Fraxinus (ash) as a food source for pollinators

Compiled by Peter Loring Borst

In this document I have gathered in one place the available information to support my contention that *Fraxinus* is a significant source of nutrition for honey bees and other beneficial insects. There is a distinct absence of study on the effect of systemics injected into trees because of the fundamental assumption that pollinators do not visit wind pollinated trees, which is false. The very first reference clearly demonstrates that in early spring wind pollinated trees are the primary source of pollen for honey bees, and even in summer corn (a wind pollinated grass species) is one of the chief sources of pollen for honey bees. The final reference fully supports the danger of systemic insecticides to non-target species. It states clearly: “All of the systemic insecticides used to control EAB will impact other species of insects that feed on treated ash trees.”

RECOMMENDED COURSE OF ACTION:
There needs to be an analysis of the pollen of treated trees to determine pesticide residues, and the impact on pollinators must be determined before going ahead with large scale deployment of systemic insecticides in ash trees.

Contents

Pollen nutrition and colony development in honey bees – Part 1

Irene Keller, Peter Fluri and Anton Imdorf

Bee World 86(1): 3-10 (2005)

Chronology of the main pollen sources

At the beginning of the vegetation period, a uniform pattern was observed across most available studies with a very pronounced dominance of different tree species as the most popular pollen sources. These included maple (*Acer* sp.), ash (*Fraxinus* sp.) different fruit trees (*Prunus* sp. and *Pyrus* sp.), poplar (*Populus* sp.), oak (*Quercus* sp.), willow (*Salix* sp.) and elm (*Ulmus* sp.). At some Swiss locations, dandelion (*Taraxacum officinale*) was also an important pollen source in spring. In May and June, the spectrum of pollen types became much more diverse and generalisations across all study sites were hardly possible.

If we considered the mode of pollination of the dominant plants, we observed a consistent pattern at different localities. Generally, wind-pollinated plants were dominant pollen sources in spring and were then replaced by insect-pollinated plants. This was a consequence of the importance of anemophilous trees as early pollen sources. The frequency of pollen from wind-pollinated plants may show a second peak in midsummer at locations where corn (*Zea mays*) was an important pollen source.

POLLEN COLLECTION BY HONEYBEES (APIS MELLIFERA)

BY A. D. SYNGE

Journal of Animal Ecology, Vol. 16, No. 2 (1947)

Throughout the seasons of 1945 and 1946 pollen has been trapped from colonies of honeybees (Apis mellifera L.) in the Home Apiary at Rothamsted and the daily catch analysed into its constituent pollen species in an endeavour to obtain a quantitative as well as a qualitative estimate of the pollen gathered by colonies of honeybees in this particular neighbourhood. It is apparent that the bulk of the pollen came from comparatively few plants and that the clovers formed the most important source, yielding almost 50 % of the total. There is obvious agreement in outline between the 2 years.

The early spring pollen comes mainly from the forest trees which characteristically yield a large amount of pollen in a very few days. Although the greatest weight of pollen trapped on a single day came from the fruit blossom, the legumes, owing to their prolonged season of flowering (11 weeks for white clover), provide a very large proportion of the total pollen collected during the year.

Seasonal distribution of pollen sources and their relative importance in 1945 and 1946. Early Spring period, 1 February - 14 April	
Main pollen sources	Unimportant pollen sources
Fraxinus (excelsior) [ash]	*Anemone*
Populus [poplar]	*Aster* type *(Doronicum)*
Ulmus (glabra) [elm]	*Chionodoxa*
	Cichorieae
Important Pollen Sources	*Corylus*
	Crocus
Buxus sempervirens [box]	*Erica*
Cupressus or *Taxus* [cypress]	*Forsythia*
Salix [willow]	*Lamium purpureum*
	Mercurialis perennis
	Tulipa
	Ulex europaeus

Studies on Honeybee-Palynology in Sapporo, 1958-1959

By Kiyoki Moriya
Zoological Institute, Hokkaido University

In order to know the principal pollen sources and their seasonal succession in the area surveyed, quantitative analyses of pollen crops were taken about weekly in 1959. In each examination, a sample of 2 g (approximately corresponding to 150 to 200 loads) was taken from the total yield which had been thoroughly mixed in advance.

First spring pollen trapped was that of coltsfoot *(Petasites japonicus* Miq,) and willows *(Salix* spp.), the former species is more abundant than the latter in early spring, but the relative weight reversed in due course. In late April, ash *(Fraxinus Sieboldina* Blume,) and pachysandra *(Pachysandra terminalis* Sieb,) appeared at the rate of 30 % and 10 % in Colony 2 and 9% and 5% in Colony 1. At the beginning of May the escaped winter rape *(Brassica napus* L.) showed the high ratios of 40% (Colony 2) and 60% (Colony 1).

