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Movement of Plastic-baled Municipal Solid Waste from Hawaii to the Continental United States

Environmental Assessment, March 2006

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I. What is this document and why has it been prepared and made available to the public?

This document is an environmental assessment that has been prepared, consistent with the Animal and Plant Health Inspection Service's National Environmental Policy Act implementing procedures (Title 7 of the Code of Federal Regulations (CFR), Part 372), for the purpose of discussing how the action described below could affect the quality of the human environment. This environmental assessment has been made available to the public and written comments were considered in the revision of this document and the issues associated with the alternatives.

II. What proposed action is examined in this document?

The Animal and Plant Health Inspection Service is considering amending its regulations[1] to allow use of certain packaging for the movement of municipal solid waste from Hawaii into the continental United States under specific conditions that mitigate potential pest risks. The regulations that currently apply to "garbage" are designed to keep harmful pests and diseases from entering the continental United States from certain locations outside of the continental United States. The regulations contain provisions that apply primarily to waste generated aboard ships and aircraft and do not specifically address municipal solid waste. Municipal solid waste covered by this regulation does not include materials such as industrial process wastes, agricultural wastes, yard wastes, mining wastes, sewage sludge, and ash (incinerator waste) because the Administrator determined that these wastes are either (1) excluded from APHIS jurisdiction due to lack of associated animal and plant risks or (2) prohibited from interstate movement due to animal or plant health issues. APHIS is considering amending its regulations to provide for the movement of municipal solid waste from Hawaii to the continental United States if it is pressed, packaged, shipped, safeguarded, and disposed of in a manner that the Administrator determines to be adequate to prevent the introduction or dissemination of plant pests, and if it is moved in compliance with all applicable laws for environmental protection. If the regulations are changed in this manner, the Administrator will evaluate specific proposals to move municipal solid waste from Hawaii to site-specific locations under these conditions. Movements would occur under

[1] *See* Title 7 of the Code of Federal Regulations (CFR), Section 330.400.

a compliance agreement. Movement-specific environmental assessments would be prepared for each site-specific compliance agreement.

On its face, the regulatory change APHIS is considering is environmentally benign. It is intended to ensure that appropriate safeguards are applied to any movement of municipal solid waste. If the regulations are changed as described above, any risks to the quality of the human environment would be associated with specific requests for movement submitted to APHIS. These specific requests will be examined in the context of the National Environmental Policy Act process at the time of each submittal.

The Center for Plant Health Science and Technology (CPHST) of the United States Department of Agriculture developed and revised a risk assessment (attached as appendix A to this document) that evaluates the ability of the packing and pressing technology to keep plant pests and noxious weeds from entering the continental United States.[2] This environmental assessment builds on the plant-health risk assessment and discusses aspects of environmental quality that could be affected were the packing and pressing technology employed. This pest risk assessment includes a list of quarantine-significant plant pests for use in further analyses of potential pest risks in the absence of adequate containment of the baled municipal solid waste. Environmental issues of employing the methodology described below in this assessment will be considered more thoroughly for specific proposals that may be submitted, should amendments to the regulations be adopted. This document is intended, in part, to facilitate further consideration of those issues in the context of such specific proposals.

III. What is the purpose of and need for the proposed action?

APHIS is considering lifting some of the quarantine restrictions for the movement of garbage from Hawaii to the continental United States due to the availability of advanced technology that could satisfy APHIS' pest risk concerns. Additionally, concern has been expressed about the long-term capacity of the major landfills in Hawaii to continue to handle municipal solid waste. By permitting municipal solid waste to be transported to the continental United States using the special processing method, Hawaii is provided a potential alternative means of dealing with disposal of

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[2] Risks to animal health from the proposed action are not addressed in the risk assessment because there are currently no known exotic animal diseases in Hawaii that would pose a threat of entry into the continental United States.

municipal solid waste. The proposed amendments have been designed to meet the requests of shippers to transport municipal solid waste to the continental United States in a manner that precludes pest risks and to provide an alternate disposal technique for municipal solid wastes.

IV. Are there any alternatives to the proposed action that should be considered, and, if so, what are they?

Other alternative waste disposal options may be available to meet the need and reduce pest risk, but none have currently been presented to the agency for our consideration. Consideration of site-specific alternatives will be addressed in further environmental analyses of specific submitted requests for movement of municipal solid waste, and certain conditions could be established as safeguards within compliance agreements for those requests. This document will analyze potential environmental effects that may be associated with the packing and pressing technology and consider in a general way those impacts associated with transportation of the packaged waste to landfill sites in the continental United States. A "no action" alternative, which assumes that municipal solid waste would not be shipped to the continental United States, is also considered to establish the environmental risk baseline for both the continental United States, as well as the origins of the municipal solid waste.[3] Since the amendments do not involve "unresolved conflicts concerning alternative uses of available resources,"[4] no other alternative is considered in this document.

[3] Under the current regulatory requirements, regulated garbage could be moved to the continental United States on a means of conveyance only if such garbage is contained in leak proof receptacles and is disposed of in an approved facility for incineration, sterilization, or grinding into an approved sewage system. *See* Title 7 CFR, § 330.400(f). It appears that the volume of municipal solid waste needed to move off island makes the current regulatory requirements economically infeasible for private entities to assume the fiscal burden of such movement.

[4] Section 102(2)(E) of the National Environmental Policy Act, codified at Title 42 of the United States Code (U.S.C.), § 4332(2)(E). An environmental assessment must include a brief discussion "of alternatives as required by Section 102(2)(E)," among other topics listed. *See* Title 40 CFR, § 1508.9(b).

V. What are the environmental effects of the proposed action and alternatives?

A. What types of impacts[5] are considered?

Regulations implementing the National Environmental Policy Act require that several types of impacts to the human environment[6] be considered. Direct effects, which are caused by the action and occur at the same time and place, must be considered. Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable, must also be considered. Finally, cumulative impacts, which are impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions, must be considered.

Pest risks associated with movement of municipal solid waste to the continental United States should be considered together with any closely related actions or reasonably anticipated future actions involving similar pest risks to satisfy cumulative impacts analysis requirements. Likewise, effects on the environment from pesticides and other measures that may be used to eradicate or control introduced pests in the continental United States should not be considered apart from the effects of other pesticides or measures being used in the affected area for whatever purpose.

B. How can the amendments to the regulations, including alternatives, affect the quality of the human environment?

A threat to environmental quality in the continental United States associated with the transporting of municipal solid waste is the entry and establishment of harmful non-indigenous plant pests and noxious weeds that might accompany such waste. Harmful non-indigenous plant pests and noxious weeds that might accompany municipal solid waste may include noxious weed seeds, for example, that could affect an ecological niche by overtaking an area previously populated by domestic plants. Appendix B provides a representative list of the quarantine-significant plant pests that need to be excluded from the continental United States by the process of plastic-baling of the municipal solid waste.

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[5] The terms "effects" and "impacts," as used in this document, are synonymous.

[6] The "human environment" is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." Title 40 CFR § 1508.14.

Were harmful non-indigenous species to find their way into the continental United States and become established, actions to eradicate or control these pests or weeds would be required. Such actions usually involve the use of pesticides, the potential effects of which on the quality of the human environment represent indirect impacts.

Other potential impacts that should be considered involve an increase in barge traffic and either rail or truck transport of the bales to a landfill. Increases in traffic are often associated with increased accident rates, as well as increased air and water pollution. The degree to which the increased traffic resulting from movements of municipal solid waste would have on the current accident rate or level of air and water pollution is unknown at this time, and can only be analyzed based on specific proposals to move such waste into the continental United States.

C. What aspects of environmental quality could be affected by amendments to the regulations, how, and to what degree?

In determining whether or not an environmental impact statement should be prepared for the regulatory amendments, the decisionmaker should evaluate certain intensity factors regarding environmental quality issues. This subsection of the environmental assessment is developed in the context of those factors and issues, which are enumerated in regulations implementing the National Environmental Policy Act.[7] Only those factors and issues that may apply are discussed below.

To better understand the magnitude of impact on the quality of the human environment from the proposed action, the "no action" alternative establishes an environmental risk baseline. For purposes of this environmental assessment, "no action" means that APHIS would not amend its regulations to provide for the movement of municipal solid waste from Hawaii using this pressing and packaging technology. The environmental risk baseline to the continental United States from no action, therefore, would remain negligible. Previous movements of such municipal wastes to the continental United States have not been substantiated and so associated pest risks have not been recorded. The "no action" alternative may involve some environmental risk to the environment due to the continuing lack of municipal waste disposal options for Hawaii.

[7] *See* Title 40 CFR § 1508.27(b). Under § 1508.27(a), the decisionmaker is also required to consider context, which "means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality."

Many of the potential environmental impacts discussed below arise from a scenario that assumes accidental introduction into the continental United States and potential establishment of harmful non-indigenous plant pests that could accompany municipal solid waste. The likelihood of such an occurrence has been evaluated for municipal solid waste that has been processed prior to shipment using a special packing and pressing technology,[8] and transported to the continental United States. Agency risk assessors have concluded in a plant pest risk assessment that, with certain safeguards, transportation of municipal solid waste from Hawaii to landfills in the continental United States does not pose a significant risk that harmful plant pests or noxious weeds will become established in the continental United States. Those safeguards include diversion of yard and agricultural waste from the municipal solid waste stream, monitoring of bales at certain locations by Federal inspectors, patching and re-wrapping of bales with breaches, storage and transport practices designed to exclude rodents, deep burial of bales in a landfill within 75 days of wrapping, and proper chemical treatment at the site of accidental breaches, spills, and leaks. Specifically, the plant pest risk assessment found that transportation of municipal solid waste from Hawaii in plastic-wrapped, airtight ". . .bales poses an insignificant risk of pest establishment."[9] Accidental introductions would only occur in the event of a breach in the wrapping since, ". . .[a]irtight enclosure from creation to burial would mitigate plant pest risks."[10]

While it is unlikely that any insect pest will survive the packing and pressing process, potential threats involving weed seeds, bacteria, and nematodes could remain an issue were the wrapping to be breached (see pest list in appendix A). The pest risk assessment for moving Hawaii's municipal solid waste in plastic-wrapped, airtight bales to the continental United States considered the likelihood of establishment of insects, plant pathogens, and weeds to be low.

The plant pest risk assessment determined that the pest risk associated with moving municipal solid waste from Hawaii to the continental United States in plastic-wrapped, airtight bales to be insignificant,[11] but not zero. The following discussion, therefore, considers whether those harmful non-indigenous plant pests (see appendix A) associated with the transportation of municipal solid waste could gain entry into the continental United States and threaten to or become established. The magnitude of potential

[8] The technology involves wrapping waste bales with adhesive backed plastic film barriers made of low density polyethylene.
[9] *See* "The Risk of Introduction of Pests to the Continental United States via Plastic-Baled Municipal Solid Waste from Hawaii," United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, March 2005, at p. 1.
[10] *Id.* at p. 1
[11] *Id.* at p. 1

impacts—direct, indirect, and cumulative—stemming from introduction of pests of concern will depend largely on how quickly those pests that have been introduced into the mainland are detected and treated. If quickly detected and treated, the pests, as well as treatments to eradicate or control them, are likely to do very little, if any, damage to the quality of the environment. The longer such pests go undetected and untreated, the greater the likelihood that they could become established.[12] If such pest establishment were to occur, the event would be capable of causing, directly and indirectly, harm to the quality of the environment. Monitoring in the vicinity of the landfill sites would ensure early detection of any potential pests that were introduced from the baled municipal waste.

1. Public Health and Safety

In Hawaii, public health could be affected directly under the no action alternative by a buildup of municipal solid waste due to the lack of disposal options and could result in the possibility of increased encroachment of vermin such as rats, fleas, and other pests and their associated diseases, into the human population. Illness could also arise as a result of inhaling foul air, which may also contain human pathogens, or as a result of ingesting pathogens that might leak from contaminated waste into water bodies or groundwater.

In the continental United States, public safety could be directly affected by a potential increase in waterway and rail or highway traffic arising through movement of municipal solid waste from Hawaii—an increase in barges arriving at ports in the continental United States and the potential for congestion at those ports, an increase in barges traveling up and down rivers in the continental United States, and an increase in rail or truck traffic carrying municipal solid waste in wrapped bales from a receiving facility to a landfill. An indirect effect could include the possibility of water pollution that could be caused by additional barge traffic and the potential for more accidents on the waterways, some of which could result in ruptures of the baled municipal solid waste or loss of cargo.[13]

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[12] Introductions of pest species into the environment, whether unintended or intended, have the potential to result in localized infestations. If enough viable pest species of the proper life stage are transported along a pathway to a site with favorable habitat, the likelihood of an infestation there is high, and damage to the local environment is probable. The potential expansion of pest populations (and the associated expansion of damage to native hosts) poses a greater threat to the environment than the initial introduction of the pest.

[13] The risk assessment states that ". . .the accident rate for trucks carrying non-hazardous materials was 0.73 accidents per million vehicle-miles. If we assume the average one-way (loaded) truck trip to a landfill will be 25 miles and use the rate for trucks carrying non-hazardous materials, then an average of one accident every 55,000 trips would occur." *See* "The Risk of Introduction of Pests to the Continental United States via Plastic-baled Municipal Solid Waste from Hawaii," United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, April 2005, at p. 6.

Public health in the continental United States also could be affected indirectly through the use of pesticides to eradicate or control any plant pests or noxious weeds that gain entry into the continental United States and threaten to become established. According to the risk assessment, the most likely pests to gain such entry are some plant pathogens and noxious weed seeds, but the risk of entry has been determined to be low.

The likelihood for pathogens and weed seeds from municipal solid waste to become established in the continental United States is remote because, according to the risk assessment, "Pathogens dispersing to a susceptible host or invasive plant seeds dispersing to a suitable site for growth is highly unlikely, assuming clean up procedures are followed scrupulously."[14]

The United States Environmental Protection Agency has determined that the use of registered pesticides, consistent with directions contained on the label, poses no undue risk to human health or the environment. The greatest potential health risk involved with pesticide use is often to applicators. Such risks are minimized, however, by requirements for applicators to adhere to published program guidance and by carefully following label instructions. Any applications of pesticides by APHIS would be conducted consistent with label directions and program guidance.

Upon detection of harmful non-indigenous pests or noxious weeds, and before any action is taken, the agency conducts a thorough investigation of the affected area and ensures that environmental impact issues are addressed appropriately, often through the preparation of an environmental assessment.

2. Unique Characteristics of the Geographic Area

Barge and truck transportation routes may pass through areas that possess unique characteristics, including, but not limited to, ecologically critical areas and scenic areas. If bales of municipal solid waste in transit along the route through an area possessing unique characteristics were accidentally breached, pest or weed species of concern could conceivably escape into the environment. Were pest or weed species of concern to be introduced into such an area and become established, potentially adverse effects on ecosystem components of the area could be experienced. Impacted ecosystem components, especially non-target organisms, could be further stressed indirectly by actions to eradicate or control the introduced pests using pesticides.

[14] *Id*. at p. 7.

Upon receipt of specific requests to move packed and pressed municipal waste into specific areas of the continental United States, the decisionmaker will analyze measures designed to reduce the potential risks to a specific area's unique characteristics. Those measures will be documented as possible mitigation strategies. Following public comment on each request, the decisionmaker will direct in its decision on the proposal that all measures necessary and appropriate to protect, insofar as possible, any unique characteristics of an affected area be taken. Any such measures would be reflected in a compliance agreement.

3. Precedent for Future Actions

If the regulations are amended to provide for the conditional movement of municipal solid waste from Hawaii to points in the continental United States, any qualified waste handler could submit a proposal to move municipal solid waste from Hawaii under the regulations. The likelihood that plant pests or noxious weeds not indigenous to the continental United States could be introduced into the continental United States as a result has been considered. The risk assessment concludes that, as "long as those processes and the procedures proposed by the companies—including diversion of yard and agricultural waste, prompt shipment, monitoring and inspection of bales, and thorough clean up of any ruptures that do occur—are followed, establishment of Hawaiian plant pests via this pathway is highly unlikely."[15] Potential risks associated with any proposals submitted to the Administrator will be examined and environmental assessments will be prepared. Thus, notwithstanding the precedent established in the regulations for this new methodology, if amended, the quality of the human environment in the continental United States will be reviewed further for individual requests.

4. Significant Cumulative Impacts

There is potential for environmental quality to be adversely affected whenever materials and goods with which harmful non-indigenous pests or noxious weeds may be associated are permitted entry into the continental United States. Many such entries are authorized each year for many different kinds of materials and goods with which a wide variety of pests or noxious weeds not indigenous to the continental United States may be associated. These authorizations may be viewed cumulatively as increasing somewhat the risk that harmful pests or noxious weeds will be introduced into the continental United States, infest an area, and directly, or indirectly through eradication or control programs, adversely affect environmental quality. But safeguards currently in place, together with measures that may be required to be taken on a case-by-case basis to keep harmful non-indigenous pests from entering the continental United States, are designed in every case to collectively reduce pest risks to a minimum.

[15] *Id.*, at p. 9.

There is also potential for cumulative harm to the environment from the use of pesticides to treat infestations that may occur. The nature and extent of cumulative risks depend upon the proximity in time and space of pesticide applications to other pesticide-type treatments that impact the human environment in a similar manner. Some pesticide residues persist for extended periods in the environment, such that recovery of non-target species populations from previous treatments in the area may be hindered by any additional program treatments. Private or commercial pesticide applications, often beyond control of the agency, in or near a program treatment area can serve to exacerbate the potential for harm to the affected environment. Finally, some pesticides are known to interact chemically with other agrochemicals to produce substances that pose an even greater risk to the human environment. This synergism is often difficult to measure, but should be considered, nevertheless.

Whereas it is difficult for the decisionmaker to analyze such impacts without proposals for specific movements into the continental United States, cumulative and synergistic impacts associated with pesticide use and other measures to deal with pest or noxious weed infestations will be considered as part of site-specific assessments.

5. Endangered or Threatened Species and Critical Habitat

It is unlikely, according to the risk assessment, that any insect pest will survive the packing and pressing process, although it has been determined that some weed seeds and plant pathogens could survive the process. Thus, endangered or threatened species and critical habitat could be potentially affected by plant pest species in the event of a breach in the wrapping. Should that happen, the potential exists for weed seeds and plant pathogens to escape into the environment and adversely affect protected species and critical habitats, were any located in the area.

Agency actions taken to eradicate or control infestations, such as use of pesticides or removal of weed species, in areas in which endangered or threatened species or critical habitat may be located could also adversely affect such species and habitat, but the handling and processing are designed to preclude breach in the wrapping.

A potential source of noxious weed seeds and plant pathogens is yard and agricultural waste, which may contain plant parts. Weed seeds and plant pathogens are the only plant pests that could survive in the anoxic environment of packed and pressed municipal solid waste. For this reason, yard and agricultural waste will be required to be excluded from the municipal waste destined for shipment to the mainland, so that the possibility that noxious weed seeds or plant pathogens within the municipal solid waste is minimized. Therefore, the potential threat to endangered or threatened species and critical habitat from introduction of noxious weeds or plant pathogens is mitigated. Remaining waste consisting mainly of paper, discarded cans and bottles, food scraps, and other items would be unlikely to harbor weed seeds or plant pathogens. Accordingly, APHIS concludes that there is no effect to listed endangered or threatened species and critical habitat as a result of the process of packing and pressing of the municipal solid waste.

