**AILANTHUS HONEYDEW AND ITS POTENTIAL EFFECTS ON HONEY BEES AND OTHER POLLINATORS**

Based on visual observations of *Ailanthus alitissima*, Tree of Heaven, it appears that invasive insect *Lycorma delicatula,* or Spotted Lanternfly, pierces the bark and feeds on the phloem, producing honeydew. It was also observed that *Ailanthus alitissima* oozes sap from some of these feeding wounds. It has been researched and documented that plants produce a variety of chemicals which are used for protection from attacking insects. There is concern about the possible effects these chemicals, which may be present both in the sap produced by *Ailanthus alitissima*, eaten by *Lycorma*  *delicatula* and changed into honeydew, as well as the oozing plant sap, will have on foraging honey bees and other pollinators. Often honeydew flows are peaking in late summer when the hot dry weather has had a negative impact on plants available for honey bees and other pollinators. Honey bees and other pollinators are drawn to the sweet honeydew. Another concern will be the effect on honey bees and other pollinators on the removal methods of *Ailanthus alitissima.*

*Ailanthus alitissima* has become naturalized in many parts of North America after being introduced to Philadelphia in 1784 and to California in the 1890’s. The tree is native to China and it was a very popular plant in the United States in the 1800’s, especially in the urban landscape. It does well in sunny areas and is able to withstand droughts, various pollutants, and is able to grow in poor soil and harsh environments. It can now be found in a wide variety of environments from urban areas to reclaimed mining sites to forests. Ailanthus can spread rapidly especially from sprouts growing up from the shallow roots and seeds. These are fast growing (up to 3-6 feet/year for the first four years), but relatively short lived trees (about 30 years). The tree produces yellowish green panicle flowers from mid-April to July, depending on location. They are dioecious, producing male and female flowers on different trees. The male trees produce an abundance of rather foul smelling flowers. Many pollinators, including honey bees, are attracted to *Ailanthus alitissima*. Honey bees will make honey from the nectar of the tree’s flowers. According to various reports, the honey does not taste very good initially, but mellows into a delicious honey over time.

An allelopathic chemical is a biochemical that will influence the survival, growth, and reproductive ability of other organisms. Ailanthus produces an allelopathic chemical called ailanthone. This chemical, which inhibits the growth of other plants, is found in the bark and roots, and to a lesser extent in the leaves, wood, and seeds. Research has shown that Ailanthus can kill many seedlings of other plants while not affecting its own seedlings. Perhaps on a related note, *Ailanthus alitissima* has been used to treat a variety of ailments for centuries. Almost all parts of the plant may be used, although care must be taken because evidence suggests that the plant may be mildly toxic. The plant contains a quinone irritant (2,6-dimethoxybenzoquinone) and active quassinoids (white bitter, crystalline substance). Contact dermatitis has been reported in humans. *Ailanthus alitissima* also has strong anti-anaphylactic and anti-inflammatory properties. This information is of concern because of possible chemical reactions related to the plant’s production of honeydew and sap.

Trees are the most common source of sap for insects producing honeydew. Examples of trees commonly producing sap include some ash species, basswood, beech, cedar, chestnut, elm, fir, hickory, larch, maple, oak, pine, poplar, spruce, sycamore, willow and black locust. As was previously stated, it has been observed that *Ailanthus alitissima* provides sap and some insects will then create honeydew. There are additional plants which commonly produce sap including sunflowers and grapes. *Lycorma delicatula* has been found to be a pest for over 50 species of orchard trees, ornamentals, hardwoods (including bee bee tree - a very popular tree for bees and some species of maples), some softwoods (including pine), and grapes.

