rainy periods. A bud-galling fly along with a mutualistic nematode (Giblin-Davis *et al.*, 2001) has recently been released which could further reduce seed production by subverting development of flower-producing branch apices, but populations have not established in the field (Blackwood *et al.*, 2005). Scientists at the USDA-ARS Invasive Plant Research Laboratory in Ft. Lauderdale, Florida continually evaluate the impact of *O. vitiosa* and *B.*

*melaleucae*. They report promising results (Rayamajhi *et al.*, 2007; Pratt *et al.,* 2003) but melaleuca regeneration from the huge, persistent seed bank continues to occur in some areas.

## B. Issue Permits for Environmental Release of *L. trifida*

Under this alternative, APHIS would issue permits for the field release of *L. trifida* for the control of melaleuca in Florida. The permits would contain no special provisions or requirements concerning release procedures or mitigating measures.

### 1. Biological control agent information

a. Taxonomy

| | |
|---|---|
| Order: | Diptera |
| Family: | Cecidomyiidae |
| Supertribe: | Cecidomyiidi |
| Genus: | *Lophodiplosis* |
| Species: | *trifida* Gagné |

Common names: gall midge, melaleuca stem-gall fly

*Lophodiplosis trifida* is a gall midge that directly attacks *Melaleuca dealbata, M. quinquenervia,* and *M. viridiflora* in Australia (Purcell and Brown, in press). Raymond J. Gagné, retired, USDA Agricultural Research Service, Systematic Entomology Laboratory, U.S. Museum of Natural History, Washington, DC, described this species, placing it in a new genus, *Lophodiplosis* (Gagné *et al.,* 1997).

Specimens are deposited in the Australian National Insect Collection, Canberra, Australia. Additional specimens from Australia are lodged at the U.S. Museum of Natural History, Washington, D.C.

b. Geographical range

*Lophodiplosis trifida* is known from Queensland and New South Wales, Australia (Gagné *et al.*, 1997; ABCL Annual Report, 2002). *Lophodiplosis trifida* has not been introduced in any countries outside its native range. The expected range in North America would be limited to southern Florida unless it migrates south to the Caribbean, or west to Louisiana, Texas, California, and Hawaii where the target host exists.

c. Known host range (specificity)

The known field host range of *L. trifida* is limited to three *Melaleuca* species in the *Melaleuca leucadendra*-complex, *M. dealbata, M. quinquenervia* and *M. viridiflora* (Purcell and Brown, in press). The known laboratory host range includes these species plus two additional species in the same complex, *M. argentea* and *M. cajuputi*.

d. Life history

*Lophodiplosis trifida* produces multiple, over-lapping generations per year. Adults are small flies, <5 millimeters (mm) in length, with long fragile legs and antennae. The eyes cover a large portion of the head. The wings, legs, antennae, and body bear numerous small, fine hairs. On average males are smaller than females. The average length of lab-reared males from head to claspers is 1.77 mm. The average length of lab-reared females from head to last abdominal segment is 2.37 mm. Within hours after emergence, females can be distinguished easily from males as their translucent abdomens are filled with red-orange eggs.

The adults do not feed, do not bite, do not sting, and are short-lived. In a quarantine laboratory study using ten males and ten females, males lived <3.5 days and females <5 days. *Lophodiplosis trifida* adults reared in a quarantine greenhouse emerged during twilight or evening hours. Mating was observed on a few occasions during daylight hours from early morning through late afternoon. Females are able to mate within hours of emergence. The elongate eggs are laid singly or in groups on young stems, buds, and leaves of melaleuca. Females laid an average of 162.2 eggs during their adult lifetime. The eggs were loosely attached, easily falling off if disturbed.

Under quarantine greenhouse conditions, eggs hatch after about six days. Newly-hatched larvae burrow into the stem or leaf tissue. They penetrate the plant stem at the base of the leaf petiole and stem axis at a point where many hairs envelop the new bud tissue. The hairs possibly protect the larvae from parasites and predators and may function as guides to entry points into the plant tissue. The newly-hatched larvae, approximately 0.28 mm long, are translucent but appear yellow. They have a red eye spot on top and paired white fat bodies on the sides of 10 segments. Last-instar (developmental stage) larvae near pupation are about 1.5 mm long, are white, and are positioned in the gall chamber like a hairpin or shape of a "u".

Larvae begin feeding after they enter the plant tissue. Enzymes in the larval saliva initiate gall formation. Galls develop in the stem, buds, and leaves but stems are most heavily galled. Galls are abnormal plant growths caused by other organisms, including insects, mites, and fungi. The galls that form can be either monothalamous (single chamber housing a single individual) or polythalamous (multiple chambers each housing one individual but sharing chamber walls); the latter being quite common. Multi-chambered galls on stems can be several centimeters long.