Listed endangered or threatened aquatic organisms and their habitat located in the environments traversed by transport barges should also be considered. The potential risk to listed species, especially aquatic species, could stem from the increase in barge traffic, and from transferring bales of municipal solid waste from one mode of conveyance to another at some point along the waterway transportation route. Transfer of bales from barges to the on-ground receiving facility increases the chances that a breach in the bale wrap might occur, thereby allowing weed seeds or plant pathogens that may be contained in the municipal solid waste to escape into the environment. Such potential risks to endangered and threatened species could only be considered based upon the specific request for transport, and the compliance agreement for each request would have to address those issues of concern for protection of species on the potential shipping route and at the potential landfill site. Therefore, to ensure protection, potential effects on endangered or threatened species or critical habitat from transport and measures other than the packing and pressing process that may be applied to deal with pests or noxious weeds of concern will be considered in the context of specific requests and site-specific analyses done prior to the issuance of each compliance agreement.

6. Other Consider-ations

Some executive orders, such as Executive Order No. 13175, Consultation and Coordination with Indian Tribal Governments, as well as departmental or agency directives, call for special reviews and consultation in certain circumstances. Some Native American Tribes have expressed concerns regarding the proposal to move municipal solid waste from Hawaii to points in the continental United States. This document serves to stimulate exchanges about such issues of concern and each site-specific request will be subject to review of this topic and other environmental considerations.

VI. What agencies and persons have been consulted?

Hawaii Department of Environmental Health

United States Army Corps of Engineers

United States Coast Guard

United State Environmental Protection Agency

Washington State Department of Agriculture

Appendix A: The Risk of Introduction of Pests to the Continental United States via Plastic-baled Municipal Solid Waste from Hawaii, March 2006

United States Department of Agriculture

Animal and Plant Health Inspection Service

March 2006

The Risk of Introduction of Pests to the Continental United States via Plastic-Baled Municipal Solid Waste from Hawaii

Executive Summary

Companies have proposed transporting large volumes of Hawaiian municipal solid waste (MSW) in airtight bales to landfills in the continental United States. The bales are created by shredding, compressing, and wrapping MSW in adhesive-backed, plastic film barriers. Airtight enclosure from creation to burial would mitigate plant pest risks, but this technology is still new and not well known. Moreover, federal regulations prohibit garbage from Hawaii from entering the continental United States. Thus, the Center for Plant Health Science and Technology (CPHST) was asked to assess the risks of plant pest establishment via this pathway. Specifically, we assessed the soundness of baling technology and the safety of the general pathway, considering here those processes likely to apply to all company proposals. Some proposal-specific parameters, such as the locations of landfills on the mainland and the types of transport to be used, will be evaluated separately for each particular proposal to identify any exceptionally significant risk factors.

Published, independent scientific testing of the baling technology confirmed manufacturers' specifications and indicated that it is likely to mitigate the risk from all types of plant pests. In particular, insects, mollusks, and some pathogens are unlikely to survive in the bales because of compression, anoxia, and the absence of hosts. To reduce the risk from hitchhiking mollusks, we also recommended proper staging of bales, and certification that they are mollusk-free before shipment. Other procedures, such as bale construction, monitoring during transport, and burial in regulated landfills, should adequately protect against escapes from within bales via accidental ruptures and punctures during handling and transport. Compliance with general procedures, such as diversion of yard and agricultural waste, and proper staging and prompt shipment of bales, is also important. If these procedures are followed, transporting municipal solid waste from Hawaiian cities in bales poses an insignificant risk of plant pest introduction. In addition, we recommend that the pathway be monitored to ensure that pathway processes and compliance do not differ significantly from descriptions here.

I. Introduction

Companies have proposed transporting about 200,000 tons of baled municipal solid waste (MSW) per year from Hawaii to landfills in the continental United States. Bales will be created by compressing and wrapping MSW in adhesive-backed, plastic film barriers made of low density polyethylene (LDPE), creating airtight packages. Bales would be transported by barge to the mainland and then perhaps by other means to landfills, and ultimately buried intact, in accordance with regulations for solid waste disposal (40CFR§258; EPA (1993)). Garbage from Hawaii is not enterable under current federal regulations for plant pests (7CFR§330.400). Therefore, an assessment of the risks of plant pest introduction via baled Hawaiian MSW to the continental United States is needed. At the request of the State of Hawaii, this assessment was done by the Center for Plant Health Science and Technology (CPHST), part of the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA).

The objective of this report is to evaluate whether the baling technology will effectively mitigate potential plant pest risks associated with MSW from Hawaii. The assessment focuses upon the planned use of the baling technology, because airtight enclosure from creation to burial would mitigate the risks of establishment by any plant pests (Appendix A). We address the following three questions:

1) Does the baling technology provide a strong, airtight barrier?
2) How likely are ruptures or punctures? and
3) Will general pathway procedures reduce pest incidence in the bales and the chances of escape in the event of accidental ruptures or punctures?

In addition, we give qualitative risk ratings for different pest types based on the likelihood of introduction. Only those pathway processes likely to be common to all company proposals to transport baled Hawaiian waste were considered. Separate assessments for particular company proposals will address factors such as the destination landfill, type of transportation to be used on the mainland, and pest species that may pose particular threats.

II. Definitions

Garbage is defined as urban (commercial and residential) solid waste from municipalities on any Hawaiian island, such as Honolulu on Oahu, and Hilo on Hawaii. Based on company proposals to move baled waste (not shown), this analysis assumed that yard and agricultural waste will be excluded from the waste stream. Therefore, the volume of any such waste accidentally entering the pathway should be minimal. If it was found that yard and agricultural waste was not typically excluded, a revised assessment might be necessary.

A spill is defined as the escape of waste material from a bale and contact with the surrounding environment, e.g. ground, truck, tractor, barge, or other terrestrial features.

Other important terms are defined as follows (Merriam-Webster, 2004):

Anoxia: hypoxia especially of such severity as to result in permanent damage
Anoxic: greatly deficient in oxygen
Hypoxia: a deficiency of oxygen reaching the tissues of the body

Anaerobic means living, active, occurring, or existing in the absence of free oxygen. Thus, the term anaerobic is only correctly applied to organisms, not non-living things like bales, or the conditions within them.

III. Detailed overview

Some details will be specific to each company proposal, such as the landfill site and means of transport within the continental U.S., but general characteristics related to the pathway include the following:
1) The material to be transported is municipal solid waste;
2) Agricultural and yard waste will be diverted to other transfer stations and waste streams;
3) A baling system will be used to create high-density bales (ca. 1000 pounds per cubic yard) wrapped with at least four layers of adhesive-backed plastic;
4) The shape and weight of the bales depends on the technology used but rectangular bales with weights from 2 to 12 tons might be expected;
5) Bales will be stored, or 'staged,' for some time before transport to allow bales to become anoxic, e.g., five days (Pacific Rim Environmental Resources, 2004);
6) Manifested bales will be moved on barges to the mainland, a trip of about 12 to 18 days;
7) Bales will eventually be unloaded and moved by truck or by rail to a landfill;
8) In procedures likely to be specified in compliance agreements, companies will monitor bales to detect ruptures and punctures during transport, with particular regard for handling operations (loading and unloading);
9) Landfilled bales will be covered with at least six inches of soil within 24 hours (EPA, 1993); and
10) Landfilled bales will ultimately be covered by at least seven feet of material if placed on the top (final) waste layer, but many more feet if placed closer to the bottom layer.

Other important points include the following:
▪ Hazardous and liquid wastes will be diverted or removed before shredding and baling;
▪ Waste and bales will not contact soil after collection or wrapping (i.e., will only be stored on asphalt, concrete, etc);
▪ Imperfectly sealed bales found during staging in Hawaii will be rewrapped and re-staged;
▪ Fewer ruptures of bales seem likely to occur with tractors that have grabbing rather than forked lift arms (Figure 1);
▪ Companies will deal appropriately with punctures and small ruptures detected after shipment;
▪ Companies will handle larger ruptures by collecting spilled waste, storing all waste in sealed containers, and rewrapping and re-staging waste;
▪ Spills will be cleaned up and disinfected according to USDA guidelines for spills of international garbage (PPQ, 2004);
▪ All ruptures and punctures will be documented and reported regularly to PPQ and State officials;
▪ Destination landfills will be modern facilities that meet all regulations for design and operation (e.g., EPA, 1993).

Finally, we presumed here that after creation, bales will only be moved once into staging, and then once again onto barges bound for the mainland. Additional handling in Hawaii, for instance to transport bales from other islands to a central location for staging and barge loading, would increase the risk of punctures and ruptures.

Figure 1. Example tractor with 'grabbing' lift arms for handling bales.

IV. Validity of the baling technology

Although sizes and shapes of bales depend on the exact technology used, bale creation processes and specifications are similar across different manufacturers (e.g., DEKRA (1996), Roll Press Pack International, Ltd. (2004), RPP America (2004), and Cross Wrap (2004)). Information from manufacturers (e.g., DEKRA, 1996) was corroborated by independent research (see below). During the baling process waste material is shredded if necessary, compressed to a high density, wrapped with bands or netting to maintain shape, and then wrapped with adhesive-coated LDPE. At least four layers of plastic are used, forming a strong, airtight barrier (Appendix A). Bale shape depends on the process, with cylinders created in "roll-press" systems and rectangles created in ramming systems (e.g., Baldasano et al., 2003). Roll-press systems tend to result in bales with less trapped air (Sieger and Kewitz, 1997). The degree of compression is typically greater with rectangular bales, and more liquid is pressed out as well. Bale densities are expected to be in the range of 800 to 1100 kg/m^3 (ca. 1300 to 1800 lbs/yd^3) (Baldasano et al., 2003).

The bales become anoxic within a few days after wrapping (Paillat and Gaillard, 2001; Robles-Martinez and Gourdon, 1999). The O_2 concentration of normal air is 21 percent (21 kPa), but concentrations in bales were near 2 percent (ca. 2 kPa). Because of that and other factors, very little biodegradation or production of gases occurs.

