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Eradication of Isolated Populations of Light Brown Apple Moth in California

Revised Environmental Assessment
July 2007

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I. Introduction

A. Biology of Light Brown Apple Moth

The light brown apple moth (LBAM) (*Epiphyas postvittana*) is native to Australia where it is considered to be an economically important pest on many fruit crops. LBAM also attacks a wide variety of plants, including over 200 other agronomically important crops and other non-crop plant species that occur in 120 plant genera (appendix A). In addition to Australia, LBAM has been found in New Zealand, New Caledonia, Hawaii, and the British Isles. The moth lays eggs in overlapping masses preferably on leaves but also on fruit and stems of the host plant. The larvae hatch and then pass through six stages where they will be approximately 18 millimeters before pupation. Young larvae are pale yellow while the mature larvae are pale green (Mo, 2006). Larvae will feed on leaves and fruit from susceptible host plants. In all stages, larvae will construct silken shelters at the feeding site, which is where pupation occurs. Adults are light brown with the females larger than the males, and females have a dark spot in the center of the front wings when folded. The number of LBAM generations produced in a growing season varies from one to over four, depending on environmental conditions (Danthanarayana, 1983; Mo et al., 2006). In cases where multiple generations occur in a season, the population can build to economically important thresholds quickly.

B. History of Infestation in California

In February, 2007, LBAM was found near Berkeley in Alameda County, California. In response, pheromone-baited traps were placed in Alameda and Contra Costa Counties in March, 2007.

On March 16, 2007, the Agriculture Research Service Systematic Entomology Laboratory in Washington, DC, confirmed that the original finds were positive for LBAM. On April 20, 2007, the California Department of Food and Agriculture (CDFA) issued a quarantine of at least 182-square miles in Alameda, Contra Costa, San Francisco, Marin, and Santa Clara Counties. This quarantine was expanded to include Monterey, Santa Cruz, and San Mateo Counties in June, 2007.

The United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) issued a Federal quarantine order on May 2, 2007, requiring inspection and certification of all nursery stock and host commodities from Alameda, Contra Costa, Marin, Monterey, San Francisco, San Mateo, Santa Clara, and Santa Cruz Counties. The Federal quarantine order mandates trapping at a rate of one trap per 5 acres and imposes additional conditions on the movement of host material to prevent the spread of LBAM.

Since March, 2007, approximately 33,000 traps have been placed throughout the State of California (USDA, 2007a). The traps are baited bimonthly and serviced biweekly. There have been over 4,900 positive detections in eleven counties. Most of the captures (99%), are from traps located in two specific geographical areas. The first area, representing 92% of all LBAM captures, encompasses southern Santa Cruz and northern Monterey Counties. The second area, which represents approximately 7% of captures, includes contiguous portions of northwest Alameda, western Contra Costa, and northern San Francisco Counties. The remaining 1% is from isolated populations, mostly represented by single trap captures, in Los Angeles, Marin, Napa, San Mateo, Solano, and Santa Clara Counties.

Treatments were initiated on two isolated populations during June, 2007 in order to begin eliminating outlier populations and reduce the opportunity for LBAM to expand its range. An environmental assessment (EA) (USDA, 2007b) for treatments of two isolated populations indicated that such treatments would not result in a significant impact to the environment. The two isolated populations where treatment has been initiated are in Napa (Napa County) and Oakley (eastern Contra Costa County). Both sites were treated via ground equipment with *Bacillus thuringiensis kurstaki* (Btk), a biologically based pesticide that is effective against early larval stages of most lepidopterans, including LBAM. It is expected that each of the sites will receive between three and six treatments of Btk.
In addition, these sites may be treated with pheromone to disrupt any potential mating.

C. Purpose and Need

APHIS is responsible for taking actions to exclude, eradicate, and/or control plant pests under the Plant Protection Act (7 United States Code (U.S.C.) 7701). Therefore, it is important that APHIS take the steps necessary to eradicate LBAM from areas in California to prevent its spread to susceptible host plants throughout the United States. APHIS, in cooperation with CDFA, is developing an eradication program for LBAM. The final recommendations of the LBAM Technical Working Group (an international panel of experts) have been received; they are currently being evaluated and incorporated into an eradication program. Once the eradication program is developed an EA will be completed on the plan.