The time between egg hatch and first emergence of adults is about six weeks at 24°C, 55-74% relative humidity. The fully developed adult leaves behind a pupal exuvia or skin, loosely attached to the exterior of the gall as it exits from the gall. Galled tissue from which individuals have emerged becomes woody or lignified.

e. Known mortality factors.

Parasitoids destroyed a laboratory colony in Australia that had heavily infested melaleuca plants in a greenhouse. The identification of the parasitoid remains unknown. Fourteen groups of parasitoids have been found in association with *L. trifida* in Australia. These parasitoids have been identified to the insect family level for twelve of the 14 groups: three groups are identified as Torymidae, two as Platygasteridae, two as Braconidae, three as Encyrtidae, and two as Eupelmidae. In Florida, spiders inadvertently transported into quarantine built webs in colony cages which entrapped *L. trifida* adults. Ants were observed harvesting adults and possibly immatures in colony cages.

# III. Affected Environment

## Areas affected by melaleuca

### 1. Native range

The center of origin of melaleuca is northeastern Australia. Its range includes much of the coastal region from Sydney northward as well as New Caledonia and Papua New Guinea (Craven and Lepschi, 1999).

### 2. Introduced range

a. World range

It is present as an ornamental in Brazil, China, Hawaii, Mexico, Venezuela, Costa Rica, and the Virgin Islands, and as a weed in Puerto Rico, the Bahamas, and Cuba. In Hong Kong, it was widely planted by local agencies and is now naturalized and spreading. This is also true in the Caribbean area (Pratt *et al.*, 2005).

b. Continental U.S. range

Melaleuca has been introduced into Florida, California, Louisiana, and Texas in the continental United States, but has not escaped cultivation and become invasive except in Florida. Large trees in central Florida die back to the trunk after hard freezes then refoliate. Freezing temperatures kill smaller trees so melaleuca probably could not invade areas far outside the current naturalized and cultivated distribution. However, within the current distribution, it could expand into coastal marshes of California and wetlands of Louisiana and Texas if seed sources were present.

c. Ecological communities in Florida

In Florida, melaleuca invades many diverse, mostly low-lying wetland habitats, including sawgrass marshes, cypress heads, mesic prairies, pine flatwoods, pastures, lake margins, highway rights-of-way, and ditch banks (Bodle *et al.*, 1994). Ecological communities within the project area where melaleuca is found are described in this section (U.S. Fish and Wildlife Service, 1999).

<u>Mesic temperate hammock</u>

Mesic temperate hammock is a closed canopy forest, dominated by temperate evergreen tree species, primarily live oak and cabbage palm. Soils in mesic temperate hammocks remain moist due to shading and dense leaf litter, but they are rarely inundated. Mesic temperate hammocks are found primarily in four topographic positions in the South Florida Ecosystem: (1) as "islands", in a pine-cypress-or graminoid-dominated community, also known as prairie hammock; (2) as "islands" on elevated areas within floodplain wetlands, (3) on levees of rivers, and (4) midslope or ecotonal between xeric communities and low-lying wetland communities.

<u>Pine rocklands</u>

The overstory of pine rocklands is open and dominated by a canopy of South Florida slash pine ranging in height from 20 to 24 meters (65.6 to 79.2 feet). In the lower Keys the pine trees are smaller and the subcanopy includes *Thrinax* and *Coccothrina*x. There is little to no subcanopy. However, hardwoods that may occur in the subcanopy include live oak (*Quercus virginiana*), wild-tamarind (*Lysiloma latisiliquum*), and willow-bustic (*Sideroxylon salicifolium*). These species are more abundant in areas where natural fire is suppressed and in pine rocklands in close proximity to tropical hardwood hammocks.

Mesic pine flatwoods

The mesic pine flatwoods habitat is dominated by a slash pine or longleaf pine overstory with an upland understory. Mesic pine flatwoods are distinct from hydric and xeric pine flatwoods in the tendency toward midstory dominance by saw palmetto and scrub species such as fetterbush (*Lyonia lucida*), tarflower (*Befaria racemosa*), rusty lyonia (*Lyonia ferruginea*), cabbage palm (*Sabal palmetto*), and wax myrtle (*Myrica cerifera*).

Hydric pine flatwoods

The hydric pine flatwoods habitat is dominated by slash pine (*Pinus elliottii* var. *densa*) overstory with a wetland plant understory. The wetland understory can be any, or a variety, of wetland plant community types ranging from wet prairie to hatrack cypress. Hydric pine flatwoods are distinct from mesic and xeric pine flatwoods in the absence of understory dominance by saw palmetto (*Serenoa repens*) and more xeric species such as pennyroyal (*Piloblephis rigida*), pawpaw (*Asimina* spp.), and prickly pear (*Opuntia* spp.). Mid-story plants of hydric pine flatwoods include cypress (*Taxodium* spp.), cabbage palm (*Sabal palmetto*), wax myrtle (*Myrica cerifera*), dahoon holly (*Ilex cassine*), and red bay (*Persea palustris*), as well as species characteristic of mixed hardwood swamp forest and cypress forest of South Florida: red maple (*Acer rubrum*) and buttonbush (*Cephalanthus occidentalis*).

