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Marketing and Regulatory Programs

Animal and Plant Health Inspection Service

Asian Longhorned Beetle Field Trial

Environmental Assessment, January 2000

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I. Need for Proposal

A. Introduction

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), is proposing a program to run field tests for the control of the Asian longhorned beetle, *Anoplophora glabripennis* (Motschulsky). The program is necessary to develop methods suitable for program operations to reduce the potential for damage from this major pest of trees. The Asian longhorned beetle bores into and kills a variety of tree species (including species of maple, elm, chestnut, birch, poplar, and willow). This nonnative pest has the potential to spread to other areas of the United States and cause extensive losses to ornamental and commercial tree species. It has been detected at several locations in the Chicago and New York City metropolitan areas, and ultimately may be found in other areas as well.

Under APHIS' National Environmental Policy Act Implementing Procedures, 7 CFR Part 372, the proposed action is a class of action for which an environmental assessment (EA) is normally prepared. This EA considers the potential effects of the proposed action and its alternatives, including no action.

North America has abundant forest resources. Most logs and lumber imported into the United States have historically been limited to those from the forests of Canada. Increased trade has resulted in more frequent and greater quantities of logs and lumber (including solid wood packing materials) entering the United States from other parts of the world. Various plant pests such as the Asian longhorned beetle from China can occur on or in these unfinished wood products. Protection of the forest resources of the United States from damage by foreign pest species is part of the mission of the U. S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) and exclusion of those pest species is the most effective method of preventing the losses associated with new pest infestations.

B. Purpose and Need

Increased trade and the resultant increased opportunities for invasion by alien agricultural pests have placed the United States and its agricultural economies at substantially increased risk in recent years. In particular, a number of infestations and interceptions of exotic forest wood boring insects have been associated with solid wood packing material (SWPM) from the People's Republic of China. Outbreaks of the Asian longhorned beetle (*Anoplophora glabripennis*), a destructive pest of maple and other hardwoods, were first detected in New York in 1996, and in Chicago, Illinois in 1998. In addition, four genera of wood borers (*Anoplophora*, *Ceresium*, *Hesperophanes*, *and Monochamus*) have been intercepted in shipments from China that were delivered to warehouses in 11 States. The effects of those outbreaks and interceptions, and of control and regulatory measures to deal with them have been costly from environmental and economic perspectives.

APHIS has responsibility for taking actions to exclude, eradicate and/or control plant pests including Asian Longhorned beetle, under the Plant Quarantine Act (7 U.S.C. 151-165, 167), the Organic Act of 1944 (7 U.S.C. 147a), and the Federal Plant Pest Act (7 U.S.C. 150dd). APHIS has been delegated the authority to administer these statutes and has promulgated Quarantines and Regulations (7 CFR 319), which regulate the importation of commodities and means of conveyance.

The current exclusion and eradication program consists of various regulations designed to require treatment of solid wood packing material from China and eliminate the Asian longhorned beetle by removing infested trees detected in the United States. This approach is currently effective at preventing new infestations from wood products imported from China, but it has not effectively contained the Asian longhorned beetle within new areas of infestation. Removal and destruction of infested host trees is time-consuming and expensive. Effective elimination of the beetle by removal of infested host plants depends upon early and timely identification of infestations in trees and cutting before the beetle can spread to nearby host plants. Small infestations that are detected early may be eradicated easily, but the infestations in New York and Illinois have spread further and become difficult to eliminate. Therefore, the program is seeking prophylactic methods to prevent infestation of healthy trees from adult beetles in the vicinity of presently infested areas. The systemic nature of the insecticide applications being considered may also eliminate beetle larvae from recent infestations of living trees. Field tests for several treatments are underway in China, but the results have not yet been tabulated. The intent of the proposed field trial is to develop cost-effective treatment methods that control the beetle and that are suitable for eradication programs in the United States.

This environmental assessment has been prepared in compliance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321-4327 (NEPA)) and its implementing regulations.

II. Alternatives

APHIS considered carefully three alternatives to respond to the need for developing better methods to contain Asian longhorned beetle infestations: (1) no field trials; (2) injection application field trials (the proposed action); and (3) injection application and bark treatment field trials. Each is described briefly in this section and the potential impacts of each are considered in the following section.