The wrapping is strong as well as airtight. According to Baldasano et al. (2003), the LDPE "…has a high, although not total, degree of resistance to perforation and tearing." Pre-stretching helps maintain bale shape, increases adhesion, and helps prevent ruptures. Bales weighing less than 1000 kg did not rupture when dropped from a height of 3 m (DEKRA, 1996). A user in Utah reported that bales larger than 1000 kg rupture when dropped 3.1 to 7.6 m (10 to 25 ft) onto the vertical sides of railroad cars (pers. comm., Barry Edwards, North Pointe Waste Transfer Station, Lindon, UT). USDA will not allow Hawaiian baled MSW to be handled that way. Pointed or sharp objects within the bales might perforate the plastic (Baldasano et al., 2003) but we found no indication that this has commonly occurred, and compression would reduce that possibility.

Under normal storage conditions, the bales typically remain airtight for many months (Robles-Martinez and Gourdon, 2000). LDPE film degrades over time when exposed to sunlight. The plastic film used in this baling process is expected to remain effective for at least 100 days (Paillat and Gaillard, 2001) and possibly for up to 12 months (Baldasano et al., 2003) in direct sunlight. The combined storage and transit time from Hawaii to the mainland is unlikely exceed 100 days (see below).

The adhesive-backing provides the plastic film with a self-sealing capability: small ruptures (size unspecified) tend to become airtight again after some time (Paillat and Gaillard, 2001). That, and the density of the waste itself, should help mitigate the chance of material escaping through punctures and small ruptures but cannot be relied upon exclusively. The plastic or metal netting used in some baling technologies to maintain shape would also limit the chance of waste and plant pests escaping through ruptures but the rectangular bale system apparently uses straps rather than netting.

Overall, the waste baling technologies using adhesive-backed plastics seem very sound, creating strong, airtight bales that can be safely handled, stored, and transported.

V. Pest risk mitigations

Mitigations considered here either result from the baling technology itself or features of the proposed pathway, including the waste type, and how bales are staged, handled, transported, and buried.

Mitigations from the baling technology

Bales that remain airtight from creation until burial completely mitigate the risk from all plant pests because the pests and pest propagules cannot escape. That mitigation is universal, i.e. it does not depend on pest type or taxonomy, and probably applies equally to both current and future pests that establish in Hawaii. Because of the possibility of accidental ruptures or punctures, however, we also consider pest mortality and the effects of other pathway factors.

Given that achieved bale densities should be in excess of 800 kg/m^3, shredding and compaction would likely kill most insects, regardless of stage (see Montgomery and Manning, 2004). This would therefore greatly reduce the possibility of boring-type insects chewing through the plastic wrapping, which, moreover, would only be possible if those insects ended up on the outermost surface of the compacted waste. Shredding and compaction may also neutralize some weed seeds and nematodes.

Anoxia would kill any insects and insect propagules or mollusks that remain viable in the bales, probably within a few days (Hinton, 1981; Hoback and Stanley, 2001; Montgomery and Manning, 2004; Robinson, 2006; Woods and Hill, 2004). This idea has been used for centuries for pest-free food storage (e.g., De Lima, 1990). Adults and eggs of insects are probably most sensitive to hypoxia (Hoback and Stanley, 2001). Insect and mollusk mortality is important because, of the pest organisms considered here, only those actively disperse.

Anoxia by itself would not kill most weed seeds (Paillat and Gaillard, 2001). Some pathogens would be killed by persistent anoxia, such as some bacteria and nematodes, but many others could be unaffected (L.M. Ferguson, 2005, CPHST, pers. commun.,).

Mitigation from pathway procedures

Waste stream. For the overall MSW stream in the United States, paper is the single largest component at 35 percent, on average, while inorganic components (e.g., plastic, glass) make up an additional 32 percent (EPA, 2005). Food waste and yard trimming each make up 12 percent, and wood makes up 6 percent of the waste stream. Exclusion of yard and agricultural waste from the baling waste stream in Hawaii should reduce the number of potential pests and pest propagules in this pathway to very low levels. Plant pests or pest propagules, as well as any potential hosts or contaminants, such as discarded fruits and flowers, are likely be an extremely small proportion of the total volume of MSW. Green recycling operations in urban areas (e.g., Refuse Division, 2006) that separate the collection and processing of yard and agricultural waste from general MSW may also help reduce the chance of waste contamination.

Staging. The minimum staging plus transport time is about 15 days (not shown), which is more than enough time for the bales to become anoxic. The maximum staging plus trip time is unknown. We recommend a waiting period before transport of less than 75 days to avoid nearing the 100-day period for the earliest possible degradation by sunlight (above).

During staging, bales might become contaminated with hitchhiking plant pests, and mollusks in particular (Robinson, 2006). For example, plastic-wrapped pallets of stone and tiles from Italy that are left in fields before shipping have often become contaminated with snails and slugs (USDA-APHIS-PPQ, 2005). The requirement that bales not contact soil (above) should reduce the risk of contamination. Still, we strongly recommend that the two following precautions also be taken: 1) that bales be staged or stored as far from vegetation and pavement borders as possible, and 2) that bales be certified as snail- and slug-free before shipment (details to be specified in compliance agreements).

Handling. Ruptures and punctures of bales are most likely to occur during loading and unloading; moving accidents will probably be rare. These rates are as yet unknown. Punctures seem very unlikely to occur if tractors have grabbing lift arms rather than forks. Bales may rupture if dropped from heights of 3 m or more (see above); that depends upon bale weight and shape and other factors. Using tractors like that in Fig. 1 will greatly reduce the risk of drops from significant heights, even if bales are occasionally stacked 3 m high or more, such as might happen during staging.

Transport on the mainland. Specific transportation means will be evaluated more fully in assessments for specific proposals. We note, however, that in general the accident rates are low for transport of cargo by truck (see below), barge (Bureau of Transportation Statistics, 2004), and rail (Federal Railroad Administration, 2004).

Transport by truck to the landfill. The risk of catastrophic rupture of bales because of truck accidents is very low: the accident rate for trucks carrying non-hazardous materials was 0.73 accidents per million vehicle-miles (Federal Motor Carrier Safety Administration, 2002). Thus, if the average one-way (loaded) truck trip to a landfill were 25 miles, for example, then on average one accident would occur every 55,000 trips. Note that not all proposals will require trucks for delivery to landfills.

Monitoring. Companies will likely be required to monitor bales for two things: 1) punctures and ruptures, and 2) the presence of hitchhiking snail and slug pests before bales depart for the mainland (above). If bales are to be certified mollusk-free, responsible parties will need to be specified in compliance agreements. Ruptures are likely to be detected, since they will probably result from drops, and we expect any dropped bales to be inspected carefully at the time. Punctures are less likely to be detected but are much less likely to occur if grabbing-type lift arms are used, and are most likely to self-seal (see above). All compliance will be monitored by PPQ and/or State personnel.

Clean up. Bale density, binding materials, and the self-sealing ability of the LDPE should all limit the amount of escaping material. Most weed seeds and plant pathogens will have little or no ability to disperse after a spill. One exception may be spores which are small enough for wind-dispersal. Pathogens dispersing to a susceptible host, or invasive plant seeds dispersing to a suitable site for growth is highly unlikely, assuming clean-up procedures are followed scrupulously. Thorough cleaning should capture nearly all waste material, and proper use of approved disinfectants (PPQ, 2004) will likely control any escaped pathogens.

Landfilling. Because of monitoring, bale-handling technologies, and the low number of times bales will be handled, only airtight bales are likely to enter the landfill. If the handling equipment used in the landfills is similar to that used previously, ruptures during placement will be unlikely. Covering with a 6-inch barrier of soil or other material (see 40CFR§258.21) within 24 hours will further mitigate the possibility of dispersal of plant pests or propagules, by both natural and vector-caused means. Baled waste is unlikely to be attractive to vectors because of its composition, appearance, and the lack of odorous biodegradation (above). Most proposals specify that bales will be landfilled separately from other waste ("monofilled"); this means bales will not be subjected to compacting of regular, loose MSW by tractors. Ultimately, landfilled bales will be covered with from seven to dozens of feet of materials (see 40 CFR §258.60), depending upon the layer in which they are placed. In addition, the final cover has water-impermeable layers (EPA, 1993).

VI. Potential plant pests

Specific pests are not discussed here because the species of interest will depend upon the destination, and because the baling technology will be universally effective against all types of pests if bales remain airtight (above). Lists of selected Hawaiian insects, pathogens, and pest plants of quarantine concern for the contiguous 48 states are given in Appendix A. Those lists include both plant pests and other pests that pose human health risks (e.g., cockroaches).

VII. Qualitative risk assessment

The baling technology is sound and should ensure that MSW is shipped only in strong, airtight bales. Compaction and the use of the baling technology may not kill seeds of invasive plants or some types of plant pathogens but makes their escape extremely unlikely. It especially mitigates against insect pests because of anoxia-induced mortality within a few days. Pathogens and seeds of invasive plants cannot actively disperse and except for significant ruptures would have little chance of escaping and coming into contact with acceptable hosts or suitable growth sites. Because of the structure of the bales, only catastrophic ruptures—which should always be detected—might facilitate significant dispersal of pests or pest propagules. The handling procedures, strength of the plastic wrapping and strapping materials, and the probable small accident rate for final transport to the landfill (above) reduce the likelihood of ruptures. Other procedures, such as patching or re-wrapping bales, cleanup and disinfection, and restaging bales will provide further mitigation.