Freshwater marshes and wet prairies

The majority of the plant associations of freshwater marshes and wet prairie are found throughout South Florida, including the Big Cypress Swamp region, St. Johns Marsh system, Kissimmee River floodplain, Lake Okeechobee perimeter marshes, and as far southward as isolated marshes in the Florida Keys. Besides the enormous expanse of marshes found in the Everglades region of South Florida, marsh and wet prairie communities are associated with natural depressions, the edges of natural lakes, ponds, creeks, rivers, and human-made impoundments such as borrow pits and canals.

Flowing water swamps

Flowing water swamps are seasonally inundated forested wetlands located along or within drainage channels. They include the floodplain wetlands along clearly defined rivers, as well as the strands and sloughs that characterize shallower and more diffuse flowways.

Typical strand swamp vegetation includes cypress, red maple (*Acer rubrum*), cabbage palm (*Sabal palmetto*), strangler fig (*Ficus aurea*), swamp bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), royal palm (*Roystonea regia*), coastal plain willow (*Salix caroliniana*), wax myrtle (*Myrica cerifera*), myrsine (*Rapanea punctata*), buttonbush (*Cephalanthus occidentalis*), poison ivy (*Toxicodendron usneoides*), swamp lily (*Crinum* spp.), leather fern (*Acrostichum* spp.), and royal fern (*Osmunda regalis*). The canopy plants are mainly temperate, while the understory and epiphytic plants are generally tropical. The deeper sloughs are characterized by a subcanopy of pop ash and/or pond apple abundantly festooned with tropical epiphytes.

<u>Pond swamps</u>

Pond swamps are seasonally inundated forested wetlands located around or within landscape depressions. They include the lake border swamps and major wetlands within large landscape basins, as well as smaller cypress domes and gum ponds. The dwarf cypress savannas that cover vast shallow basins in the Big Cypress subregion are also categorized as pond swamps.

Typical dome swamp plants include pond cypress, red maple (*Acer rubrum*), dahoon (*Ilex cassine*), swamp bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), coastal plain willow (*Salix caroliniana*), wax myrtle (*Myrica cerifera*), buttonbush (*Cephalanthus occidentalis*), St. John's wort (*Hypericum* spp.), chain fern (*Woodwardia* spp.), poison ivy (*Toxicodendron radicans*), laurel greenbrier (*Smilax laurifolia*), Spanish moss (*Tillandsia usneoides*), and fireflag (*Thalia geniculata*). Dominant basin swamp plants include blackgum (*Nyssa sylvatica* var. *sylvatica*), cypress, and slash pine (*Pinus elliottii*). Other typical plants include red maple, swamp bay, sweetbay, loblolly bay (*Gordonia lasianthus*), Virginia willow (*Itea virginica*), wax myrtle, buttonbush, laurel greenbrier, and Spanish moss.

<u>Seepage swamps</u>

Seepage swamps are forested wetlands characterized by saturated soils rather than periodic inundation. They include baygalls at the base of seepage slopes, bayheads in peat-filled depressions or at the downstream ends of Everglades teardrop islands, and hydric hammocks on low sand or limestone rises within periodically inundated wetland systems.

<u>Coastal salt marsh</u>

Salt marshes are found in flat, protected waters usually within the protection of a barrier island, estuary, or along low-energy coastlines. Situated between the land and the sea, salt marshes experience the effects of both salt and fresh water. Tidal effects are greatest on marsh areas below mean low water, while upland freshwater sources influence areas above mean high water.

# Plants related to melaleuca and their distribution

## 1. Taxonomically related plants

The family Myrtaceae includes about 130 genera and 4,600 species of trees or shrubs (Mabberley, 1997). Most are tropical species and native to the Americas, Asia, and Australia. Various species have been cultivated, mainly for their fruits: guava (*Psidium*), Malabar plum or rose-apple (*Syzygium jambos*), jaboticaba (*Myrciaria cauliflora*), Surinam cherry (*Eugenia uniflora*), oil of bay or bay-rum tree (*Pimenta racemosa*), allspice (*Pimenta dioica*), feijoa or pineapple guava (*Acca sellowiana*), and bottlebrushes (*Melaleuca* spp.). Eucalyptus (*Eucalyptus* spp.), which is often cultivated for timber, exists in Florida mainly in experimental plantings.

Thorne (1983) proposed three subfamilies of Myrtaceae: Psiloxyloideae, Heteropyxidoideae, and Myrtoideae. Other authors recognize only two: Leptospermoideae and Myrtoideae which is adopted in this document. *Melaleuca quinquenervia* is in the subfamily Leptospermoideae along with the introduced ornamentals: bottlebrush (*Callistemon*), eucalyptus (*Eucalyptus*), and manuka, (*Leptospermum scoparium*).

Most *Melaleuca* species in the United States (Arizona, California, and Florida), present in ornamental plantings or sold in the ornamental trade, are narrow- or needle-leaved species. These are very distinct from the 16-20 species in the broad-leaved *Melaleuca leucadendra*-complex that includes *M. quinquenervia*. In Arizona and California, six narrow-leaved species have been sold: *M. decussata, M. elliptica, M. ericifolia, M. hypericifolia, M. nesophila*, and *M. styphelioides*. Of these, only *M. styphelioides* overlaps in distribution with *M. quinquenervia* in Australia. In California and Florida, *M.* (*Callistemon*) *citrinus* and *M.* (*C.*) *viminalis* species are currently available in the wholesale trade. Varieties of these species appear similar to *M. quinquenervia* but are not included in the *Melaleuca leucadendra*-complex. Both overlap in distribution with *M. quinquenervia* in Australia.

All native Florida Myrtaceae and most introduced species are in the subfamily Myrtoideae. The native Myrtaceae include four genera: *Calyptranthes* (two species), *Eugenia* (four species), *Myrcianthes* (one species), and *Mosiera* (including two synonymized Florida species originally in *Myrtus*) (one species). None are federally listed as endangered or threatened, but three are State-listed as endangered (*Calyptranthes zuzygium, Eugenia confusa*, and *E. rhombea*) and three are State-listed as threatened (*Calyptranthes pallens, Myrcianthes fragrans*, and *Mosiera* (=*Psidium*) *longipes*) in Florida (Coile and Garland, 2003). All but *E. confusa* are being promoted for commercial propagation in the native plant industry and are sold by native plant nurseries.

Outside of the continental United States, there are five federally-listed endangered plants in the family Myrtaceae in Puerto Rico and the Virgin Islands: *Calyptranthes thomasiana, Calyptranthes estremerae, Eugenia haematocarpa, Eugenia woodburyana*, and *Myrcia paganii*. In Hawai'i, there is one known federally-listed endangered plant in the family Myrtaceae, *Eugenia koolauensis*. These plants are all in a separate subfamily from *M. quinquenervia* and the two subfamilies are not phylogenetically close.

# IV. Environmental Consequences

## A. No action

### 1. Impact from melaleuca on non-target plants

The impacts of melaleuca have been documented in the Florida economic impact statement (Diamond *et al.*, 1991), the Army COE Environmental Assessment for management control options (Silverberg, 1995), and most recently by Turner *et al.* (1998). Melaleuca has invaded approximately 200,000 hectares of agricultural, riparian and wetland systems. This invasive tree is competitively superior to many native plants and rangeland grasses with infestations causing degradation of native wildlife habitat and of the limited grazing lands in south Florida. Melaleuca invasion has transformed graminoid-herbaceous wetlands, including portions of the Everglades National Park, into closed-canopy swamp forests. These melaleuca swamp forests typically form dense monocultures characterized by a sparse understory. The increased structural diversity associated with open melaleuca savannahs temporarily results in increased biodiversity, but diversity is drastically reduced during later stages of invasion as monocultures form and displace native vegetation (O'Hare and Dalrymple, 1997). Accumulations of adventitious roots (roots that arise from any plant part other than the primary root) that filter and capture debris along with large quantities of litter production result in soil increase. This process increases the elevation of infested areas which results in drier habitats. In addition, melaleuca degrades vital waterways that contribute to productivity of fisheries, act as nursery sites for fish and crustaceans, regulate run-off quantity and quality, mitigate flooding, and control soil erosion.

Economists and ecologists estimate the value of services provided by wetlands to be worth $14,785 per hectare per year (Costanza *et al.,* 1997). Assuming minimal losses comprising only 1% of these services arising from current melaleuca infestations (about 200,000 hectares; Schmitz *et al.*, 1997), the lost value would total nearly $30 million per year. Furthermore, melaleuca is continuing to invade new areas causing accelerated degradation of wetlands. Infestation levels reported in 1994 were attained in less than 88 years, so melaleuca increased during this period at an average rate of 2,250 hectares per year or approximately 6.2 hectares per day. Assuming a continuous linear rate of change and 100% decrement of wetland functions due to infestation, potential added losses could be as high as $33.3 million per year. The South Florida Water Management District alone spent nearly $11 million to control this tree during 1991 to 1997 (Laroche, 1998), and estimates of losses to the local economy range as high as $168.6 million per year (Diamond *et al.*, 1991).

Homes located in developments built near or within melaleuca stands experience an increased fire risk. The hazard results from the high essential oil content of the foliage which is explosively flammable. Melaleuca is a hot-burning timber and produces a noxious black smoke which impacts public health during "brush" fires, and the reduced visibility creates a hazard for local drivers. The tree itself is also thought to be a source of aeroallergens (Sweeny *et al.,* 1994, but see Stablein *et al.,* 2002).