As noted above, there are two population centers of LBAM, one in the San Francisco area and one in the Santa Cruz/Monterey County area. In addition to these two population centers, there are approximately 35 individual isolated populations. Treatment of these small, isolated populations of LBAM is a desirable strategy to limit the spread of the moth until an eradication program can be implemented.

This EA evaluates the potential impacts from eradication treatments of small isolated detections of LBAM. The original EA (referred to in section I.B., above (USDA, 2007b)) had specific details regarding the treatments in Napa and Oakley, California (the first isolated populations that had been designated for treatment). Upon review, it was decided that the original EA should be revised to clarify that the EA covers treatment of all isolated populations known to date and found in the future. A map of LBAM finds is located on the CDFA web site (http://www.cdfa.ca.gov/phpps/pdep/lbam_main.htm). This web site is updated as new information becomes available.

This EA has been prepared consistent with the National Environmental Policy Act of 1969 (NEPA) and APHIS' NEPA implementing procedures (7 Code of Federal Regulations (CFR) part 372) for the purpose of evaluating how the proposed action, if implemented, may affect the quality of the human environment.

A 30-day public comment period is being provided with this EA. Due to the nature of LBAM infestations in these areas, and the potential for the rapid and harmful spread of the LBAM infestations, it may be necessary to treat some sites prior to the end of the comment period. If this is the case, a finding of no significant impact (FONSI) will be issued and made available in the same manner as the notice of the EA. Comments received prior to the FONSI will be addressed at that time. Comments received after the FONSI is issued, and before the 30-day comment period has expired, will be considered for future actions and will be made available in a separate document. A FONSI will be prepared for each isolated population before it is treated.

D. Affected Environment

LBAM has been found in eleven counties in central California. As mentioned before, there are two main population clusters. Small populations where generally less than 10 moths have been captured outside these general population clusters are considered isolated populations. Currently, there are approximately 35 isolated populations; however, it is anticipated that more are likely to be found in the future. In general, the isolated population areas have been non-crop areas in either open recreational areas or residential or commercial developments.

II. Alternatives

This EA analyzes the potential environmental consequences of the proposed action to eradicate isolated populations of LBAM from California where it has been detected. Two alternatives are being considered: (1) no action by APHIS to eliminate LBAM, and (2) treatment of isolated populations of LBAM. Treatment of LBAM would include one of three options: use of Btk; use of a pheromone in traps or for mating disruption; or, a combination of Btk and a pheromone.

A. No Action

The no action alternative consists of maintaining the current Federal order without further action by APHIS. Private landowners would manage LBAM infestations, as appropriate.

Pursuant to the Federal order, the following regulated articles would not be moved interstate from a quarantine area except in accordance with this order:

- Nursery stock;
- Cut flowers, garlands, wreaths, or greenery of any plants;
- Trees and bushes, including cut Christmas trees;
- Greenwaste;
- Fruits and vegetables;
- Hay, straw, fodder, and plant litter;
- Bulk herbs and spices;
- Any other products, articles, or means of conveyance of any character whatsoever, when it is determined by an inspector that they present a hazard of spread of LBAM.

B. Treatment Alternative

The treatment alternative consists of maintaining the Federal quarantine order to prevent the artificial spread of LBAM, as well as using Btk and/or pheromone treatments specific for LBAM to eradicate small, isolated (outlier) populations of the moth from areas in California in which LBAM has been found. Treatment areas are anticipated to consist of a small radius (approximately 200 to 250 meters) around traps that have captured one or more LBAMs and that are located outside of the two most densely populated areas described in section I.B. above. Depending on site conditions and proximity of the isolated LBAM populations to sensitive areas, a treatment regime of Btk, pheromone, or a combination of both will be administered.