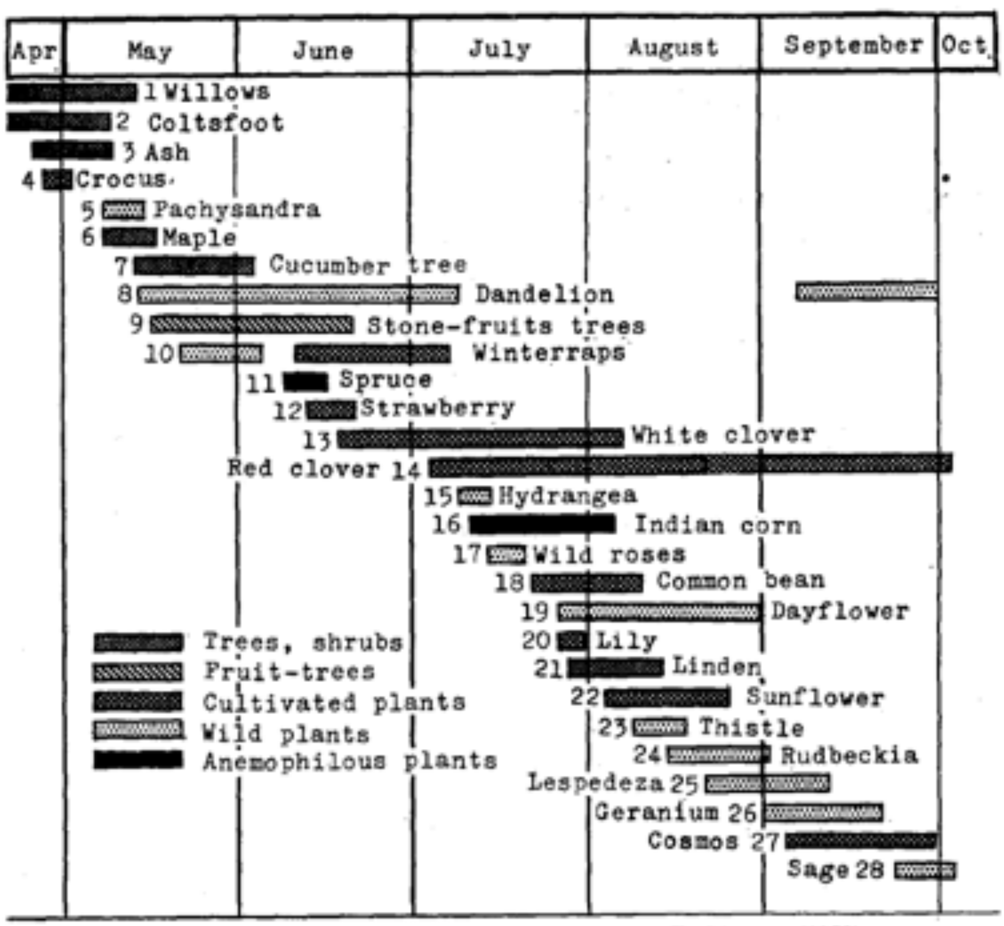

Fig. 6. A calendar of pollen loads trapped at Tsukisappu (1958).

POLLEN GATHERING BY HONEY BEES IN LACROSSE COUNTY, WISCONSIN

by David William Severson. September 1978

Thesis Submitted to the Faculty of University of Wisconsin

Tree species provided the majority of the pollen samples until late May. Boxelder (Acer Negundo L.) provided up to 89.86% of the mid-April pollen, but was not utilized after April. Pollen from trembling aspen (Populus tremuloides Michx.) and ash (Fraxinus sp.) was also collected in mid-April, with ash providing up to 38.97% of the weekly total. Pollen from apple and cherry (Prunus sp.) was collected from late April through May Oak pollen was collected extensively from late April to late May. Willow provided pollen from mid-April until late May. Dandelion pollen provided up to 31.55% of the Hay weekly total and was the only herbaceous pollen collected in abundance until late May.

A study of the major pollen sources within LaCrosse County Wisconsin, revealed that these sources are quite varied throughout the blooming season. Some of the more dominant and long-blooming species were oak, dandelion, fruit trees, clovers, sumac, corn, buckwheat, and composites. Other species such as boxelder, ash, raspberry, and red-osier dogwood are utilized for large amounts of pollen but have relatively short blooming periods.