We qualitatively assessed the likelihood of introduction for general pest classes of insects, pathogens, and pest plants (invasive plants and weeds). We followed the PPQ guidelines for conducting pathway-initiated risk assessments (PPQ, 2000), and modified them where appropriate. Some subelements were removed because they did not apply to this pathway, and totals were revised accordingly. Only the general pest classes of insects, mollusks, pathogens, and pest plants (invasive plants and weeds) were scored, because the baling technology is so broadly effective, and the very small likelihood of introduction for any particular pest. For each subelement a score of either none = 0, low = 1, moderate = 2, or high = 3, was given. Values of zero are not usually possible but were reasonable here because of the potential effectiveness of the technology. Cumulative risk rating intervals were Low = 0 to 6, Moderate = 7 to 9, and High = 10 to 12 (after PPQ, 2000).

The likelihood of introduction of plant pests inside bales of MSW was least for insects and mollusks (score = 1; Table 1), as expected due to mortality from anoxia. Cumulative ratings for pathogens and pest plants were greater because of the increased likelihood of survival inside the bales, but were still Low overall. Even if we assumed a moderate rate for accidental ruptures of bales, so that the likelihoods of pests dispersing and coming in contact with a suitable host or site were equal to 1, the overall risk estimates would still be Low (total = 6, for pathogens and weeds).

Lastly, we did not include hitchhiking mollusks in Table 1, because as contaminating pests they would not reside *in* the bales, but under the same scoring they would rate High risk (1 + 3 + 3 + 3 = 10). This highlights the need to properly stage bales and certify them as being mollusk-free before shipment (see above).

Table 1. Qualitative risk ratings for the likelihood of introduction into the continental United States for three pest types via Hawaiian municipal solid waste in airtight bales. Hitchhiking pests were not considered here (see text).

Pests	Risk subelements				Cumulative risk ratings
	1 Annual quantity imported	2 Survive baling and shipment	3 Moved to suitable habitat	4 Contact suitable host or site	
Insects	1[a]	0	0	0	1
Mollusks	1	0	0	0	1
Pathogens	1	2	2	0	5
Pest plants	1	2	2	0	5

[a] The total amount of baled municipal solid waste may be high, but the proportion of waste that might harbor plant pests is low.

VIII. Conclusions

Transporting urban solid waste from Hawaiian cities to the continental United States in airtight bales poses a Low risk of pest introduction. That is because the baling technology mitigates the risk from all types of plant pests, and the other pathway procedures should adequately protect against accidental ruptures and punctures in bales during the handling and transport process and subsequent escapes of pests and pest propagules. We also recommend proper staging of bales and certifying them as mollusk-free to mitigate against contaminating pests. So long as those processes and the procedures proposed by the companies—including diversion of yard and agricultural waste, prompt shipment, monitoring and inspection of bales, and thorough clean up of any ruptures that do occur—are followed, establishment of Hawaiian plant pests via this pathway is highly unlikely. We recommend that this new pathway be monitored for some time to ensure that pathway procedures match those described here from proposals.

Last, only the plant pest risk associated with the pathway was addressed here. Although we concluded that the overall pest risk was Low, complete approval by USDA for the pathway or particular procedures should not be inferred. The pathway, in whole or in part, may still be subject to denial or modification based upon other constraints (pest or non-pest related), such as logistics, available resources, or other Federal regulations.

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Appendix A. Lists of selected Hawaiian pests, including insects, pathogens, and pest plants of quarantine significance to the continental United States. The lists focus on plant pests but also include other categories of pests, such as human health pests.

Table A1. Selected exotic or quarantine-significant plant pests from Hawaii for the 48 contiguous states in the United States. NOTE: This is not a complete list of all quarantine-significant pests from Hawaii and should not be regarded as such.

Pest	Geographic Distribution[1]	References
INSECTA		
ACARI		
Tetranychidae		
Oligonychus biharensis (Hirst)	HI	Bolland, et al., 1998; CABI, 2004; Nishida, 2002
Oligonychus mangiferus (Rahman & Sapra)	HI	Bolland et al., 1998
BLATTODEA		
Blaberidae		
Diploptera punctata (Eschscholtz)	HI	Anon., 2005; Evans, 2004; Nishida, 2002
Blattellidae		
Blattella lituricollis (Walker)	HI	Anon., 2005; Evans, 2004; Nishida, 2002
Blattidae		
Neostylopyga rhombifolia (Stoll)	HI	Anon., 2005; Evans, 2004; Nishida, 2002
Platyzosteria soror (Brunner)	HI	Anon., 2005; Evans, 2004; Nishida, 2002
Polyphagidae		
Euthyrrhapha pacifica (Coquebert)	HI	Anon., 2005; Evans, 2004; Nishida, 2002
COLEOPTERA		
Anthribidae		
Exillis lepidus Jordan	HI	Swezy, 1950
Bostrichidae		
Sinoxylon conigerum Gerstaeker	HI	CABI, 2004; Nishida, 2002
Cerambycidae		
Ceresium unicolor (F.)	HI	Nishida, 2002

Pest	Geographic Distribution[1]	References
Coptops aedificator (F.)	HI	Bridwell, 1920
Lagocheirus sp.	HI, US	Nishida, 2002; USDA-APHIS-PPQ, 2005
Oopsis nutator (F.)	HI	Swezy, 1950
Sybra alternans (Wiedemann)	HI	Nishida, 2002; UH-CTAHR and HI-DoA, 2005; USDA-APHIS-PPQ, 2005
Chrysomelidae		
Metriona circumdata (Herbst)	HI	CABI, 2001; HI-DoA, 2002
Octotoma scabripennis Guerin-Meneville	HI	CABI, 2003; Nishida, 2002
Cucujidae		
Parandrita aenea (Sharp) (= *Laemophlaeus minutus* [Oliv.])	HI	Nishida, 2002
Curculionidae		
Elytroteinus subtruncatus (Fairmaire)	HI	UH-CTAHR and HI-DoA, 2005; USDA-APHIS-PPQ, 2002
Euscepes postfasciatus (Fairmaire)	HI, CA	HI-DoA, 2002; O'Brien and Wibmer, 1982
Dryophthorus distinguendus Perkins	HI	Swezy, 1950
Orchidophilus aterrimus (Waterhouse)	HI	Tenbrink and Hara, 1994a
Orchidophilus perigrinator (Buchanan)	HI	Tenbrink and Hara, 1994b
Oxydema fusiforme Wollaston	HI	Swezy, 1950
Nitidulidae		
Carpophilus oculatus Murray	HI	Ewing and Cline, 2005; Gillogly, 1962; Nishida, 2002
Epuraea munda (Sharp)	HI	Ewing and Cline, 2005
Epuraea ocularis Fairmaire (= *Haptoncus ocularis* [Fairmaire])	HI	Chûjô and Lee, 1994; Ewing and Cline, 2005; Nishida, 2002
Haptoncus ocularis (Fairmaire)	HI	Gillogly, 1962; Nishida, 2002
Phenolia attenuata (Reitter)	HI	Ewing and Cline, 2005
Phenolia limbata (F.)	HI	Ewing and Cline, 2005

Pest	Geographic Distribution[1]	References
Platypodidae		
Platypus cupulatus Chapuis	HI	Wood and Bright, 1992
Scarabaeidae		
Adoretus sinicus Burmeister	HI	CABI, 2004; Nishida, 2002; USDA-APHIS-PPQ, 2005
Protaetia fusca (Herbst)	HI	CABI, 2004; Nishida, 2002; USDA-APHIS-PPQ, 2005
Scolytidae		
Coccotrypes sp.	HI	USDA-APHIS-PPQ, 2005
Ericryphalus henshawi Hopkins	HI	Swezy, 1949
Ericryphalus sylvicola (Perkins)	HI	Swezy, 1950
Ericryphalus trypanoides Beeson	HI	Van Zwaluwenburg, 1956
Euwallacea fornicatus (Eichhoff)	HI	CABI 2004; Hill 1994; Nishida, 2002; UH-CTAHR and HI-DoA, 2005; Wood and Bright, 1992
Hypothenemus ruficeps Perkins	HI	Swezy, 1941
Xyleborus fornicatus Eichhoff	HI	Swezy, 1950
Xyleborus perforans (Wollaston)	HI	CABI, 2004
Xylosandrus morigerus (Blandford)	HI	CABI, 2004; Wood and Bright, 1992
DIPTERA		
Agromyzidae		
Liriomyza huidobrensis (Blanchard)	HI, CA	CABI, 2004; Nishida, 2002; USDA-APHIS-PPQ, 2005
Melanagromyza splendida Frick	HI	Frick, 1953
Ophiomyia phaseoli Tryon	HI	CABI, 2003; Hill, 1994; Nishida, 2002; Spencer and Steyskal, 1986
Lauxaniidae		
Homoneura hawaiiensis (Grimshaw)	HI	Hardy and Delfinado, 1980

Pest	Geographic Distribution[1]	References
Lonchaeidae		
Lamprolonchaea metatarsata (Kertész)	HI	Hardy and Delfinado, 1980
Muscidae		
Atherigona hendersoni Malloch	HI	Hardy, 1981
Otitidae		
Euxesta annonae (F.)	HI, FL	Steyskal, 1969; Stone et al., 1965
Euxesta wettsteini Hendel	HI	Hardy and Delfinado, 1980
Phoridae		
Puliciphora lucifera Dahl	HI	Hardy, 1964
Sciaridae		
Bradysia spatitergum (Hardy) (= *Sciara spatitergum* Hardy)	HI	Hardy, 1960; Nishida, 2002
Scatopsciara nigrita Hardy	HI	Hardy, 1960
Stratiomyidae		
Cephalochrysa maxima (Bezzi) (= *Cephlochrysa* [sic] *hovas* [Bigot])	HI	Hardy, 1960; Nishida, 2002
Exaireta (= *Noexaireta*) *spinigera* (Wiedemann)	HI	Hardy, 1960; Nishida, 2002
Syrphidae		
Syritta oceanica Macquart	HI	Hardy, 1964
Syritta orientalis Macquart	HI	Hardy, 1964
Tephritidae		
Bactrocera cucurbitae (Coquillett)	HI	CABI, 2003; Nishida, 2002; USDA-APHIS-PPQ, 2005; White and Elson-Harris, 1994
Bactrocera dorsalis (Hendel)	HI	CABI, 2004
Bactrocera latifrons (Hendel)	HI	CABI, 2004
Ceratitis capitata (Wiedemann)	HI	CABI, 2003; Liquido et al., 1991
Tipulidae		
Limonia perkinsi (Grimshaw)	HI	Hardy, 1960