1. Btk

The biological insecticide, Btk, may be applied in areas where LBAM has been found. Btk is a naturally derived pesticide that has specific insecticidal activity against certain larval butterfly and moth species, including LBAM. Applications will occur at approximately 10- to 14-day intervals using ground equipment. Products registered with the Environmental Protection Agency (EPA) will be used according to label instructions.

2. Pheromone

Female moths naturally emit pheromones to attract male moths. Utilizing this phenomenon, synthetic pheromones have been developed and used to trap male moths and disrupt mating. The pheromones emitted by the female moth are very specific to the species and attract only that species of moth. An LBAM-specific pheromone has been developed and will be utilized where applicable.

In trapping, the pheromone is generally applied to a trap to attract the male moth and the trap is configured to capture it either through the use of a sticky pad or other trap configuration. This is used to help determine where a species occurs and/or whether eradication has been successful. The amount of pheromone that the trap emits is much higher than the amount of pheromone the female moth produces naturally and is more likely to attract a male moth.

Pheromones may also be used in mating disruption. The idea behind this is to saturate the area with so much pheromone that it is impossible for the male moth to find a female. Thus, fewer females actually mate resulting in few fertile eggs being laid; the consequence is a reduction in LBAM populations. Mating disruption has proven to be an effective technique in low-level populations such as occurs in the small, isolated LBAM populations. Applications of pheromone can occur in a variety of ways. The pheromones used for the treatment of LBAM will be applied via ground either through the use of a dispenser that is applied in trees or shrubs, or on sticks (if there are no trees), or through a microencapsulated spray.

III. Environmental Impacts

A. No Action

Under the no action alternative, the current Federal order would remain in place without application of Btk and/or the pheromone to eliminate LBAM from small outlying areas where limited numbers of moths have been detected. The use of insecticide applications would only occur by private individuals who need to control LBAM on crops. This would leave infested non-agricultural areas with susceptible plant hosts without a coordinated treatment plan. Agricultural areas that had been previously treated for LBAM would be susceptible to reinfestation from adjacent untreated sites. These sites would require additional pesticide applications thus increasing pesticide loading to the environment. Alternative pesticides may have higher use rates and increased risk to human health and the environment. In addition to environmental impacts, the economic costs to California agriculture could exceed $133 million dollars in lost production and control costs based on the gross value of crops in 2005 for apples, pears, oranges, grapes, apricots, avocados, kiwifruit, strawberries, and peaches (CDFA, 2007). Potential costs could be higher if costs to nurseries and other host crops are included. The loss of revenue from international and domestic markets is currently unknown but could be significant if LBAM becomes established in California. In 2003, California shipped over $7.2 billion in food and agricultural commodities around the world (CASS, 2004).

B. Treatment Alternative

Under the treatment alternative, Btk, pheromone, or a combination of Btk and pheromone will be used to treat isolated populations of LBAM. How an area is treated will be dependent on site conditions and proximity of the isolated LBAM populations to sensitive areas. Pheromone will be used in the more sensitive areas since it is more specific to LBAM and doesn't affect nontarget species. The environmental effects of each of the treatment options will be discussed below.

1. Btk

Bt is a common bacteria found naturally in soil, foliage, wildlife, water, and air throughout the world. Several isolates of Bt exist that have selective insecticidal activity against different groups of invertebrates. Btk is an isolate that is effective against certain butterflies and moths.

a. Toxicity

Based on mammalian toxicity studies testing the technical active ingredient and the formulated product, Btk has low acute oral, dermal, and inhalation toxicity and pathogenicity (EPA, 1998; USFS, 2004). These laboratory studies have also been supported by epidemiology studies that revealed no direct human health effects from Btk applications. Results from laboratory and epidemiology studies indicate that Btk is not a carcinogen, mutagen, or a reproductive toxicant (EPA, 1998; USFS, 2004). Btk is not considered a strong irritant; however, there are laboratory and field data that show that it is a mild eye and inhalation irritant.