The large scale negative impact of melaleuca on the south Florida landscape was recognized more than 20 years ago. This led to its designation as a Florida Prohibited Aquatic Plant in 1990 and as a Federal Noxious Weed in 1992. As such, it is unlawful to possess melaleuca except under permit, and state and federal agencies are actively trying to "eradicate" melaleuca from public lands.

## 2. Impact from use of other control methods

The continued use of mechanical, chemical and biological controls at current levels would be a result if the “no action” alternative is chosen.

The effects on biological resources will vary depending upon the method(s) of management being used. Mechanical control methods will have no adverse effects outside of the treatment areas. There will be long term benefits from the restoration of native plant and animal communities with an increase in diversity. However, mechanical control is not appropriate for sensitive natural areas due to the habitat destruction caused by heavy equipment. Chemical control methods may have some short-term effects on non-target organisms, but will result in a long-term benefit of restoration of native plant and animal communities. However, chemical control treatments can be expensive. Aerial application of herbicides to small melaleuca stands is not appropriate because of potential impact of herbicide drift or overspray on non-target plants. Complete biological control of melaleuca by existing natural enemies is unlikely. The unique effect of *L. trifida* will complement the effects of existing natural enemies.

These environmental consequences may occur even with the implementation of the biological control alternative, depending on the efficacy of *L. trifida* to reduce melaleuca populations in Florida.

## B. Issue permits for environmental release

### 1. Impact of *L. trifida* on melaleuca

Potential impact of *L. trifida* on melaleuca is difficult to predict. However, laboratory studies indicate that *L. trifida* could impact melaleuca in Florida (Center, 2007). This insect is not expected to control melaleuca alone, but rather, is expected to complement the effects of other melaleuca biological control organisms by curtailing seed production and sapling growth. Galling of melaleuca stems by *L. trifida* is not expected to result in mortality of mature trees but may cause mortality in seedlings and saplings.

### 2. Impact of *L. trifida* on non-target plants

In egg laying tests, *L. trifida* laid eggs on 76.2% of the 63 non-target plant species but fewer eggs were laid on the non-target species than on melaleuca (see appendix 1 for a list of plant species tested). The majority of eggs laid on non-target plants were on 5 species: *Myrcianthes fragrans* (Myrtaceae: Myrtoideae), *Melaleuca viminalis* (Myrtaceae: Leptospermoideae), *Lagerstroemia indica* (Lythraceae), *Psidium cattleianum* (Myrtaceae: Myrtoideae), and *Ilex cassine* (Aquifoliaceae). However, galls occurred on only one of the 63 non-target species tested, *Melaleuca viminalis*, an exotic species occurring in Florida and California. Galls formed on four of seven *M. viminalis* plants (57%) versus 100% of *M. quinquenervia* control plants. One hundred percent of *M. quinquenervia* plants had three galled stems as compared to only 43% for *M. viminalis*, suggesting that *M. viminalis* would be less suitable as a host.

*L. trifida* did not complete development on any non-target species, including *M. viminalis*. Though *L. trifida* initiated small galls on *M. viminalis*, regular dissections revealed that only early larval stages inhabited the galls. One small empty chamber, smaller than a typical mature chamber on *M. quinquenervia,* was found once on *M. viminalis*. This observation indicates that a small adult could have emerged from this chamber, but in all other dissections of hundreds of *M. viminalis* chambers both in Australia and Florida, no pupae or new adults were observed. The attempted development on *M. viminalis* caused minor cosmetic damage consisting of swollen tissue where galls were initiated. While plants in these tests were not held to determine the effect of the swollen tissue on further growth, it was observed that affected stems of *M. viminalis* plants in Australia did continue to grow beyond the swollen areas.

Based on these laboratory tests and observations in Australia, *L. trifida* appears to be host-specific and is not expected to affect native, non-target plants in the continental United States.

### 3. Uncertainties regarding the environmental release of *L. trifida*

Once a biological control agent such as *L. trifida* is released into the environment and becomes established, there is a slight possibility that it could move from the target plant (melaleuca) to attack non-target 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 *L. trifida*, the resulting effects could be environmental impacts that may not be easily reversed. Biological control agents such as *L. trifida* 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, these agents may not be successful in reducing melaleuca in Florida. 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 melaleuca by *L. trifida* will not be known until after release occurs and post-release monitoring has been conducted. It is not expected that *L. trifida* alone will control melaleuca, but will act in combination with other biological control agents.