Pest	Geographic Distribution[1]	References
HEMIPTERA		
Aleyrodidae		
Aleurocanthus woglumi Ashby	HI, FL	CABI 2004; Hill 1994; HI-DoA 2005; Nishida, 2002; USDA-APHIS-PPQ, 2005
Aleurothrixus antidesmae Takahashi	HI	Nishida, 2002; UH-CTAHR and HI-DoA, 2005
Aleurotulus anthuricola Nakahara	HI	Nishida, 2002; UH-CTAHR and HI-DoA, 2005
Orchamoplatus mammaeferus (Quaintance & Baker)	HI	Nakahara, 1982
Parabemisia myricae (Kuwana)	HI, CA, FL	Nishida, 2002; USDA-APHIS-PPQ, 2005
Trialeurodes vaporariorum (Westwood)	HI, FL	UH-CTAHR and HI-DoA, 2005
Aphididae		
Melanaphis sacchari (Zehnter)	HI, FL	CABI, 2001; Zimmerman, 1948
Sitobion (= *Macrosiphum*) *luteum* (Buckton)	HI, FL	Johnson, 2006; Tenbrink and Hara, 1995
Toxoptera citricida (Kirkaldy)	HI, FL	CABI 2004; Nishida, 2002; USDA-APHIS-PPQ, 2005
Cicadellidae		
Gyponana germari (Stal)	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
Coccidae		
Coccus capparidis (Green)	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
Coccus viridis (Green)	HI, FL	Ben-Dov et al., 2005; Wood, 2000
Vinsonia stellifera (Westwood)	HI, AL, FL, GA	Ben-Dov et al., 2005; CABI, 2004; Dawson, 1999
Coreidae		
Physomerus grossipes (F.)	HI	HI-DoA, 2002
Delphacidae		
Aloha ipomoeae Kirkaldy	HI	Giffard, 1917
Nesosydne ipomoeicola Kirkaldy	HI	Fullaway, 1943
Derbidae		
Lamenia caliginea (Stål)	HI	Kessing and Mau, 1992

Pest	Geographic Distribution[1]	References
Diaspididae		
Andaspis punicae (Laing)	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
Lepidosaphes laterochitinosa Green (= *L. spinulosa* Beardsley)	HI	Beardsley, 1966, 1975; Ben-Dov et al., 2005; Nishida, 2002
Parlatoria ziziphi (Lucas)	HI, MS	CABI, 2003; USDA-APHIS-PPQ, 2005
Pseudaulacaspis subcorticalis (Green)	HI	Ben-Dov et al., 2005
Flatidae		
Siphanta acuta (Walker)	HI	Nishida, 2002; UH-CTAHR and HI-DoA, 2005
Lygaeidae		
Graptostethus manillensis (Stal)	HI	Sakimura, 1944
Miridae		
Halticus tibialis Reuter	HI	CABI, 2001; HI-DoA, 2002
Hyalopeplus pellucidus (Stal)	HI	HI-DoA 2005; UH-CTAHR and HI-DoA, 2005
Pseudococcidae		
Maconellicoccus hirsutus (Green)	HI, CA, FL	CABI, 2003; USDA-APHIS-PPQ, 2005
Nipaecoccus viridis (Newstead)	HI	Ben-Dov et al., 2005; CABI, 2004
Paracoccus marginatus Williams & Granara de Willink	HI, FL	CABI 2004; USDA-APHIS-PPQ, 2005
Pseudococcus cryptus Hempel (= *P. citriculus* Green)	HI	Ben-Dov, 1994; USDA-APHIS-PPQ, 2005
Pseudococcus dendrobiorum Williams	HI	UH-CTAHR and HI-DoA, 2005; Nishida, 2002
Puto barberi (Cockerell)	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
Psyllidae		
Blastopsylla occidentalis Taylor	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
HYMENOPTERA		
Formicidae		
Camponotus variegatus (F. Smith)	HI	Anon., 2006; Nishida, 2002
Pheidole megacephala (F.)	HI	Williams, 1931

Pest	Geographic Distribution[1]	References
ISOPTERA		
Rhinotermitidae		
Reticulitermes speratus (Kolbe)	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
Termitidae		
Nasutitermes cornigera (Motschulsky)	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
LEPIDOPTERA		
Crambidae		
Omphisa anastomosalis (Guenee)	HI	HI-DoA, 2002
Udea despecta (Butler)	HI	Zimmerman, 1958
Geometridae		
Anacamptodes fragilaria (Grossbeck)	HI, CA	HI-DoA, 2002
Lycaenidae		
Lampides boeticus Linnaeus	HI	CABI, 2003; Hill, 1994; Nishida, 2002; USDA-APHIS-PPQ, 2005; Zhang 1994
Lyonetiidae		
Bedellia orchilella Walsingham (= *B. somnulentella*)	HI	HI-DoA, 2002
Noctuidae		
Achaea janata L.	HI	CABI, 2004; Hill, 1994; Nishida, 2002; Robinson et al, 2003; USDA-APHIS-PPQ, 2005
Athetis thoracica (Moore)	HI	Zimmerman, 1958
Chrysodeixis erioosoma (Doubleday)	HI	Swezy, 1944
Eudocima fullonia (Clerck)	HI	CABI, 2004
Spodoptera litura (Fabricius)	HI	CABI, 2003; Hill, 1994; Nishida, 2002; Pogue, 2003; USDA-APHIS-PPQ, 2005; Zhang, 1994
Spodoptera mauritia subsp. *acronyctoides* Guenée	HI	CABI, 2003; Hill, 1994; Nishida, 2002; Pogue, 2003; USDA-APHIS-PPQ, 2005; Zhang, 1994
Stictoptera cucullioides (Guenée)	HI	Zhang, 1994

Pest	Geographic Distribution[1]	References
Pieridae		
Colias sp.	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
Pyralidae		
Cryptoblabes gnidiella (Milliere)	HI	CABI, 2004; Nishida, 2002; Zhang 1994
Hellula undalis (F.)	HI	Zimmerman, 1978
Maruca vitrata Fabricius	HI	CABI, 2003; Hill, 1994; Nishida, 2002; Robinson et al, 2003; USDA-APHIS-PPQ, 2005; Zhang 1994
Tineidae		
Opogona purpuriella Swezy	HI	Zimmerman, 1978
Tortricidae		
Cryptophlebia illepida (Butler)	HI	Zimmerman, 1978
Cryptophlebia ombrodelta (Lower)	HI	CABI, 2004; Robinson et al., 2003; Zimmerman, 1978
Epiphyas postvittana (Walker)	HI	Ebeling 1959; HI-DoA, 2005; Nishida, 2002; UH-CTAHR and HI-DoA, 2005; USDA-APHIS-PPQ, 2005; Zhang, 1994
ORTHOPTERA		
Gryllotalpidae		
Gryllotalpa africana Palisot de Beauvois	HI	CABI, 2004
Pyrgomorphidae		
Atractomorpha sinensis Bolivar	HI	Holdaway, 1944
Tettigoniidae		
Conocephalus saltator (Saussure)	HI	Mau, 1977
Elimaea punctifera (Walker)	HI	UH-CTAHR and HI-DoA, 2005
Xiphidiopsis lita Hebard	HI	Nishida, 2002; USDA-APHIS-PPQ, 2005
PSOCOPTERA		
Ectopsocidae		
Ectopsocus fullawayi Enderlein	HI	Zimmerman, 1948

Pest	Geographic Distribution[1]	References
THYSANOPTERA		
Thripidae		
Chaetanaphothrips signipennis (Bagnall)	HI	Wood, 2000
Dichromothrips corbetti (Priesner)	HI	Nishida, 2002; UH-CTAHR and HI-DoA, 2005
Frankliniella schultzei (Trybom)	HI, FL	CABI, 2004
Helionothrips errans (Williams)	HI	Nishida, 2002; UH-CTAHR and HI-DoA, 2005
Scirtothrips dorsalis Hood	HI	CABI, 2003
Thrips palmi Karny	HI, FL	CABI, 2004; Wood, 2000
CHROMISTA		
Albugo sp. (Oomycetes: Peronosporales)	HI	Farr et al., 2005
Aphanomyces sp. (Oomycetes: Saprolegniales)	HI	Farr et al., 2005
Phytophthora katsurae Ko & Chang (Oomycetes: Pythiales)	HI	Farr et al., 2005
Phytophthora meadii McRae (Oomycetes: Pythiales)	HI	Farr et al., 2005
Phytophthora tropicalis Aragaki & J.Y. Uchida (Oomycetes: Pythiales)	HI	Farr et al., 2005
FUNGI		
Acremonium recifei (Leão & Lôbo) W. Gams (Ascomycetes: Hypocreales)	HI	Farr et al., 2005
Acrodictys fimicola Ellis & Gunnell (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Allomyces arbusculus Butler (Chytridiomycetes: Blastocladiales)	HI	Farr et al., 2005
Alternaria aragakii Simmons (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Amazonia spp. (Ascomycetes: Meliolales)	HI	Farr et al., 2005
Anungitea fragilis Sutton (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005