Btk is considered to have low toxicity to birds based on acute oral and dietary toxicity values. Oral median lethal dose ($LD_{50;}$ i.e. the dose required to kill 50% of a test population) values were greater than 3,333 mg/kg day and dietary median lethal concentration ($LC_{50;}$ i.e. the concentration required to kill 50% of a population) values were greater than 1.8×10^{10} spores/kg for the bobwhite quail and mallard duck (EPA, 1998). Chronic toxicity data for birds is not available based on the low acute toxicity of Btk. The lack of acute toxicity to birds is supported by several field studies where no direct effects to birds were seen in forestry applications of Btk. However, some indirect effects were noted in studies where birds relied on caterpillar larvae as a primary food source. In some cases slight effects on reproduction, such as nestling growth rates, were noted (Norton et al., 2001); however, in other studies, no indirect effects on reproduction were noted (USFS, 2004). The studies that noted indirect effects had applications over large forested areas which will not occur in the proposed treatments for LBAM. Effects to nontarget terrestrial invertebrates are highly variable and dependent on the test organism. Even within the lepidopteran group that contains butterflies and moths, sensitivities can be highly variable (Peacock et al., 1998). In general, toxicity to pollinators and beneficial insects is considered low based on laboratory and field studies testing honey bees as well as other beneficial insects (USFS, 2004).

Btk has low acute aquatic vertebrate toxicity based on laboratory studies with multiple freshwater and saltwater fish species. In all cases, the calculated LC_{50} value was above the highest test concentration used in the study (USFS, 2004). Sublethal toxicity to fish is also low with a reported no observable effect concentration (NOEC) of 1.4 mg/L for the most sensitive fish species. Btk has low toxicity to *D. magna* in 21-day studies with EC_{50} values between 5 and 50 mg/L, while other aquatic invertebrate groups such as mayflies, stoneflies, copepods, and mysid shrimp appear to be tolerant of Btk when exposed to concentrations well above those expected in the environment (USFS, 2004). Results from laboratory studies are supported by field data that suggest minimal effects to aquatic invertebrates from Btk use (Richardson and Perrin, 1994; Kreutzweiser et al., 1992, 1994; USFS, 2004).

b. Exposure and Risk

Btk persistence in terrestrial environments is dependent upon light, moisture, and temperature. Increased exposure to light, higher temperature, and moisture decrease the viability of Btk. In a summary regarding the environmental fate of Btk, a majority of studies indicate that insecticidal activity of Btk to be approximately 1 week (USDA, 1995); however, other studies have shown that while spore viability can decrease rapidly, insecticidal activity can persist up to 3 months under certain environmental conditions. In water, Btk activity is light sensitive and dependent on organic matter content and salinity (USDA, 1995). Spores have been detected in aquatic field studies for 13 days and up to 4 weeks after spraying.

Based on the method of application and environmental fate information for Btk, nontarget exposure is expected to be low. Low toxicity and exposure will result in minimal risk to nontarget organisms. Label language prohibiting the application of Btk to surface water will further reduce the risk to aquatic nontarget organisms.

2. Pheromone

A selective pheromone has been developed to attract the male LBAM. The pheromone is specific to LBAM and has been isolated and identified as two compounds, (E)-11-tetradecen-1-yl acetate and (E,E)-9,11-tetradecadien-1-yl acetate. Both compounds have been identified in extracts of female moths and are LBAM-specific when combined (Bellas et al., 1983). The pheromone can be applied in individual dispensers or ground equipment can be used to broadcast spray the material. For the dispensers, the pheromone is contained within a sealed polyethylene tube containing 163.25 mg of (E)-11-tetradecen-1-yl acetate and 6.74 mg of (E,E)-9,11-tetradecadien-1-yl acetate. A wire is fused inside the plastic so that the dispenser can be twisted around a branch. The pheromone is released into the surrounding area and disrupts the ability of male LBAM to locate females. This method of control has been shown to be an effective means of LBAM control in citrus, grapes, apple, and apricot orchards when adequate numbers of dispensers are used (Mo et al., 2006b). Over larger areas, pheromone can be applied in a biodegradable 80 to 150 µm microencapsulated polymer which has been shown to be an effective method of application when applied appropriately (Wilkins, 1990; Knight and Larsen, 2004; Mihou et al., 2007).