A. No Field Trials

Under the no field trials alternative, APHIS would take no action of any kind to develop suitable methods for control of Asian longhorned beetle. Some research could be taken by other Federal or non-Federal entities; those actions would not be under APHIS control or funded by APHIS. In the absence of development of more effective measures to contain and control Asian longhorned beetle, the continuing gradual spread of the beetle in the vicinity of the New York and Illinois area infestation would be expected to continue. This would result in continuing costs for detection and removal of infested host trees. Although the anticipated spread to surrounding areas is limited, the cumulative environmental and fiscal costs could be considerable and would increase commensurate with the expansion of the area infested by the Asian longhorned beetle.

B. Injection Application Field Trials (Proposed Alternative)

Under this alternative, field trials would be conducted applying systemic insecticide treatments against Asian longhorned beetles by various injection methods. This would include testing by either soil injections or injections directly into the lower plant trunk just above the roots of uninfested trees. Current regulations require any infested trees discovered by the program to be marked and cut in a manner that eliminates all life stages of the beetle. The intent of the injection treatments would be to facilitate transport of the active ingredient of the pesticide from the site of application (root zones) to active tree growth areas where the beetles would be expected to feed and lay eggs.

Uninfested trees adjacent to those infested by Asian longhorned beetles would receive priority to test the field effectiveness. The desired period of protection for the uninfested trees coincides with the period of beetle activity and is primarily between June 15 and October 15. The limited testing of possible insecticides with systemic activity against woodboring beetles indicates that imidacloprid (Merit 75WP®) shows the most promise for effective use in an operational program. The preliminary testing indicates some activity of imidacloprid against adult beetles as they feed on small twigs and possibly when the female beetles deposit their eggs. Some reports have indicated that imidacloprid provided two years of control against target insect pests.

The soil injections of imidacloprid are made with a power soil injector at 100 to 250 pounds per square inch (psi) pressure to a depth of 4 to 8 inches in a circular pattern surrounding the tree trunk. Application rates for soil and trunk injections are determined by the diameter of the trees at breast height (DBH). A minimum of 2 quarts of formulation (1.89 g Merit 75WP®) are required per inch of DBH. The treatment holes will generally be made in a circle that is 3 feet from the trunk. A second circle may be treated at 6 feet from the trunk as required for larger trees based upon the tree diameter at breast height. The systemic uptake by the tree will require approximately 2 months, depending upon the tree species, soil conditions, and the time of year when the application is applied. Optimal timing of soil treatments are during the Fall (September/October) or during the Spring (March/April) when systemic transport of insecticide could occur throughout the tree. Soil applications are less effective when drought conditions result in dry soil.

These applications do require large amounts of water to ensure that the mixture will be taken up by the tree. The advantage of soil injection is that the placement occurs where exposure to people or nontarget wildlife is unlikely and the applicator may proceed to treat the next tree without need to limit access (unlike Mauget® trunk injections) to the area after application is made. Imidacloprid has moderate water solubility, but it has low soil mobility due to adsorption to soil particles, so exposure to humans by these applications is unlikely unless the soil under the trees is dug up. If pavement covers the soil under trees in urban areas, soil injection treatments may not be an option and the trunk injections described in the next paragraph may be selected.

The trunk injections of imidacloprid are applied through four milliliter Mauget® trunk injectors. One injector is required for every 2 inches of DBH of the tree. Holes are drilled at a 45 degree angle to the trunk for dispenser placement in the root flares close to the soil (two to six inches above the soil wood line). Dispensers are activated by hitting the top with a rubber mallet or pressing with hands. The injection takes a few hours and the area must be secured to prevent disturbance of injectors during this period. Maintaining security is important both to ensure effective treatment and to prevent public exposure to imidacloprid from contact with dispenser contents. Preliminary tests indicate that this method may provide some control of newly developing larvae as well as feeding adult beetles. The systemic movement of imidacloprid from these injections in the tree occurs shortly after treatment to 3 weeks. This is much less than the two month period required for soil injection, but the insecticidal properties may not last as long in the tree as with soil injection. Unlike soil injections, no water or mixing tank are needed. This method is preferable in areas where soil under trees is paved and where high water table or related problems prevent soil injection. Damage to trees from drill holes could be a problem, but the primary concerns would relate to pests other than insects (e.g., fungal pathogens).