Pest	Geographic Distribution[1]	References
Aschersonia marginata Ellis & Everh. (Ascomycetes: Hypocreales)	HI	Farr et al., 2005
Ascochyta spp. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Aspergillus spp. (Ascomycetes: Eurotiales)	HI	Farr et al., 2005
Asteridiella spp. (Ascomycetes: Meliolales)	HI	Farr et al., 2005
Asteromella lantanae Petr. (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Atichia solaridiscoidea Meeker (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Bactridium flavum Kunze (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Beauveria sp. (Ascomycetes: Hypocreales)	HI	Farr et al., 2005
Beltraniella portoricensis (Stevens) Piroz. & Patil (Ascomycetes: Xylariales)	HI	Farr et al., 2005
Bipolaris spp. (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Botryodiplodia sp. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Botryosphaeria parva Pennycook & Samuels (Ascomycetes: Dothideales)	HI	Farr et al., 2005
Botrytis spp. (Ascomycetes: Helotiales)	HI	Farr et al., 2005
Calonectria insularis Schoch & Crous (Ascomycetes: Hypocreales)	HI	Farr et al., 2005
Calonectria pauciramosa Schoch & Crous (Ascomycetes: Hypocreales)	HI, FL	Farr et al., 2005
Cercospora aciculina Chupp (Ascomycota: Mycosphaerellales)	HI	Farr et al., 2005
Ceuthospora latitans (Fr.:Fr.) Höhn. (Ascomycetes: Helotiales)	HI, AK	Farr et al., 2005
Chaetophoma sp. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Cladosporium spp. (Ascomycota: Mycosphaerellales)	HI	Farr et al., 2005

Pest	Geographic Distribution[1]	References
Clypeoseptoria rockii Stevens & Young (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Colletotrichum artocarpi Delacr. (Ascomycetes: Phyllachorales)	HI	Farr et al., 2005; Raabe et al., 1981
Colletotrichum dianellae Stevens & Young (Ascomycetes: Phyllachorales)	HI	Farr et al., 2005
Coniothyrium nitidae Crous & Denman (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Cordana musae (Zimmerm.) Höhn. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Cryptosporiopsis eucalypti Sankaran & B. Sutton (Ascomycetes: Helotiales)	HI	Farr et al., 2005
Curvularia spp. (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Cylindrocarpon spp. (Ascomycetes: Hypocreales)	HI	Farr et al., 2005
Cylindrocladium spp. (Ascomycetes: Hypocreales)	HI	Farr et al., 2005; Killgore, 2005; UH-CTAHR and HI-DoA, 2005
Cylindrosporium sp. (Ascomycetes: Helotiales)	HI	Farr et al., 2005
Cytospora sp. (Ascomycetes: Diaporthales)	HI	Farr et al., 2005
Dinemasporium sp. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Diplodia shearii Petr. (Ascomycetes: Dothideales)	HI	Farr et al., 2005
Discosia spp. (Ascomycetes: Incertae sedis)	HI	CSREES, 2004
Dothiorella opuntiae Siemaszko ex Petr. (Ascomycetes: Dothideales)	HI	Farr et al., 2005
Elsinoë batatas Viégas & Jenkins (Ascomycota: Myriangiales)	HI	CABI, 2001; Raabe et al., 1981
Enthallopycnidium gouldiae Stevens (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Eriosporella calami (Niessl) Höhn. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005

Pest	Geographic Distribution[1]	References
Exserohilum spp. (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Flavodon cervinogilvum (Jungh.) Corner (Basidiomycetes: Polyporales)	HI	CSREES. 2004; Farr et al., 2005; Gilbertson, et al., 2002
Fomitopsis nivosa (Berk.) Gilb. & Ryvarden (Basidiomycetes: Polyporales)	HI, FL, SC	Farr et al., 2005; Gilbertson, et al., 2002
Fusarium spp. (Ascomycetes: Hypocreales)	HI	Farr et al., 2005
Fusicoccum canavaliae Lyon (Ascomycetes: Dothideales)	HI	Farr et al., 2005
Gampsonema exile (Tassi) Nag Raj (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Gloeocoryneum hawaiiense Sutton & Hodges (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Gloeosporium spp. (Ascomycetes: Helotiales)	HI	UH-CTAHR and HI-DoA, 2005
Harknessia gunnerae Stevens & Young (Ascomycetes: Diaporthales)	HI	Farr et al., 2005
Lasmenia sp. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Leptothyrium gleicheniae Stevens & Young (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Libertella kokiae Petr. (Ascomycetes: Xylariales)	HI	Farr et al., 2005
Marssonina sp. (Ascomycetes: Helotiales)	HI	Farr et al., 2005
Melanconium sp. (Ascomycetes: Diaporthales)	HI	Farr et al., 2005
Microporus flabelliformis (Klotzsch) Pat. (Basidiomycetes: Polyporales)	HI	Farr et al., 2005
Mycoacia kurilensis Parmasto (Basidiomycetes: Polyporales)	HI	Farr et al., 2005; Gilbertson, et al., 2002
Mycosphaerella artocarpi Stevens & Young (Ascomycetes: Mycosphaerellales)	HI	Farr et al., 2005; Raabe et al., 1981
Mycotribulus mirabilis Nag Raj & Kendr. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005

Pest	Geographic Distribution[1]	References
Neonectria rugulosa (Pat. & Gaillard) Mantiri & Samuels [= *Nectria rugulosa* Pat. & Gaillard] (Ascomycetes: Hypocreales)	HI	Farr et al., 2005
Penicillium sp. (Ascomycetes: Eurotiales)	HI	CABI, 2001; Raabe et al., 1981
Pestalotia sp. (Ascomycetes: Xylariales)	HI	
Phanerochaete australis Jülich (Basidiomycetes: Polyporales)	HI	Farr et al., 2005; Gilbertson and Adaskaveg, 1993
Phellinus grenadensis (Murrill) Ryvarden (Basidomycetes: Hymenochaetales)	HI, LA	Farr et al., 2005
Phlebia acanthocystis Gilb. & Nakasone (Basidiomycetes: Polyporales)	HI	Farr et al., 2005; Gilbertson, et al., 2002
Phoma agapanthi (Thüm.) Sacc. (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Phoma caricae-papapae (Tarr) Punith. (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Phomopsis caricae-papayae Petr. & Cif. (Ascomycetes: Diaporthales)	HI	Farr et al., 2005
Phyllosticta acicola Bissett & Palm (Ascomycetes: Dothideales)	HI	Farr et al., 2005
Pleurophomopsis eucalypti Petr. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Pyrenochaeta sp. (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Ramularia ipomoea Stevens (Ascomycetes: Mycosphaerellales)	HI	Farr et al., 2005
Rhabdospora pittospori Stevens & Young (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Rhizoctonia spp. (Basidiomycetes: Polyporales)	HI	Farr et al., 2005; Killgore, 2005
Rhizopus sp. (Zygomycetes: Mucorales)	HI	Raabe et al., 1981

Pest	Geographic Distribution[1]	References
Robillarda rhizophorae Kohlm. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Septogloeum arachidis Racib. (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
Septoria canavaliae Lyon (Ascomycetes: Mycosphaerellales)	HI	Farr et al., 2005
Septoriella rockiana (Petr.) Nag Raj (Ascomycetes: Dothideales)	HI	Farr et al., 2005
Sphaceloma sp. (Ascomycetes: Myriangiales)	HI	Farr et al., 2005
Sphaeropsis tumefaciens Hedges (Ascomycetes: Incertae sedis)	HI, FL	CABI, 2004; Farr et al., 2005
Sporonema sp. (Ascomycetes: Helotiales)	HI	Farr et al., 2005
Stagonospora erythrinae Stevens & Young (Ascomycetes: Pleosporales)	HI	Farr et al., 2005
Uredo artocarpi Berk. & Broome (Urediniomycetes: Urediniales)	HI	Gardner, 1991
Waydora typica (Rodway) B. Sutton (Ascomycetes: Incertae sedis)	HI	Farr et al., 2005
MOLLUSCA		
Achatinidae		
Achatina fulica Bowdich	HI, FL	Cowie, 1997, 2002b; Robinson, 2006
Ampullaridae		
Pila ampullaceae (Linne)	HI	Robinson, 2006
Pila conica (Wood)	HI	Cowie, 1997, 2002a; Robinson, 2006
Pila sp.	HI	Cowie, 2002b; Robinson, 2006
Pomaceae canaliculata (Lamarck)	HI, CA, TX, FL	Cowie, 1997, 2002b; Robinson, 2006
Helicarionidae		
Parmarion cf. *martensi* (Simroth) [Tentative]	HI	Cowie, 1997, 2002b; Robinson, 2006

Pest	Geographic Distribution[1]	References
Helicidae		
Cornu aspersum (Müller) [= *Cryptomphalus aspersus* (Müller); *Helix aspersa* Müller]	HI, CA[2], OR[2], LA, PA[2], NC[2], NJ[2], SC[2], UT, WA	Cowie, 1997, 2002b; Robinson, 2006
Philomycidae		
Meghiamtium straitum (Hasselt)	HI	Cowie, 2002a; Robinson, 2006
Subulinidae		
Beckianum beckianum (Pfeiffer)	HI	Robinson, 2006
Paropeas achatinaceum (Pfeiffer)	HI	Cowie, 1997; Robinson, 2006
Veronicellidae		
Laevicaulis alte (Ferussac)	HI	Cowie, 1997, 2002b; Robinson, 2006
Veronicella cubensis (Pfeiffer)	HI (Tentative), AS, PR	Cowie, 1997, 2002b; Robinson, 2006
NEMATODA		
Anguinidae		
Ditylenchus dipsaci (Kühn) Filipjev	HI, US	CABI, 2001
Aphelenchidae		
Aphelenchoides sp.	HI	USDA-ARS, 2005
Seinura filicaudata Christie	HI	Handoo et al., 1998; USDA-ARS, 2005
Belonolaimidae		
Tylopharynx annulatus (Cassidy) Golden	HI	USDA-ARS, 2005
Criconematidae		
Criconemoides palmatum (Siddiqi & Southey)	HI	USDA-ARS, 2005
Heteroderidae		
Meloidogyne konaensis Eisenback	HI	Zhang and Schmitt, 1994
Mononchidae		
Monochus sp.	HI	USDA-ARS, 2005
Panagrolaimidae		
Panagrolaimus sp.	HI	USDA-ARS, 2005

Pest	Geographic Distribution[1]	References
Pratylenchidae		
Hirschmanniella diversa Sher	HI	USDA-ARS, 2005
Rhabditidae		
Rhabditus sp.	HI	USDA-ARS, 2005

[1] Distribution: AK = Alaska, AL = Alabama, AS = American Samoa, CA = California, FL = Florida, GA = Georgia, HI = Hawaii, LA = Louisiana, MS = Mississippi, NJ = New Jersey, NC = North Carolina, OR = Oregon, PA = Pennsylvania, PR = Puerto Rico, SC = South Carolina, TX = Texas, UT= Utah, and WA = Washington

[2] These states have quarantines and or eradication programs in place

Table A2. Selected pest plants (i.e., weeds, invasive plants) in Hawaii that are quarantine-significant for the contiguous 48 states in the United States. NOTE: This is not a complete list of all quarantine-significant plant pests from Hawaii and should not be regarded as such. All pest plant references include USDA NRCS, 2006.