a. Toxicity

Based on available toxicity data for the pheromone, it has low acute oral and dermal toxicity in rats with median lethal dose (LD_{50}) values of greater than 5,000 mg/kg and 2,000 mg/kg, respectively. Acute inhalation toxicity is also low, based on the acute inhalation median lethal concentration (LC_{50}) value of greater than 5.25 g/L. These values are consistent with the toxicity profile for other lepidopteran pheromones that have been tested (OECD, 2002; Weatherston and Stewart, 2002). Available data suggests that lepidopteran pheromones have very low chronic toxicity to mammals (OECD, 2002; EPA, 1996). The LBAM pheromone is considered a slight to moderate dermal irritant and is not considered to be carcinogenic or mutagenic (Pacific Biocontrol Corporation, 2007).

Data for structurally similar pheromones indicate there is very low acute toxicity to birds with LD_{50} values greater than 2,000 mg/kg (Weatherston and Stewart, 2002). Toxicity to aquatic organisms is unknown for LBAM pheromone specifically; however, data for other pheromones suggests low acute toxicity to fish and moderate to high toxicity to aquatic invertebrates with fish LC_{50} values greater than 100 parts per million (ppm), and aquatic invertebrate toxicity LC_{50} values that range from the upper parts per billion to low ppm range (Weatherston and Stewart, 2002; PMRA, 1994; Inscoe and Ridgway, 1992).

b. Exposure and Risk

Lepidopteran pheromones are sensitive to ultraviolet radiation and oxidation where they breakdown rapidly in terrestrial and aquatic environments. The rapid breakdown and volatilization of lepidopteran pheromones and their mammalian toxicological profile have resulted in EPA waiving the requirement of a food tolerance when applications do not exceed 150 g active ingredient/acre/year (EPA, 2007). In addition to rapid degradation, lepidopteran pheromones have very low solubility, or are insoluble in water, suggesting low aquatic residues (OECD, 2002). The LBAM pheromone is reported to be insoluble in water (Pacific Biocontrol Corporation, 2007).

Exposure to human health and the environment is expected to be minimal. In the case of the dispenser application, the pheromone is inside a plastic tube that is suspended in a tree; therefore, no human-related exposure from residues or drinking water is expected. The same would also be true for terrestrial nontarget organisms where, based on the method of application, exposure would be expected to be minimal. Exposure to aquatic organisms would not be expected since the pheromone will be applied using dispensers and label language prohibits discarding dispensers in surface water. Pheromone that could move off-site into surface water as drift from ground broadcast applications would be of low risk to aquatic organisms due to the low application rates and favorable environmental fate and toxicity profile for related pheromone products.

3. Comination of Btk and Pheromone

The use of Btk along with pheromone in the same treatment area does not produce any additional effects than those that are discussed in sections III,B,1. and 2., above. Btk and pheromone do not act synergistically to create additional environmental effects. Each treatment targets a different part of the LBAM life cycle making the combination of treatments desirable when multiple life stages are present in a given area. Btk is designed to kill the moth at the larval stage during feeding, whereas, the pheromone is designed to disrupt mating by confusing the male moth so he is unable to find and mate with a female moth.

C. Cumulative Effects

Treatments of other isolated populations of LBAM have begun in the Napa and Oakley areas of California. These treatments consist of using a combination of Btk and pheromone, similar to one of the treatment options in this action. Approximately 35 isolated populations of LBAM have been identified but it is likely that additional isolated populations will be found outside the 2 population centers.

Cumulative effects from potential pheromone use are expected to be negligible due to the specificity of the pheromone to LBAM and its minimal risk to human health and the environment. Cumulative impacts to nontarget butterflies and moths from the use of pheromones are also not anticipated because the pheromone is selective for LBAM.