Most plant sap contains water, sugars, amino acids in small amounts, and other chemicals. Aphids, leafhoppers, psyllids, and other plant sucking insects use some of the nutrients and sugars found in the sap, but since the sap is only made up of 1-2% protein, they must consume a great deal of sap to obtain needed proteins. The insect expels the extra sweet, sticky sap, now called honeydew and it can be found on the trunk, branches, leaves, and the ground. In some cases, there is so much honeydew produced that the dried honeydew forms “cakes” under the tree. To be real honeydew, the plant sap must go through the insect’s digestive tract where is undergoes various chemical changes. The chemical composition of honeydew varies tremendously, but it contains water, sugars, tannins, as well as other chemicals. There is concern that the honeydew produced by *Lycorma delicatula* may contain chemicals which will taint the honey. Around the world, some honeydew is eaten and enjoyed by other insects, animals and even humans. We are not sure if this is the case with honeydew produced by *Lycorma delicatula.*

Honey made from honeydew is also known or called by different names including forest honey, tree honey, bug honey, and flea honey, as well as plant specific names like fir honey, pine honey, and oak honey. Many people think that honey is produced by honey bees utilizing the sap secreted directly from the tree and do not realize another insect is also involved. If a tree is injured or shocked, it may produce a honeydew-like substance, but this is not as common and it is not honeydew. Honeydew honey is highly prized in many areas of the world for its healthful properties and strong flavors. While the honeydew honey’s characteristics will vary depending on the plants, many are dark in color with a warm and woody aroma. The taste is described as medium intensity, no bitterness, less sweet, woody and warm. Honeydew honey is higher in amino acids, minerals, and certain sugars when compared to blossom honey. Unfortunately, I could not find any repots on the taste of honey produced from *Ailanthus alitissima* honeydew.

According to research conducted in New Zealand, honey bees visited beech trees (*Nothofagus* spp.), feeding on honeydew produced by the native scale insect, *Ultracoelostoma assimile*. The honey bees would obtain the honeydews in several ways. Sometimes they would crawl from scale to scale, knocking the scale’s anal tube causing additional honeydew to flow. Other times the bees would brush drops off of the scale’s anal tube, grooming to remove the drops. Still other times the bees would hover while removing drops from the anal tube and then continuing on to the next scale. The honey bees also crawled on the tree lapping up drops. Researchers discovered that the amount and size of honeydew droplets varied a great deal, depending on many different factors including weather and amount and types of insects seeking the honeydew. In New Zealand, the honeydew honey produced by honey bees from beech trees is very popular and sought after.

In many locations, there are times when there are very few plants available for honey bees and other pollinators to collect nectar and/or pollen. This often occurs during the late summer during hot and dry conditions. If needed and available, the honey bees and other pollinators will collect honeydew and treat it the way they treat flower nectar. Since the liquid in honeydew will evaporate quickly, honey bees will collect it in the morning and evenings. In the hive, the honey bee will store the honeydew in cells separately and/or in cells mixing it in with existing nectar. For the honey bees, the honeydew honey has a higher ash content, higher electrical conductivity, and due to the higher fructose and low glucose levels, it tends to resist crystallization.

There have been reports that overwintering honey bees have trouble digesting the honeydew honey due to higher ash content and indigestible sugars. Dysentery and death of colonies has been reported for some overwintering hives with stores of honeydew honey. During the cold winter, honey bees can make fewer cleansing flights and this can compound problems. Dysentery is a digestive issue and can be a symptom of another honey bee disease called nosema. In at least one case, the bees with dysentery in the dying colony were tested for nosema and the test was negative. In some places, beekeepers will remove honeydew honey from the hive and feed the colony sugar water instead.

It has also been reported that the bees have collected so much honeydew that all of the cells are filled with honeydew and the queen does not have room to lay eggs. If this is happening, the beekeeper removes some of the honey frames and replaces them with foundation. The bees will rapidly draw out the wax and create new cells for the egg laying to continue.

Another problem can be seen if the bees are not bringing in their protein source – pollen. When they bring in flower nectar, pollen is present as well. The bees do not bring in pollen when collecting honeydew. The beekeeper must monitor this and add pollen patties if needed.

Honey bees also make a resinous material called propolis from tree buds, sap flows, and resins. Propolis is composed of about 50 different constituents. Propolis is used by the honey bees in their colonies to coat foreign objects which the bees cannot remove and to seal holes and cracks in the hive. Propolis has antibacterial and antiviral properties. The exact composition of the propolis varies due to the plants used. It is not known what affect, if any, *Lycorma delicatula* may have on the sap or other tree parts that the honey bee may use to make propolis. Propolis is not the same as honeydew honey. While it is very sticky and soft initially, it will become very hard over time.