The pollen season can be divided into three distinct categories: the early April to late May tree sources, the late May to mid-June shrubs, and the herbaceous species from mid-June through September.

A considerable amount of the pollen collected came from supposedly wind-pollinated species, raising some question as to the true nature of pollination vector and flower-form relationships. Honeybees are a highly specialized pollination vector but appear to be inclined to forage from any floral source in the apiary vicinity that offers adequate amounts of pollen, rather than rigidly observing floral relationships.

Flower Phenology and Pollen Choice of *Osmia lignaria* in Central Virginia

Mark E. Kraemer and Françoise D. Favi

Environmental Entomology, 34(6):1593-1605. (2005)

The extent to which *O. lignaria lignaria* explored its environment for preferred floral resources was indicated by the large amount of pollen from sparse or rare sources. Pollen from *Salix* was a major component of nest cell provisions from mid-season and was found at all nest site locations.

Eastern redbud was the dominant pollen resource for *O. lignaria lignaria* during the first 3 wk of nest construction and accounted for ~24% of all pollen by volume on a seasonal basis (Table 9). This was about twice that of the next most abundant pollen species, boxelder and oak. Boxelder, a dioecious maple (*Acer*), is a minor source of nectar for early season honey bees, but an important pollen resource (Lovell 1977). The quantity of oak pollen found in nest provisions was surprising because oak is wind pollinated and does not produce nectar. However, oak was common, and its pollen was available in quantity over most of the period of nest construction.

In our study, pollen from another anemophilous tree, white ash, was a common component of *O. lignaria* nest provisions. Although not abundant, several large canopy trees were widely distributed throughout the study area. The males of this dioecious tree are, like oak, a cornucopian source of pollen.

Other than oak and perhaps ash, pollen from the most common species of canopy trees was seldom or never found in the nest provisions (Table 1). Only small amounts (1%) of pollen from American beech, sweetgum (*Liquidambar styraciflua L.*) and American sycamore (*Platanus occidentalis L.*) were found, and none from tuliptree (*Liriodendron tulipifera L.*), hackberry (*Celtis occidentalis L.*), or hickory (*Carya spp.*).

Most vines (Table 3) flowered in late April to early May, but only the pollen of poison ivy was collected by *O. lignaria lignaria* in quantity, perhaps partially because of its ubiquity both at forest edge and within.

A study on the pollen sources for honey bees in Udine province (northern Italy)
Laura FORTUNATO, Federica GAZZIOLA, Renzo BARBATTINI, Franco FRILLI
Bulletin of Insectology 59 (1): 39-43 (2006)

The most important pollen plants (in northeastern Italy) were identified at the end of March 2003. In this period pollen loads were collected, grouped according to colour and 142 slides prepared. Using an optical microscope, the different plant pollens were identified. The relationship between pollen load colours and pollen plants was studied; pollen plants that were preferentially visited by honey bees were identified. *Taraxacum officinale* Weber, *Fraxinus*, *Salix*, Liliaceae races and *Populus* resulted the most important pollen plants, in this area.

Bees often visited *Fraxinus*, *Salix* and *Taraxacum* for pollen. In particular *Fraxinus* seems to be very important in Cornino and San Daniele; there on the 23rd of March, this species was the only plant from which bees gathered pollen. Moreover *Fraxinus* pollen was collected by bees in all four places on the 27th of March, and on that day pollen.

Orange pollen loads: all the pollen grains were identified as Taraxacum.

White pollen loads: this group included pollen belonging to different families among which Liliaceae and Magnoliaceae, in particular *Allium*. Other plants, which have the same colour of pollen grains, belong to Salicaceae (*Populus*) and Ulmaceae (*Ulmus*) families.

Yellow pollen loads: *Salix* and *Fraxinus* showed this colour and sometimes races of Caryophyllaceae family. In some cases also *Calystegia* and the Ranunculaceae family produce the same colour of pollen grains.

Grey pollen loads: races of Ranunculaceae and, in a few cases, pollen grains from Cruciferae and Magnoliaceae have this colour.

Brown pollen loads: pollen loads with this colour were found to contain pollen grains of plants belonging to different genera, for example *Acer*, *Papaver*, *Corylus* and *Prunus*; *Populus* and, in a few cases, the Cruciferae and Liliaceae families, were also represented.

Black pollen loads: these pollen grains belonged to races of Liliaceae and in particular *Colchicum*; sometimes even *Papaver* presented this colour.

Red pollen loads: *Papaver* sometimes showed this colour.

Green pollen loads: this group included pollen grains belonging to *Crataegus*, which presents only this colour, and in a few cases *Acer* and *Calystegia*. Sometimes even *Fraxinus* and *Salix* were present.