Where Btk applications are prescribed, the proposed treatments cover small, isolated populations in small areas and will provide negligible increased environmental loading of *Bacillus* spores. Label language prohibiting applications to surface water and the short half-life in water will reduce additional loading to aquatic environments. Cumulative effects to nontarget terrestrial organisms are expected to be minor due to the low risk of Bt and the small areas where applications will occur.

An eradication plan is in development and, if implemented, will likely call for the use of Btk treatments alone or in conjunction with pheromone treatments. In addition, the Seaside and Marina areas in Monterey County are being considered for pheromone treatments. Environmental effects of implementing an eradication plan and treating Seaside and Marina areas will be analyzed in separate EAs. Both EAs will consider potential cumulative impacts from all previous LBAM-associated activities.

D. Threatened and Endangered Species

Section 7(a)(2) of the Endangered Species Act (ESA), and its implementing regulations, require all Federal agencies to insure their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat. CDFA and APHIS are working with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) to insure that treatment activities considered in this EA do not affect listed species or their designated and proposed critical habitats. No treatments will occur until CDFA and APHIS have completed a determination of effects on listed species and their habitats and, if necessary, section 7 consultation with FWS and/or NMFS has been concluded.

APHIS has designated CDFA as its non-Federal representative for the purpose of conducting informal consultation with FWS and NMFS on APHIS activities associated with the LBAM eradication program in California. APHIS will work with CDFA to develop all necessary consultation documents and will review any assessment completed by CDFA. If a biological assessment, or its equivalent, is necessary, APHIS will provide CDFA with all relevant guidance for the preparation and completion of the assessment. APHIS retains ultimate responsibility for its compliance with section 7 of the ESA.

APHIS and CDFA will continue to work in close cooperation with FWS and NMFS to insure that potential impacts to listed species and their designated critical habitats are avoided or minimized, to the extent possible, and consistent with the statutory and regulatory requirements of section 7 to insure compliance with ESA throughout the development and implementation of the LBAM eradication program.

E. Other Considerations

Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," focuses Federal attention on the environmental and human health conditions of minority and low-income communities and promotes community access to public information and public participation in matters relating to human health or the environment. This EO requires Federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefiting from such programs. It also enforces existing statutes to prevent minority and low-income communities from being subjected to disproportionately high or adverse human health or environmental effects. APHIS has determined that the environmental and human health effects from the proposed applications for treatment of LBAM in California are minimal and are not expected to have disproportionate adverse effects to any minority or low-income populations.

EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks," acknowledges that children, as compared to adults, may suffer disproportionately from environmental health and safety risks because of developmental stage, greater metabolic activity levels, and behavior patterns. This EO (to the extent permitted by law and consistent with the agency's mission) requires each Federal agency to identify, assess, and address environmental health risks and safety risks that may disproportionately affect children. Applications will be made using ground equipment which will minimize off-site movement of any material. If treatments are needed for other isolated LBAM populations, care will be taken to minimize any potential for exposure of children to LBAM treatments. A low potential for exposure and low toxicity of either product minimizes any potential risk to children.

IV. List of Agencies and Persons Consulted

U.S. Fish and Wildlife Service
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California Department of Food and Agriculture
Plant Health and Pest Prevention Services
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Appendix A. Light Brown Apple Moth Host List

Abies grandis (grand fir)
Acacia spp. (acacias)
Achillea millefolium (common yarrow)
Actinidia chinensis (Chinese gooseberry)
Actinidia deliciosa (kiwifruit)
Adiantum spp. (maidenhair ferns)
Alnus glutinosa (black alder/European alder)
Amaranthus spp. (amaranths)
Apium graveolens (celery)
Aquilegia spp. (columbines)
Arbutus spp. (madrone, strawberry tree)
Arctotheca spp. (capeweeds, cape dandelion)
Arctotis stoechadifolia (African daisy)
Artemesia spp. (mugwort, sage brush, tarragon, worm wood, etc.)
Astartea spp.
Aster spp. (asters)
Baccharis spp. (coyote brush, desert broom)
Boronia spp. (boronias)
Brassica spp. (broccoli, cabbage, cress, mustard, radish, turnip, etc.)
Breynia spp. (snow bush)
Buddleia spp. (butterfly bush)
Bursaria spp. (black thorns)
Calendula spp. (calendula)
Callistemon spp. (bottle brush)
Camellia japonica (camellia)
Campsis spp. (trumpet creeper, trumpet vine)
Capsicum frutescens (chile pepper)
Cardus nutans (musk thistle)
Cassia spp. (golden shower, pink shower, rainbow shower, gold medallion tree)
Ceanothus spp. (buck brush, wild lilac)
Cedrus spp. (cedar)
Centranthus spp. (fox’s brush/heliotrope/valerian)
Chamaecyparis lawsoniana (Lawson’s cypress)
Chenopodium album (fat-hen)
Chimonanthus sp. (wintersweet)
Choisya spp. (Mexican orange)
Chrysanthemum spp. (chrysanthemums)
Chrysanthemum x *morifolium* (mums)
Cirsium arvense (Canada thistle)
Cirsium vulgare (bull thistle)
Citrus spp. (citrus)
Clematis spp. (clematis, virgin’s bower, lather flower, vase vine)
Clerodendron spp. (bleeding heart vine, bowers, tubeflower, Turk’s turban)
Conyza bilbaoana (a fleabane)
Cordyline australis (cabbage tree)
Correa spp. ((Australian fuchsia)
Cotoneaster spp. (cotoneaster)
Crataegus spp. (hawthorn)

Crocosmia spp. (montbretia)
Cryptomeria japonica (Sugi)
Cucumis sativus (cucumber)
Cucurbita spp. (pumpkin)
Cupressus sp. ((cypress)
Cydonia spp. (quince)
Cyphomandra betacea (tree tomato)
Cytisus scoparius (Scotch broom)
Dahlia spp. (dahlia)
Datura spp. (angel's trumpet, Jimson weed, thorn apple)
Daucus spp. (carrot, Queen Anne's lace)
Dodonaea spp. ((hop bush, hopseed bush)
Diospyros spp. (persimmon)
Erica lustanica (Spanish heath)
Eriobotrya spp. (loquat)
Eriostemon spp. (wax flower)
Escallonia spp. (escallonias)
Eucalyptus spp. (eucalyptus, gum trees)
Euonymus spp. (euonymus)
Feijoa sellowiana (feijoa, pineapple guava)
Forsythia spp. (forsythias)
Fortunella spp. (kumquats)
Fragaria spp. (strawberry)
Fraxinus velutina (velvet ash)
Gelsemium spp. (Carolina jessamine)
Genista spp. (brooms)
Gerbera spp. (Transvaal daisy)
Gypsophila paniculata (baby's breath)
Grevillea spp. (hummingbird bush, grevilleas)
Hardenbergia spp. (lilac vine)
Hebe spp. (hebe)
Hedera spp. (ivy)
Helianthus tuberosus (Jerusalem artichoke)
Helichrysum spp. (curry plant, licorice plant, straw flower)
Humulus lupulus (hops)
Hypericum androsaemum (sweet-amber)
Hypericum calycinum (Aaron's beard)
Hypericum humifusum (trailing St. John's wort)
Hypericum perforatum (St John's wort)
Ilex sp. (holly)
Jasminum spp. (jasmine)
Juglans spp. (California black walnut, butternut)
Kunzea ericoides (white tea tree)
Lagunaria patersonii (Norfolk Island hibiscus)
Lathyrus spp. (sweet pea)
Lavendula spp. (lavenders)
Leptospermum spp. (tea trees)
Leucodendron spp. (silver tree)
Ligustrum spp. (privet)
Linum spp. (flax)
Litchi chinensis (litchi)

