Section V: Risk management

5.1 Risk management for insect pollinators in the United States: past practices, current developments, and future directions

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Abstract

Past practices: Over the last 140 years, most serious bee kill incidents in the United States were caused by the use of highly toxic insecticides with extended residual toxicity. Several universities conducted research on pollinator safety, and their research was used to develop guidance on protecting bees from pesticides and USEPA test methods for pollinators. