A PRELIMINARY INVESTIGATION OF PESTICIDES IN VERMONT POLLEN: 2012

Vermont Agency of Agriculture, Food, and Markets

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For the past several years there has been considerable concern for the health of honey bees, both locally and world-wide, and the possible role of pesticides in their decline. Of particular interest is a new class of insecticides (termed "neonicotinoids") which are especially toxic to bees. These insecticides, along with fungicides, are routinely applied to corn seeds when planted (as a 'seed treatment'), they then circulate through the corn plant and protect the growing corn plant from insects and diseases. Initially, the concern was whether these systemic pesticides were getting into corn pollen in sufficient concentrations to affect pollinating insects and honey bees in particular. In recent years research has suggested the possibility that these compounds are being scraped off of the treated seeds during the planting process and being carried by the wind to nearby flowers where bees can collect the dust along with pollen.

In 2012, the Vermont Agency of Agriculture, Food, and Markets (VAAFM), conducted a preliminary study to investigate whether we could determine levels of pesticides in pollen as delivered to the hive by honey bees. Pollen traps, which scrape pollen off of the bees as they return to the hive, were used in this study to collect pollen for pesticide analysis. This technique makes it possible to determine what pesticides the bees are actually eating, since pollen is the major protein source for bees.

We had several objectives for this preliminary feasibility study:

1) Could we logistically collect pollen weekly from two hives throughout the summer?
2) Could we develop an analytical method with adequate sensitivity and analyze weekly samples from two hives, given the limited resources of the VAAFM Pesticide Lab?
3) If pesticides are present in pollen, are there trends in pesticide concentration with time thru the summer?
4) If pesticides are present in pollen, can we determine which plants are the source of the pollen?

RESULTS:

In 2012 we were able to place pollen traps on two hives and collect pollen on a more or less weekly basis throughout the summer. The two hives were both in Addison County, Vermont, which is dominated by corn and hay/pasture based agriculture. Hive #1 was located in an area dominated by hay/pasture farmland, while hive #2 was in an area of predominantly field corn. Pesticides selected for analysis were: atrazine and metolachlor (herbicides often sprayed on corn), imidacloprid, thiamethoxam, and clothianidin (neonicotinoid insecticides used as seed treatment on conventional, non-organic, seed corn), and metalaxyl and trifloxystrobin (fungicides used as seed treatment on conventional ,non-organic, seed corn). These pesticides are not used exclusively on corn crops, therefore any detections may possibly be from other uses.

Pollen samples were collected weekly, when possible, from each of the two hives in 2012, for a total of 22 samples. We were able to get 15 weekly pollen samples from hive #1, spanning most of the period from May 6-Sept. 7, 2012. At hive #2 we got 7 samples from the period June 11-August 9, 2012. An analytical method was developed with sufficient sensitivity to detect all seven pesticides at levels of concern. Pesticide results in the following tables are reported in parts per billion (PPB), analogous to one second in thirty-two years.

HIVE #1.

DATE	ATRAZINE	METOLACHLOR	IMIDACLOPRID	TRIFLOXYSTROBIN
5/6/12 – 5/12/12				
5/13/12 – 5/19/12	2.6 PPB			
5/20/12 – 5/26/12	1.0 PPB			
5/27/12 – 6/2/12	6.1 PPB			
6/3/12 – 6/9/12	1.2 PPB			1.3 PPB
6/10/12 – 6/16/12	1.8 PPB			
6/17/12 – 6/23/12	3.8 PPB			
7/15/12 – 7/21/12				
7/22/12 – 7/28/12				
7/29/12 – 8/4/12				
8/5/12 – 8/11/12				
8/12/12 – 8/18/12				
8/19/12 – 8/25/12				
8/26/12 – 9/1/12				
9/2/12 – 9/7/12				

HIVE #2.

DATE	ATRAZINE	METOLACHLOR	IMIDACLOPRID	TRIFLOXYSTROBIN
6/11/12 – 6/15/12	68 PPB	25 PPB	0.7 PPB	5.5 PPB
6/18/12 – 6/22/12	75 PPB	4.4 PPB		0.64 PPB
6/25/12 – 7/2/12	18 PPB	4.2 PPB		
7/9/12 – 7/13/12	19 PPB	1.1 PPB		
7/16/12 – 7/20/12	24 PPB	1.1 PPB		
7/25/12 – 8/1/12*	2.2 PPB			
8/2/12 – 8/9/12*	0.50 PPB			
LD50 (in PPB)	980,000	1,260,000	280	1,750,000

* = corn tasseled in area

Hive #1 had lower levels of all pesticides than Hive #2, which might be expected since there is more corn grown near Hive #2 and we were looking for pesticides related to corn crops. At least 1 of the 7 pesticides was detected in 13 of the 22 pollen samples collected. Thiamethoxam, metalaxyl, and clothianidin were not detected in any samples so they are not included in the above tables, blank spaces indicate none was detected. As can be seen, atrazine was the most common pesticide detected, and at the highest concentrations. Atrazine is one of the most common pesticides used on corn in Vermont so this is not unexpected. Both atrazine and metolachlor are routinely sprayed on corn fields as weed killers, so one would expect them to be in higher concentrations than pesticides applied to individual seeds. No pesticide detections were observed near levels which are toxic to bees, as defined by the LD50 (dose which is toxic to 50% of the bees), so there is no evidence that these levels of pesticides were killing any bees. There is not enough information to know if there were sub-lethal effects on any bees, but none were reported by the beekeepers.

Highest concentrations of pesticides were observed in early to mid-June, while corn was not flowering until late July. So it appears that corn pollen is not the source of the pesticides detected. Unfortunately, we were not able to start collecting pollen at Hive #2 until mid-June, so we can't say when elevated levels of pesticides started to appear in the pollen from this hive. Since the source of the pesticides is not corn pollen, efforts are underway to see if we can identify the plant source of the pollen at different times during the summer.

Insecticides and fungicides applied to seed corn were a primary emphasis of this study, and we were able to detect them sporadically. Of the neonicotinoid insecticides, we only detected imidacloprid once and this was in the same pollen sample which had relatively high concentrations of three other pesticides. The presence of all four pesticides; atrazine, metolachlor, imidacloprid and trifloxystrobin in Hive #2 early in the season (the week of 6/11/2012) indicate that either these pesticides are in the soil where pollen producing plants were growing or that they drifted onto these plants during planting and spraying. In conclusion, this feasibility study was successful in collecting pollen in a systematic way, developing an analytical method for pesticides of concern, and analyzing the pollen to get useful results. Plans are underway to determine what follow-up work will be possible in 2013.