### 4. 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).

Past and present actions in Florida to control melaleuca

Historically, various agencies from County, State and Federal levels have played a role in melaleuca control. In 1990, the South Florida Water Management District helped the Exotic Pest Plant Council to form a multi-organizational Melaleuca Task Force to develop a regional melaleuca management plan. The Army Corps of Engineers have provided research funds and have treated melaleuca around Lake Okeechobee. The National Park Service has treated melaleuca in many areas of their properties with mixed results. Efforts to control melaleuca have occurred in Arthur R. Marshall Loxahatchee National Wildlife Refuge, Big Cypress National Preserve, and Everglades National Park. State cooperators like the South Florida Water Management District and Florida Department of Environmental Protection have taken the lead on treating melaleuca using herbicides on public lands in their respective jurisdictions, which has led to substantial reductions of large trees in State-managed lands. Counties, such as Lee, Palm Beach, and Miami-Dade, have aggressively treated melaleuca in parks and natural areas. Unfortunately, not all agencies are equally able to address the melaleuca problem and thus a patchwork of treatments and control efforts blanket Florida, with melaleuca reinvading treated areas from adjacent untreated lands. Private land owners rarely manage melaleuca-invaded lands.

The Areawide Management and Evaluation of Melaleuca (TAME) is a management program designed to promote long-term, biologically-based management for the invasive melaleuca problem in southern Florida. Through partnerships with public agencies and private land managers, the goal is to demonstrate the effectiveness of an Integrated Pest Management (IPM) approach for controlling melaleuca in the United States and beyond. Project collaborators include the South Florida Water Managment District, U.S. Army Corps of Engineers, U.S. Department of Interior, The Nature Conservancy, Lee County Parks and Recreation, Private Landowners, Miami-Dade County, National Park Service, Audubon, Bureau of Invasive Plant Management, University of Florida, Boise State University, and the USDA, Agricultural Research Service. TAME demonstration sites throughout South Florida showcase the combined effectiveness of multiple control tactics that IPM offers, with special emphasis on the use of biological control. Using demonstration site tours and other educational outreach activities, TAME provides land managers and property owners the information needed to apply these tactics to their own melaleuca infestations.

Release of *L. trifida* is not expected to have negative cumulative impacts in the continental United States because of its host specificity to melaleuca. Effective biological control of melaleuca wouldhave beneficial effects for weed management programs, and could result in a long-term, non-damaging method to assist in the control of melaleuca in Florida.

### 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.

No federally-listed species within the plant family Myrtaceae occur within the continental United States. Federally-listed species in the plant family Myrtaceae that occur in Hawaii, Puerto Rico, and the Virgin Islands would not likely be exposed to environmental release of *L trifida*. These include *Calyptranthes thomasiana, Calyptranthes estremerae, Eugenia haematocarpa, Eugenia woodburyana*, *Myrcia paganii*, and *Eugenia koolauensis*. All of these species are in a separate subfamily from *M. quinquenervia* and the subfamilies are not closely related. For these reasons and because of the host-specificity demonstrated by *L. trifida* in laboratory testing and observations in Australia, there will be no effect on any federally-listed threatened or endangered plants or critical habitat from the release of this organism into the environment.

## 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 *L. trifida* 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 *L. trifida*.

# VI. Agencies, Organizations, and Individuals Consulted

The Technical Advisory Group for the Biological Control Agents of Weeds (TAG) recommended the release of *L. trifida* on December 18, 2007. TAG members that reviewed the release petition (Center, 2007) included representatives from the U.S. Fish and Wildlife Service, Bureau of Indian Affairs, the Weed Science Society of America, Cooperative State Research, Education, and Extension Service, Environmental Protection Agency, National Plant Board, U.S. Forest Service, U.S. Geological Survey, U.S. Army Corps of Engineers, and Agriculture and Agri-food Canada.

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
Agricultural Research Service
Invasive Plant Research Laboratory
3225 College Ave.
Fort Lauderdale, FL 33314

# VII. References Cited

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# Appendix 1.  Test Plant List for *Lophodiplosis trifida*

## Category 1 – Genetic Type of the Target Weed Species

| Genus and Species | Common Name | N American Status |
|---|---|---|
| *Melaleuca quinquenervia* (Cav.)S.T.Blake | melaleuca, paperbark, punk | FL invasive exotic<br>CA, HI, LA, PR exotic |

## Category 2 – Same Genus as Target Weed

| Genus and Species | Common Name | N American Status |
|---|---|---|
| *Melaleuca alternifolia* Maiden & Betche ex Cheel | narrow leaved tea tree | not present |
| *Melaleuca armillaris* (Sol. ex Gaertn.)Sm. | bracelet or giant honey myrtle | CA exotic |
| *Melaleuca citrinus* (Curtis)Skeels ( as `*citrina*' ) | crimson bottlebrush | FL, LA, PR exotic |
| *Melaleuca viminalis* (Sol. ex Gaertn.)Byrnes | weeping bottlebrush | FL, naturalized exotic, CA exotic |
| *Melaleuca trichostachya* Lindl. | | FL exotic, CA exotic? |