The precise placement of injection treatments and the security during applications preclude many potentially adverse environmental effects. The physical environment is minimally impacted because imidacloprid residues are restricted to the tree or the treated soil. Neither persistence nor bioaccumulation problems are expected from injection treatments. In the unlikely event that a person did receive imidacloprid exposure from the injection applications, their exposure would not be expected to result in any adverse effects to human health as long as the individual did not have allergies or other sensitivity to the formulation. There are some nontarget species that occur in trees and soil under trees that could be affected by these treatments. In particular, invertebrates directly exposed to imidacloprid would be expected to have high mortality, but the effects on local populations of these species are anticipated to be temporary. Some local insectivores could have to increase their foraging efforts. Other nontarget wildlife are not expected to be affected.

C. Injection Application and Bark Treatment Field Trials

Under this alternative, field trials would include the testing of the injection techniques as described above. In addition, this alternative would also analyze the effectiveness of various bark treatments in control of Asian longhorned beetle. Bark sprays are made to target the adult beetles as they feed on the twigs and deposit eggs. These applications would need to be made during or just prior to the adult flight period between June 15 and October 15 to provide effective control. The efficacy results from these treatments are readily observable, but the residual action depends upon environmental conditions. More than one bark treatment could be required during the long flight season of the Asian longhorned beetles. Complete coverage of the bark is necessary for these treatments to be effective, therefore, a hydraulic type sprayer with high pressure (400-800 psi) is required for pesticide application. Adequate coverage of the bark may be difficult for 60 to 80 foot trees. Unlike some injection treatments, these applications to bark have not been shown to have systemic action against larvae. Large amounts of water are used for this type of application and limiting runoff is important. The potential bark treatment insecticides include formulations of permethrin, chlorpyrifos, bifenthrin, and deltamethrin.

The bark treatments have several environmental consequences to the physical environment, human health, and nontarget species that would not be expected for injection applications. Phytotoxicity to some plants could be an important issue, particularly where bark applications must penetrate through the foliage. Air, soil and water quality could be affected by contamination from drift and runoff from bark treatments. The full coverage increases the likelihood of exposure to humans and other nontarget species with increased risk of adverse effects from these treatments. Other than direct effects on invertebrates, toxicity to birds from the full coverage treatment is likely, particularly with chlorpyrifos. Unlike the injections that limited residues to locations within the tree and below the soil surface, detectable residues from bark treatments are likely to occur at locations where humans and animals could be exposed. In addition to higher potential exposure from bark treatments, the relative toxicity of the bark treatment insecticides is comparable to or higher than that of imidacloprid. These potential adverse effects from the bark treatments greatly exceed those from injection applications.

III. Environmental Consequences

A. Potential Impacts

There are potential impacts from each of the alternatives being considered. The pest risk from Asian longhorned beetle is an important consideration for all alternatives. Potential program impacts arise from each of the chemical treatments, but most of the treatment impacts are not expected to be substantial. The potential affected areas are primarily urban parks and residential areas. Exposure to humans and potential effects to human health are primary considerations addressed for program actions in these locations.