4.1.2.4.1. Honey Bees

The honeybee is the standard test species used by the U.S. EPA to assess toxicity to nontarget terrestrial invertebrates. Typically, both contact and oral toxicity studies in bees are available. For emamectin benzoate, however, **only one contact bioassay** is available which reports an LD_{50} of 3.5 ng/bee, equivalent to 0.0035 µg/bee.

As discussed in Section 4.1.2.1, the lowest LD_{50} 16 of emamectin benzoate in mammals is 22 mg/kg in mice (MRID 42743612). Based on 17 this comparison, emamectin benzoate is more than 600 times more toxic to bees than to 18 mice [22 mg/kg bw ÷ 0.035 mg/kg bw ≈ 628.57].

The only other toxicity study on bees is the foliar contact bioassay by Chukwudebe et al. (1997b). In this study, substantial mortality was noted in bees in contact with alfalfa treated with emamectin benzoate at an application rate of 0.0168 kg a.i./ha (≈0.14 lb a.i/acre). This type of bioassay is designed to assess the residual toxicity of a pesticide following foliar applications. **This type of bioassay has little relevance** to the current Forest Service risk assessment which considers only the injection of ash trees with 26 emamectin benzoate.

4.1.2.4.3. Other Insects

While studies indicate that emamectin benzoate is highly toxic to honey bees and at least some populations of lepidopterans, there are no studies on the toxicity of emamectin benzoate to the emerald ash borer, a coleopteran and the target species considered in the current Forest Service risk assessment.

4.2.3.2.2. Honeybees

No exposure assessment for honeybees is conducted, because ash trees are wind pollinated (e.g., http://www.treecaretips.org/Diseases/About_EAB.htm).

Azadirachtin: An Effective Systemic Insecticide for Control of *Agrilus planipennis* (Coleoptera: Buprestidae)

NICOLE McKENZIE, et al

J. Econ. Entomol. 103(3): 708 (2010)

Currently, there are several products registered for the control of emerald ash borer in the United States. Most relevant to this study are trunk-injection products, many of which contain the active ingredient imidacloprid. In two recent articles by Kreutzweiser et al. (2008a,b), imidacloprid has been implicated for negative impacts on beneficial soil-dwelling arthropods. The relative safety associated with all neonicotinoids, including imidacloprid, has been questioned in Germany where its use [was] suspended due to perceived negative impacts on honey bees.

Products currently registered in the United States provide adequate control of emerald ash borer larvae; however, based on their residual effects, toxicity ratings and fate properties, their use in environmentally sensitive and urban areas may not be warranted. Currently, there are no pest control products with a full registration available for the control of emerald ash borer in Canada.

A recent study by Mota-Sanchez et al. (2009) confirmed that injected imidacloprid accumulates in the leaves of treated trees and steadily increases over the growing season. However, 1 yr postinjection, foliar, trunk, and root imidacloprid levels sharply declined, indicating that after entering the transport system of a tree, the injected product most likely becomes xylem-mobile. For relatively newer active ingredients such as emamectin benzoate and fipronil, within tree movement and flow dynamics are not well or fully understood (Grosman et al. 2009).

In this study, systemic injections of azadirachtin killed emerald ash borer larvae in situ. Given the dramatic effect on larval development and reductions in feeding galleries, even at relatively low dose levels, further research and development of systemic injection of azadirachtin for protection of ash trees is clearly warranted. This is particularly important given the inherent advantages of systemic injection techniques in sensitive and urban environments.

Frequently Asked Questions Regarding Potential Side Effects of Systemic Insecticides Used To Control Emerald Ash Borer

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February 2011

Will these insecticides harm honey bees?

Ash trees are wind-pollinated and are not a nectar source for bees. Furthermore, ash flowers are produced early in the growing season and are present for only a limited number of days. It is highly unlikely that bees would be exposed to systemic insecticides applied to ash.

Will these insecticides harm other insects?

All of the systemic insecticides used to control EAB will impact other species of insects that feed on treated ash trees. For example, emamectin benzoate has been shown to affect a broad range of plant-feeding insects. Products with imidacloprid generally have little effect on caterpillars, mites, and armored scales, but will impact most sawflies, leaf-feeding beetles, and sap-feeding insects such as aphids and soft scales. Studies have shown that beneficial insect predators and parasitoids — such as lady beetles, lacewings, and parasitic wasps — can be killed by indirect exposure to imidacloprid through their prey, or directly by feeding on nectar from treated plants. However, systemic insecticides are generally considered to have less impact on natural enemies than broad-spectrum insecticides applied as foliar or cover sprays.