A very serious concern is the problem farmers, orchardists, and municipalities are facing when an important plant or crop is being attacked by insects producing honeydew. A few years ago in California, a pecan grower sprayed Chloropyrifos to control scale. There were no honey bee colonies in the actual pecan orchard, but there was a large pesticide kill on honey bees which foraged on the honeydew on the pecan trees. Pesticide analysis revealed over 200 times the national average of Chloropyrifos.

An additional concern of applying pesticides to *Lycorma delicatula* is that the chemicals may kill natural enemies of pests also on host plants. It is thought that *Lycorma delicatula* was introduced to Korea in the 1930’s, but did not really become a pest until the 2000’s when it began causing damage to grape vineyards, fruit trees, and arbores when the native natural enemies began to decrease. It is also thought that climate warming has had an effect on this problem. Researchers have found that physical trapping methods, including stick traps are fairly effective. There is research being done with parasitic insects which may be helpful. Treating host plants with systemic insecticides could kill honey bees and other pollinators as they feed on the honeydew, blossom nectar, and/or collect pollen. The chemicals are moved throughout the plant, including nectar, pollen, and sap.

Another method of controlling *Lycorma delicatula* is to remove host plants. This could be problematic since there appear to be over 50 host plants. The elimination of existing *Ailanthus alitissima* has been researched and studied since many people do not like this tree and may be interested in removing it anyway. Herbicides are often thought of as the first and best choice, but they are only one tool. Other methods or combinations of methods should be considered. There are physical, thermal, biological and chemical controls available. Physical methods, while labor intensive, are quite effective and include hand pulling of young seedlings, cutting and hand digging, and girdling. Thermal control involves controlled burning. Mowing seedlings and sprouts is very effective, killing the young plants and exhausting the roots. This is useful after removing the larger trees by any method. Coppicing can also be done in some instances. This involves pruning the Ailanthus to create an informal hedge out of trees by regularly cutting the female trees to the ground and not allowing the trees to flower. Goats will strip bark and cattle will eat seedlings. Sometimes deer will eat the seedlings. Some have tried a basal bark application of oil-soluble triclopyr in late winter or early spring on smaller trees, while others have had success during the growing season by cutting the tree down and immediately applying an herbicide. The use of a non-selective synthetic, systemic glyphosate, like Round-up, Rodeo, or Accord has been used. Triclopyr (Garlon 3A and Garlon 4), a systemic, synthetic herbicide, selective for broadleaf and woody plants has also been used. These products may need to be reapplied to be effective. Research at The Pennsylvania State University has shown that the “inert” ingredient in the herbicide glyphosate, N-methyl-2-pyrrolidone (NMP, CAS 872-50-4) or NMP was toxic, at varying levels, to honey bee larvae when they were fed food containing varying amounts of NMP. This “inert” ingredient makes up a good bit of the glyphosate and is used to increase the efficacy and stability of the pesticide. It is a colorless liquid and can be mixed with water and many other common organic solvents. Currently inert ingredients are not tested like the active ingredients for their effect on nontarget species. Other research has shown developmental toxicity in rats and a high toxicity potential for aquatic invertebrates. California lists this chemical as causing developmental toxicity on list of “CHEMICALS KNOWN TO THE STATE TO CAUSE CANCER OR REPRODUCTIVE TOXICITY”.

This is a big problem and should be addressed before herbicides are applied. Honey bees and other pollinators have been declining in number over the past few years and solving one problem while adding to another problem is not a good solution. In addition, some of these herbicides may kill nontarget trees, even when injected into the stems of Ailanthus. The roots exude the herbicide and there have been cases when native hardwoods near the Ailanthus were killed after an application of imazapyr. Some plants have become or are becoming immune to these herbicides. One group found that cutting the *Ailanthus alitissima* trees, treating the stumps with glyphosate, and then pulling seedlings and mulching helped control regrowth. Planning and planting desirable species should be included in this integrated pest management.

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