## Category 3 – Species in Other Genera in the Same Family and Subfamily, Leptospermoideae, as Target Weed

| Genus and Species | Common Name | N American Status |
|---|---|---|
| *Eucalyptus amplifolia* Naudin | cabbage gum | FL exotic |
| *Eucalyptus camaldulensis* Dehnh. | Murray red gum | CA, HI, PR exotic |
| *Eucalyptus cinerea* F. Muell. ex Benth. | silver dollar tree | HI exotic |
| *Eucalyptus grandis* W. Hill | rose gum | FL exotic |
| *Leptospermum lanigerum* (Sol. ex Aiton) Sm. | woolly tea tree | CA, FL exotic |
| *Leptospermum petersonii* F.M.Bailey ( as `*Petersoni*' ) | lemon scented tea tree | CA, HI exotic |
| *Leptospermum rotundifolium* Domin [ nom. illeg. ] | round-leaved tea tree | CA exotic |
| *Leptospermum scoparium* J.R. Forst. & G. Forst. | manuka or manuka tea tree | FL, HI exotic |
| *Acca sellowiana* (O. Berg) Burret | feijoa, pineapple guava | FL exotic, crop |
| *Calyptranthes pallens Griseb.* | pale lidflower, spicewood | FL native |
| *Calyptranthes zuzygium* (L.) Sw. | myrtle-of-the-river | FL native |
| *Eugenia aggregata* (Vell.) Kiaerskov. | cherry-of-the-Rio-Grande | FL exotic |
| *Eugenia axillaris* (Sw.) Willd. | white stopper | FL native |
| *Eugenia brasiliensis* Lam. | Brazil cherry | FL exotic |
| *Eugenia confusa* DC. | redberry stopper; redberry Eugenia | FL native |

| | | |
|---|---|---|
| *Eugenia foetida* Pers. | Spanish stopper, boxleaf stopper | FL native |
| *Eugenia reinwardtiana* (Blume) DC. | mountain stopper | FL exotic |
| *Eugenia rhombea* Krug & Urb. ex Urb. | red stopper | FL native |
| *Eugenia uniflora* L. | Surinam cherry | FL naturalized exotic |
| *Eugenia uvalha* Camb. | uvalha | FL exotic |
| *Mosiera longipes* (O. Berg) Small | mangroveberry | FL native |
| *Myrcianthes fragrans* (Sw.) McVaugh | twinberry, Simpson's stopper | FL native |
| *Myrciaria cauliflora* (C. Martius) O.Berg | jaboticaba | FL exotic, crop |
| *Pseudanamomis umbellulifera* (Kunth) Kausel | | FL exotic |
| *Pimenta dioica* (L.)Merr. | allspice, pimento | FL exotic |
| *Pimenta racemosa* (Mill.)J.Moore | bay rum tree | FL exotic |
| *Psidium cattleianum Sabine* | strawberry guava | FL invasive exotic |
| *Psidium friedrichsthalianum* (O. Berg) Niedenzu | Costa Rican guava | FL exotic |
| *Psidium guajava* L. | guava | FL naturalized exotic, crop |
| *Syzygium cumini* (L.) Skeels | Java plum | FL invasive exotic |
| *Syzygium jambos* (L.) Alston | Malabar plum, rose apple | FL exotic |
| *Syzygium malaccense* (L.) Merr. & Perry | rose or malay apple | FL exotic |
| *Syzygium paniculatum* Gaertn.(*E. compacta*) | Australian brush cherry | FL exotic |
| *Syzygium samarangense* (Blume) Merr. & Perry | wax jambu | FL exotic, crop |

**Category 4 – Florida State-Listed Threatened and Endangered Species in the Same Family as Target Weed**

| Genus and Species | Common Name | N American Status |
|---|---|---|
| *Calyptranthes pallens* Griseb. | pale lidflower, spicewood | FL threatened |
| *Calyptranthes zuzygium* (L.) Sw. | myrtle-of-the-river | FL endangered |
| *Eugenia confusa* DC. | redberry stopper, redberry Eugenia | FL endangered |
| *Eugenia rhombea* Krug & Urb. ex Urb. | red stopper | FL endangered |
| *Mosiera longipes* (O. Berg) Small | mangroveberry | FL threatened |
| *Myrcianthes fragrans* (Sw.) McVaugh | Simpson's stopper | FL threatened |
| No North American Myrtaceae are on the Federal Endangered and Threatened Species List. There are five species in Puerto Rico and the Virgin Islands: *Calyptranthes thomasiana, Calyptranthes estremerae, Eugenia haematocarpa, Eugenia woodburyana*, and *Myrcia paganii*. In Hawai'i, there is one known federally endangered Myrtaceae, *Eugenia koolauensis*. | | |

### Category 5 – Species in the Same Order, Myrtales, as Target Weed

| Family, Genus and Species | Common Name | N American Status |
|---|---|---|
| Melastomataceae: *Tibouchina granulosa* (Desr.) Cogn. | glory bush | FL exotic |
| Combretaceae: *Bucida buceras* L. | black olive | FL exotic |
| Lythraceae: *Lagerstroemia indica* L. | crape myrtle | FL exotic |