1. No Field Trials

Environmental impacts that could result from APHIS' implementation of the no field trials alternative relate primarily to pest risk effects if current eradication programs fail to contain and eliminate new infestations of Asian longhorned beetle. The lack of available treatments for controlling this insect pest restricts control measures to removal of infested trees and elimination of potentially available host plants. The adverse effects from removal of individual plants may be minimal, but the Asian longhorned beetle has many host plants and the potential impacts from ongoing removal of infested vegetation are considerable with expansion of the infested areas. The potential establishment of Asian longhorned beetle would be associated with damage to and loss of valuable ornamental and commercial trees, spread of the beetle to other areas of the country with resultant damage to and loss of trees, loss of associated forest products (e.g., maple syrup), and private or uncoordinated use of pesticides to control the pest with associated adverse impacts to the environment (the physical environment, human environment, and nontarget species). The wide distribution of host plants suggests the danger of spread across much of the country with increases in damage and losses commensurate with the spread. The damage and losses could result in reductions in private property value. Structural lumber could be internally damaged, resulting in risk of structural failure, losses to property, and injuries to humans. The damage and losses to commercial trees would lower the value and production of timber and tree products such as maple syrup. The changes in the composition and age structure of forests resulting from no action could have long-term effects on the ecological relationships in the forested areas. There could be losses in recreational revenue to some areas from diminished amount of certain activities such as fall foliage visitations. There would be losses of valuable shade and ornamental trees in residential areas. The potential for future quarantine restrictions on the export of logs and nursery stock increases if field trials do not provide more effective control and eradication methods. The primary environmental consequences of this alternative are increased risk of pest spread and elevated environmental risks from uncoordinated application of pesticides to limit damage from the Asian longhorned beetle. The potential adverse impacts from selection of this alternative are considerably greater than those anticipated for the other alternatives.

2. Injection Application Field Trials

The environmental consequences of this alternative relate primarily to the potential for decreased pest risk and to potential environmental effects from treatment methods. Development of an effective prophylactic injection application could be applied operationally to protect susceptible host plants and assist in the efforts to contain and eradicate Asian longhorned beetle from infested areas of Illinois and New York. This could eliminate concerns about continuing expansion of the current eradication program. It could prevent the damage to and loss of many valuable ornamental and commercial trees, loss of associated forest products (e.g., maple syrup), and private or uncoordinated use of pesticides to control the pest with associated adverse impacts to the environment (the physical environment, human environment, and nontarget species).

The development of effective injection applications would provide an alternate means of protection for trees to the present program practice of removing and destroying newly infested trees. The insecticide proposed for field testing this technique is imidacloprid. Determination of the potential environmental impacts from this alternative requires analysis of toxicity, environmental fate, exposure, and associated risks from imidacloprid injections.

Toxicity

Imidacloprid is a systemic, chloronicotinyl insecticide. The mode of toxic action is unique and involves direct binding to the acetylcholine receptors. This binding causes a nerve impulse to be sent, but acetylcholinesterase is incapable of removing imidacloprid from the site. The receptor site becomes overstimulated and is eventually blocked. The nicotinergic site of action is more prevalent in insects than in higher organisms, so the toxicity is selectively more toxic to insects.

The acute toxicity to mammals is moderate. The acute oral median lethal dose of imidacloprid to rats is 450 milligrams per kilogram (mg/kg) body weight. The acute dermal median lethal dose to rats of imidacloprid is greater than 5,000 mg/kg. Imidacloprid is not irritating to eyes or skin and is not a skin sensitizer. Signs and symptoms of intoxication include fatigue, twitching, cramps, and muscle weakness including the muscles for breathing.

Chronic toxicity from imidacloprid is low. The systemic No Observed Effect Level (NOEL) for a 2-year feeding study of male rats was 5.7 mg/kg based on increased thyroid lesions observed at the next higher dose, 17.1 mg/kg. The reproductive NOEL determined from a three generation reproduction study of rats was 8 mg/kg based upon decreased pup body weight at 20 mg/kg. Imidacloprid may be weakly mutagenic. Test results were negative for mutagenicity in all but two of the 23 laboratory mutagenicity assays conducted. The positive assays were for genotoxicity in Chinese hamster ovary cells and changes in chromosomes in human lymphocytes. The U.S Environmental Protection Agency (EPA) has classified imidacloprid in "Group E" in regards to carcinogenic potential. This indicates that the submitted studies provide evidence of noncarcinogenicity for humans.

Toxicity to other wildlife varies considerably. Imidacloprid is moderately to severely toxic to birds. It is severely toxic to bees, but it is not considered a hazard to bees when used as a seed treatment. Imidacloprid is practically nontoxic to fish and slightly toxic to daphnia.