Family	Pest plant	Geographic distribution[1]	Noxious weed list[2]			Additional References
			HI	Fed	Other[1]	
Acanthaceae	*Asystasia gangetica* (L.) T. Anders.	HI, FL				
Agavaceae	*Furcraea foetida* (L.) Haw.	HI, FL				HEAR, 2006
Amaranthaceae	*Alternanthera sessilis* (L.) R. Br. ex DC.	HI, FL, GA, LA, TX		✓	AL, AR, CA, FL, MA, MN, NC, OR, SC, VT	
Anacardiaceae	*Schinus terebinthifolius* Raddi	HI, CA, FL, PR, TX			FL, TX	
Araliaceae	*Schefflera actinophylla* (Endl.) H.A.T. Harms	HI, FL, PR				
Asteraceae	*Ageratina adenophora* (Spreng.) King & H.E. Robins.	HI, CA	✓	✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
	Elephantopus mollis Kunth	HI, PR	✓			
	Montanoa hibiscifolia (Benth.) Standl.	HI	✓			
	Senecio madagascariensis Poir.	HI	✓			

Family	Pest plant	Geographic distribution[1]	Noxious weed list[2]			Additional
			HI	Fed	Other[1]	References
Asteraceae	*Tridax procumbens* L.	HI, FL, PR		✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
Basellaceae	*Anredera cordifolia* (Ten.) Steenis	HI, CA, DC, FL, LA, PR, TX	✓			
Bignoniaceae	*Spathodea campanulata* Beauv.	HI, FL, PR				HEAR, 2006
Boraginaceae	*Cordia glabra* L.	HI, PR				APWG, 2006
Cactaceae	*Cereus hildmannianus* K. Schum.	HI, PR	✓			
	Harrisia martinii (Labouret) Britt.	HI	✓			
Casuarinaceae	*Casuarina equisetifolia* L.	HI, FL, PR			FL	
Cecropiaceae	*Cecropia obtusifolia* Bertol.	HI				UH-Botany, 1998
Commelinaceae	*Commelina benghalensis* L.	HI, CA, FL, GA, LA		✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
Convolvulaceae	*Ipomoea aquatica* Forssk.	HI, CA, FL		✓	AL, AZ, AR, CA, FL, NC, OR, SC, TX, VT	
Cucurbitaceae	*Coccinia grandis* (L.) Voigt	HI, FL	✓			
Fabaceae	*Caesalpinia decapetala* (Roth) Alston	HI, PR				UH-Botany, 1998
	Prosopis juliflora (Sw.) DC.	HI	✓			
	Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	HI, PR		✓	AL, CA, MA, MN, NC, OR, SC, VT	
	Pueraria phaseoloides (Roxb.) Benth.	HI, PR	✓			
	Spartium junceum L.	HI, CA, OR, WA	✓		OR, WA	
	Ulex europaeus L.	HI, CA, MA, NY, OR, PA, VA, WA, WV	✓		CA, OR, WA	
Lamiaceae	*Hyptis pectinata* (L.) Poit.	HI, FL, PR	✓			

Family	Pest plant	Geographic distribution[1]	Noxious weed list[2]			Additional
			HI	Fed	Other[1]	References
Lamiaceae	*Hyptis suaveolens* (L.) Poit.	HI, PR	✓			
Malvaceae	*Malachra alceifolia* Jacq.	HI, FL, PR	✓			
	Urena lobata L.	HI, FL, LA, PR	✓			
Marattiaceae	*Angiopteris evecta* (J.R. Forst.) Hoffmann	HI				UH-Botany, 1998
Melastomataceae	*Clidemia hirta* (L.) D. Don	HI, PR	✓			ISSG, 2006
	Medinilla venosa (Blume) Blume	HI				
	Melastoma candidum D. Don	HI	✓			
	Melastoma malabathricum L.	HI		✓		
	Miconia calvescens DC.	HI	✓			
	Oxyspora paniculata (D. Don) DC.	HI				UH-Botany, 1998
	Tibouchina herbacea (DC.) Cogn.	HI	✓			
	Tibouchina longifolia (Vahl) Baill. ex Cogn.	HI	✓			
	Tibouchina urvilleana (DC.) Cogn.	HI, PR	✓			
Mimosaceae	*Acacia mearnsii* Willd.	HI, CA	✓			
Myricaceae	*Morella faya* (Ait.) Wilbur	HI	✓			
Myrsinaceae	*Ardisia elliptica* Thunb.	HI, FL	✓			
Myrtaceae	*Melaleuca quinquenervia* (Cav.) Blake	HI, FL, LA, PR		✓	AL, CA, FL, MA, NC, OR, SC, TX, VT	
	Rhodomyrtus tomentosus (Ait.) Hassk.	HI, FL	✓		FL	
Oleaceae	*Fraxinus uhdei* (Wenzig) Lingelsh.	HI, PR				HEAR, 2006; UH-Botany, 1998

Family	Pest plant	Geographic distribution[1]	Noxious weed list[2]			Additional References
			HI	Fed	Other[1]	
Papaveraceae	*Bocconia frutescens* L.	HI, PR	✓			
Passifloraceae	*Passiflora bicornis* P. Mill.	HI	✓			
Pinaceae	*Pinus caribaea* Morelet	HI, PR				UH-Botany, 1998
Piperaceae	*Piper aduncum* L.	HI, FL, PR	✓			
Pittosporaceae	*Pittosporum undulatum* Vent.	HI, CA	✓			
Poaceae	*Cenchrus echinatus* L.	HI, AL, AZ, CA, DC, FL, GA, LA, MS, NC, NM, SC, TX			AZ, CA	UH-Botany, 1998
	Chrysopogon aciculatus (Retz.) Trin.	HI		✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
	Cortaderia jubata (Lem.) Stapf	HI, CA, OR				
	Cymbopogon refractus (R. Br.) A. Camus	HI	✓			
	Digitaria abyssinica (Hochst. ex A. Rich.) Stapf	HI		✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
	Paspalum scrobiculatum L.	HI, AL, GA, MD, NJ, TX		✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
	Pennisetum macrourum Trin.	HI, CA, TX		✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
	Saccharum spontaneum L.	HI, PR		✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
	Themeda villosa (Poir.) A. Camus	HI	✓			
Polygonaceae	*Emex spinosa* (L.) Campd.	HI, CA, FL, MA, TX	✓	✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
Pontederiaceae	*Monochoria vaginalis* (Burm. f.) K. Presl ex Kunth	HI, CA		✓	AL, CA, FL, MA, NC, OR, SC, VT	
Proteaceae	*Grevillea banksii* R. Br.	HI	✓			

Family	Pest plant	Geographic distribution[1]	Noxious weed list[2]			Additional References
			HI	Fed	Other[1]	
Rhizophoraceae	*Bruguiera sexangula* (Lour.) Poir.	HI				HEAR, 2006
Rosaceae	*Rubus ellipticus* Sm. var. *obcordatus* Focke	HI	✓			
Rosaceae	*Rubus niveus* Thunb.	HI, FL	✓			
	Rubus sieboldii Blume	HI	✓			
Rubiaceae	*Cinchona pubescens* Vahl	HI				ISSG, 2006
Solanaceae	*Solanum robustum* Wendl.	HI				
	Solanum torvum Sw.	HI, AL, FL, MD, PR		✓	AL, CA, FL, MA, MN, NC, OR, SC, VT	
Sterculiaceae	*Melochia umbellata* (Houtt.) Stapf	HI				UH-Botany, 1998
Tiliaceae	*Heliocarpus popayanensis* Kunth	HI				UH-Botany, 1998
	Triumfetta rhomboidea Jacq.	HI, FL, PR	✓			
	Triumfetta semitriloba Jacq.	HI, FL, GA, PR	✓			
Ulmaceae	*Trema orientale* (L.) Blume	HI				HEAR, 2006
Verbenaceae	*Clerodendrum japonicum* (Thunb.) Sweet	HI, MD				HEAR, 2006; UH-Botany, 1998
Zingiberaceae	*Hedychium gardnerianum* Shepard ex Ker-Gawl.	HI		✓		

[1] Distribution: AL = Alabama, AR = Arkansas, AZ = Arizona, CA = California, DC = District of Columbia, FL = Florida, GA = Georgia, HI = Hawaii, LA = Louisiana, MD = Maryland, MA = Massachusetts, MN = Minnesota, MS = Mississippi, NC = North Carolina, NJ = New Jersey, NM = New Mexico, NY = New York, OR = Oregon, PA = Pennsylvania, PR = Puerto Rico, SC = South Carolina, TX = Texas, VA = Virginia, VT = Vermont, WA = Washington, and West Virginia.

[2] ✓ = Listed

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