### Category 6 – Species in Other Orders than the Target Weed

| Order, Family, Genus and Species | Common Name | N American Status |
|---|---|---|
| Laurales: Lauraceae: *Persea americana* Mill | avocado | FL exotic, crop |
| Urticales: Moraceae: *Ficus aurea* Nutt. | golden fig, strangler fig | FL native |
| Myricales: Myricaceae: *Myrica cerifera* L. | southern bayberry, wax myrtle | FL native |
| Fagales: Fagaceae: *Quercus virginiana* Mill. | live oak | FL native |
| Theales: Clusiaceae: *Hypericum fasciculatum* Lam. | sandweed, peelbark St. Johns'-wort | FL native |
| Salicales: Salicaceae: *Salix caroliniana* Michx. | Carolina willow, coastalplain willow | FL native |
| Evenales: Sapotaceae: *Sideroxylon reclinatum* Michx. | Florida bully | FL native |
| Primulales: Myrsinaceae: *Rapanea punctata* (Lam.) Lundell | myrsine, colicwood | FL native |
| Rosales: Pittosporaceae: *Pittosporum tobira* (Thunb.) Aiton | Japanese cheesewood | FL exotic |
| Rosales: Rosaceae: *Eriobotrya japonica* (Thunb.) Lindl. | loquat | FL exotic |
| Rosales: Rosaceae: *Prunus caroliniana* (Mill.) Aiton | Carolina laurelcherry | FL native |
| Celastrales: Aquifoliaceae: *Ilex* cassine L. | Dahoon | FL native |
| Rhamnales: Vitaceae: *Vitus rotundifolia* Michx. | | FL native |
| Sapindales: Rutaceae: *Citrus x limon* (L.) Osbeck | lemon | FL exotic, crop |
| Sapindales: Rutaceae: *Citrus x aurantium* L. | grapefruit | FL exotic, crop |
| Sapindales: Rutaceae: *Citrus x aurantium* L. | sweet orange | FL exotic, crop |
| Dipsacales: Adoxaceae: *Sambucus nigra* L. supbsp. *canadensis* (L.) Bolli | America elder, elderberry | FL native |
| Arecales: Arecaceae: *Serenoa repens* (w. Bartram) Small | saw palmetto | FL native |
| Cyperales: Poaceae: *Saccharum officinarum* L | sugarcane | FL exotic, crop |
| Cupressales: Cupressaceae: *Taxodium distichum* (L.) Rich.[b] | bald-cypress | FL native |
| Pinales: Pinaceae: *Pinus elliottii* Englem.[b] | slash pine | FL native |

**Category 7 – Any species on which Target Agent or Close Relative Found**

| Genus and Species | Common Name | N American Status |
|---|---|---|
| *Melaleuca viridiflora* (Soland. ex Gaertn.) | broad leaved paperbark | not present |
| *Melaleuca dealbata* S.T.Blake | broad leaved aperbark | not present |

**Decision and Finding of No Significant Impact**
**for**
**Field Release of the Biological Control Agent *Lophodiplosis trifida* Gagné (Diptera: Cecidomyiidae) for the Control of *Melaleuca quinquenervia* (Cav.) S.T. Blake (Myrtales: Myrtaceae) in the Continental United States**
**April 2008**

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), is proposing to issue permits for release of a nonindigenous stem-gall fly, *Lophodiplosis trifida* Gagné (Diptera: Cecidomyiidae). The agent would be used by the applicant for the biological control of melaleuca (Australian broad-leaved paperbark), *Melaleuca quinquenervia* (Cav.) S.T. Blake (Myrtales: Myrtaceae: Leptospermoideae) in Florida. 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
Permits, Registrations, Imports and Manuals
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 melaleuca and contain infestations: (1) no action, and (2) issue permits for the release of *L. trifida* for biological control of melaleuca. A third alternative, to issue the permit 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 melaleuca. These control methods described are not alternatives for decisions to be made by APHIS, but are presently being used to control melaleuca in Florida and may continue regardless of permit issuance for field release of *L. trifida.* The EA was made available for public comment in the Tampa Tribune on February 12 and 13, 2008 and the Miami Herald on February 11 and 12, 2008 for 30-day comment periods. No comments were received on the EA.

I have decided to authorize the PPQ permit unit to issue permits for the environmental release of *L. trifida*. 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.

- *L. trifida* poses no threat to the health of humans or wild or domestic animals.

- No negative cumulative impacts are expcted from release of *L. trifida.*

- 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 *L. trifida* 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

Dr. Michael J. Firko
Director
Permits, Registrations, Imports, and Manuals
APHIS Plant Health Programs
Plant Protection and Quarantine

4/14/08
Date