Environmental Fate and Exposure

Imidacloprid residues from injection applications are not expected to persist in the environment. The vapor pressure of imidacloprid is low and little volatilization to the atmosphere is expected. Imidacloprid is moderately soluble in water and the half-life in water exceeds 31 days at pH 5, 7, and 9. Soil injection applications and trunk injections are not expected to result in any transport of imidacloprid to groundwater or surface water. Imidacloprid adsorbs to soil particles and has low mobility. The half-life in soil varies from 48 to 190 days depending upon the organic matter, ground cover, and plant uptake. The systemic action of Imidacloprid from trunk injections would be expected to carry the residues to other locations within the plant.

Adherence to the pesticide label and standard operating procedures ensures that exposures are minimal. The injections would not be expected to routinely result in any exposure to humans except the program applicators. The required protective gear and safety precautions minimize applicator exposure. The applicators ensure that the Mauget® injection dispensers are not disturbed during injection and the dispensers are removed from the drill holes when the application is complete to prevent exposure to the public. The only route for potential exposure of the public to imidacloprid is from the accidental scenario of a person digging in the treated soil following soil injection applications. Much of the compound would have adsorbed to soil particles and the actual exposure to imidacloprid would be minimal. The injection applications avoid exposure to most species of wildlife. The only species likely to be directly exposed by these injections are those nontarget invertebrates present in the treated soil or in the wood of the treated tree. Some insectivores and scavengers could also be exposed to residues during foraging activities in the soil below or in the bark of treated trees. The exposures of these species to imidacloprid are expected to be light.

Risk Assessment

The risk of adverse effects to environmental quality are minimal. The imidacloprid from soil injections and trunk injections is not expected to volatilize to the atmosphere, is not expected to be leached to groundwater, and is not expected to be carried to surface water except from heavy rainstorms. The soil and plant residues are expected to remain active for up to 2 years to protect the trees from infestation by Asian longhorned beetles.

The risks to human health are minimal. The required protective gear and safety precautions for applicators result in potential exposures much lower than any that could result in adverse effects. The anticipated margins of safety from the accidental exposure scenario where a person digs up the soil from the treated area under a tree are less than for the applicators, but no adverse effects are anticipated for those individuals either.

Mortality from exposure would be expected for some invertebrates. The populations of insects directly exposed to imidacloprid would be expected to decrease temporarily in the treatment area until the residues decrease and recolonization occurs from surrounding areas. This recovery would be expected to occur more rapidly in the soil because the compound would be readily taken up by the tree roots and residues would not persist in the soil. The insects exposed to residues in the trees would require longer periods of time for recolonization. Although the prey for some insectivores would decrease in treated areas, the additional forage effort by these species is not expected to be increased greatly. The low exposures to birds and insectivores foraging in the soil and tree bark are not expected to result in any adverse effects to those species.

Other Issues

An effort was made by APHIS to determine what if any measures would be required for compliance of the field trials with the Endangered Species Act of 1973. The potential for exposure and any adverse effects was analyzed for those endangered and threatened species and their habitats within the proposed program area for the field trials. Based upon the findings of that analysis, it was determined that the proposed field trials would have no effect on those species or their habitats.

Consistent with Executive Order No. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," APHIS considered the potential for disproportionately high and adverse human health or environmental effects on any minority populations and low-income populations. The environmental and human health effects from the proposed field trials are minimal and are not expected to have disproportionate adverse effects to any minority or low income populations.

Consistent with Executive Order No. 13045, "Protection of Children From Environmental Health Risks and Safety Risks," APHIS considered the potential for disproportionately high and adverse environmental health and safety risks to children. The field trials include applications to trees and soil below trees in urban parks and residential areas where children would be expected to play and climb trees. The program applicators ensure that the general public is not in or around areas being treated, so no exposure will occur for Mauget® injection applications and the only possible exposure could occur from a child playing in the treated soil under a tree. This accidental exposure scenario was analyzed and it was determined that no adverse human health effects would result to the child. Therefore, it was determined that no disproportionate effects on children are anticipated as a consequence of implementing the proposed field trials.

3. Injection Application and Bark Treatment Field Trials

The environmental consequences of this alternative related to the potential for decreased pest risk and injection applications are the same as those described for the injection application field trials alternative. The field trials using the bark treatments, however, have considerably greater potential for adverse effects to the physical environment, human health, and nontarget species. The insecticides being considered for bark treatments include permethrin, chlorpyrifos, bifenthrin, and deltamethrin.