Lonicera spp. (honeysuckles)
Lupinus spp. (lupines)
Lycopersicum spp. (tomatoes)
Macadamia spp. (macadamia)
Malus spp. (apple)
Mangifera spp. (mango)
Medicago sativa (alfalfa)
Melaleuca spp. (honey myrtle, bottlebrush)
Mentha spp. (mint)
Mesembryanthemum spp. (ice plant)
Metrosideros excelsa (New Zealand Christmas tree)
Michelia spp. (michelia)
Monotoca spp. (broomheaths)
Myoporum spp. (myoporum)
Olea europaea (olive)
Oxalis spp. (lady's sorrel, redwood sorrel, wood sorrel)
Parkinsonia aculeata (Mexican Palo Verde)
Parthenocissus spp. (woodbine, Virginia creeper)
Passiflora edulis (passionfruit)
Passiflora mollissima (banana passionflower or passionfruit or poka)
Pelargonium spp. (florist's geraniums)
Persea americana (avocado)
Persoonia spp.
Petroselinum spp. (parsley)
Phaseolus vulgaris (common bean)
Philadelphus spp. (mock orange)
Phormium tenax (New Zealand flax)
Photinia spp. (photinia)
Picea spp. (spruce)
Pieris japonica (Japanese pieris or andromeda)
Pinus spp. (pines)
Pisum sativum (pea)
Pittosporum spp. (pittosporums)
Plantago lanceolata (narrowleaf plantain)
Plantago major (common plantain)
Platysace spp. (native parsnip)
Polygala spp. (milkworts)
Polygonum spp. (fleece flower, knotweed, smartweed)
Populus spp. (cottonwood, poplar)
Prunus amygdalus (almond)
Prunus armeniaca (apricot)
Prunus avium (sweet cherry)
Prunus domestica (plum)
Prunus persica (peach)
Prunus persica var *nectarina* (nectarine)
Pseudopanax sp. (lancewood)
Pseudotsuga japonica (Japanese Douglas-fir)
Pseudotsuga menziesii (Douglas-fir)
Pteris spp. (brake, dish fern, table fern)
Pulcaria spp.
Pyllanthus spp.

Pyracantha spp.(fire thorn)
Pyrus spp. (pear)
Quercus spp. (oak)
Ranunculus spp. (buttercups, crowfoot)
Raphanus spp. (wild radish)
Reseda spp. (mignonette)
Rhododendron spp. (rhododendron)
Ribes spp. (currant)
Robinia pseudoacacia (black locust)
Rosa spp. (roses)
Rubus spp. (blackberry, boysenberry, raspberry)
Rumex acetosa (garden sorrel, spinach dock)
Rumex acetosella (common sheep sorrel)
Rumex pulcher (fiddle dock)
Rumex crispus (curled dock)
Rumex obtusifolius (broadleaf dock)
Salix spp. (willow)
Salvia spp. (sages)
Senecio spp. (dusty-miller, groundsels)
Sequoia sp. (redwood)
Sida spp. (Virginia mallow)
Sisymbrium spp.
Smilax spp. (greenbrier, Jacob's ladder, wild sarsaparilla)
Solanum tuberosum (potato)
Solidago canadensis (Canada goldenrod)
Sollya spp. (Australian bluebells, bluebell creeper)
Sonchus asper (spiny sowthistle)
Sonchus kirkii (shore sowthistle)
Sonchus oleraceus (common sowthistle)
Thuja plicata (Western red cedar)
Tithonia spp. (Mexican sunflower)
Trema spp.
Trifolium spp. (clover)
Triglochin spp. (arrow grass)
Ulex europaeus (gorse)
Urtica spp. (nettles)
Vaccinium sp. (blueberry)
Viburnum spp. (arrowwoods)
Vicia faba (broad bean)
Vinca spp. (periwinkles)
Vitis spp. (grape)
Weinmannia racemosa (kamahi)
Zea mays (corn)
Zelkova serrata (Japanese zelkova)

Source: CDFA 2007. Light Brown Apple Moth Pest Profile. http://www.cdfa.ca.gov/phpps/pdep/LBAM_profile.htm. Accessed June 26, 2007.