Effective bark treatments require application to all surfaces of bark on the tree. The logistics for complete bark treatment of tall trees (60 to 80 foot) are challenging and would require ladders or tall cherry pickers to be close enough for good treatment, even with the high-pressure hydraulic rig applicators used. These treatments could result in considerable drift, particularly on windy days. Runoff from these applications to nearby water is likely, particularly if a rainstorm occurred shortly after treatment. Chemicals used in the bark treatments are expected to undergo degradation (photolysis or chemical breakdown) over time and could require more than one treatment to ensure good control during the period of June 15 to October 15 when the adult beetles are active. For example, deltamethrin residues on some treated plants have been shown to decrease to below the detection limit within 10 days. The high visibility of these treatment would be expected to draw the public's attention to the actions and increase the potential for direct exposures.

Toxicity

The bark treatment insecticides are of two chemical classes. Chlorpyrifos is an organophosphate insecticide. Permethrin, bifenthrin, and deltamethrin are synthetic pyrethroid insecticides. Although both classes affect the nervous system, the mechanisms of intoxication differ. The mode of toxic action of chlorpyrifos occurs primarily through acetylcholinesterase (AChE) inhibition. Inhibition of AChE results in an accumulation of acetylcholine at the nerve synapse and continual transmission of nerve impulses. The mode of toxic action of the synthetic pyrethroids occurs through effects on the sodium channels that stimulate nerves to produce repetitive discharges. Muscle contractions are sustained until a block of the contractions occurs.

The insecticides all have moderate acute oral toxicity to mammals, but differ considerably in other known toxicological effects. The acute oral median lethal doses to rats range from 53.8 mg/kg for bifenthrin to 430 mg/kg for permethrin. The systemic NOEL values range from 0.03 mg/kg/day for chlorpyrifos to 5 mg/kg/day for permethrin. Reproductive and developmental toxicity from these compounds occurs only at much higher exposures. None of the insecticides are known to be skin sensitizers. Irritation to skin and eyes of rabbits from exposure tests was undetectable to slight. Mutagenicity tests have shown negative results (deltamethrin, permethrin) or both positive and negative results (bifenthrin, chlorpyrifos). The carcinogenic potential of these insecticides vary considerably. Information about oncogenicity studies was not located for deltamethrin. EPA has classified chlorpyrifos as not carcinogenic. Permethrin is suspected of being a weak oncogen, but EPA has not determined carcinogenic potency for these borderline effects. Bifenthrin has been classified by EPA as a class C (possible human) oncogen. The cancer potency of bifenthrin was determined by EPA to be 5.4 x 10^{-1} $(mg/kg/day)^{-1}$ in human equivalents.

The toxicity to nontarget wildlife depends upon the insecticide. All are moderately toxic to mammals. Permethrin is very slightly toxic to birds. Bifenthrin and deltamethrin are slightly toxic to birds. Chlorpyrifos is moderately to severely toxic to birds. All insecticides are severely toxic to terrestrial invertebrates. All are very highly toxic to fish and aquatic invertebrates.

Environmental Fate and Exposure

The environmental fate of these insecticides applied to the bark of trees will depend upon the weather conditions. Chlorpyrifos is quite volatile and detectable amounts could be detected in the air. There could be some permethrin residues in air following bark treatments, but these should dissipate readily. Bifenthrin and deltamethrin have lower vapor pressure and their residues would not be expected to remain detectable in air after treatments are completed. None of these compounds are very mobile in soil and adsorption to soil organic matter would be expected. The half-life in soil varies from one to two weeks for deltamethrin to as long as a year for chlorpyrifos. All of these compounds readily adsorb to sediments in water, but residues may persist for several weeks. These bark applications would not be expected to contaminate water except possible drift or runoff from a heavy storm. These compounds are not systemic and little if any translocation within the treated plants is expected. Residues of these insecticides on the foliage and bark of treated plants may persist throughout the growing season (permethrin) or degrade within as little as 10 days (deltamethrin).

The bark treatments require complete coverage to be effective against Asian longhorned beetle. Penetration of the thick foliage to treat the bark of trees with a hydraulic rig indicates that all parts of the trees above the roots will have residues of the insecticide. The exposure from these applications would be expected to be high to tree-dwelling invertebrates, woodland birds, and squirrels. Drift and runoff to the soil below treated trees would expose some soil and ground-dwelling organisms, but most of these exposures would be more moderate. The human exposures would depend primarily upon contact with the tree. Program pesticide applicators are required to wear protective gear and follow specific safety precautions. These individuals would not be expected to have high exposures. An individual who decide to lean against a treated tree or climb without protective clothing could receive a high exposure, particularly if the treatment on the bark had not dried.

Risk Assessment

The risk of adverse effects to environmental quality are greater for this alternative than from the injection applications. The chlorpyrifos for some bark treatments could volatilize with detectable residues in the atmosphere. Leaching to groundwater is highly unlikely, but drift and runoff could contaminate surface waters, particularly in areas where many trees are treated and heavy rainstorms occur shortly after treatments. Any need for additional treatments within the season when the beetle are active makes the potential for contamination more likely. The plant residues are expected to remain active for several months to protect the trees from infestation by Asian longhorned beetles. Residues in soil may remain for extended periods of time, particularly with chlorpyrifos.

The potential risks to human health from these bark treatment applications are considerably greater than from injection applications. The required protective gear and safety precautions for applicators result in potential exposures much lower than any that could result in adverse effects for all compounds except chlorpyrifos. The risks to mixers and loaders of chlorpyrifos are negligible, but exposures of hydraulic rig applicators exceed the regulatory reference value for both routine and extreme exposure scenarios. Adherence to proper protective gear and safety precautions by hydraulic rig applicators is important if chlorpyrifos applications are to be considered. The anticipated effects to the general public could be adverse for some individuals. Exposures to the individual who leans against a treated tree or climbs without any protective clothing could be expected to have some symptoms of intoxication. Chlorpyrifos exposures from scenarios for soil consumption, contaminated runoff, and contaminated vegetation all exceed regulatory reference values, so adverse effects to the public from chlorpyrifos applications would be likely. Use of the other bark treatment insecticides do not pose such high risks in these scenarios.

Mortality from exposure would be expected for many tree-dwelling and soil-dwelling invertebrates. The populations of tree-dwelling insects directly exposed to the bark treatments would probably decrease temporarily in the treatment area until the residues decrease and recolonization occurs from surrounding areas. This recovery would depend on the size of the area where trees were treated. Recovery would take longer if all trees in a large city park were treated because the insect populations in the surrounding areas might not include all species in the park trees. The quantitative risk assessment determined that populations of honey bees would be adversely affected by all of the bark treatments.

The soil invertebrates exposed to runoff and drift would also have decreases in population. Their populations would recover more readily than tree-dwelling insects for some treatment chemicals (eg., deltamethrin), but recovery could be slower for the insecticides that persist in soil such as chlorpyrifos. Effects on nesting birds from bark treatments could be devastating, particularly with a severely toxic insecticide to birds such as chlorpyrifos. The quantitative risk assessment for chlorpyrifos applications predicted mortality for all nontarget species analyzed except deer and dogs. Although squirrels and other tree-dwelling mammals are unlikely to receive a direct exposure, their exposures to these moderately toxic insecticide residues could result in various sublethal neurological effects that make them more susceptible to predation. Likewise, any insectivores that forage on the treated trees or soil within the dripline could have exposures that result in adverse effects on potential survival.

The environmental consequences and risks to the physical environment, human health, and nontarget species of this alternative are clearly greater than those from the injection application field trials alternative. The logistics of treating all bark surfaces on tall trees make this alternative difficult to achieve, particularly for potential future operations in urban parks and along residential streets. The bark treatments can only ensure suppression of the adult beetle population for as long as residues persist and this may only provide protection for part of a season before retreatment is needed. Based upon these limitations, the injection application field trials alternative would be more reasonable to consider for development as a program control measure against the Asian longhorned beetle.

IV. Agencies, Organizations, and Individuals Consulted

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

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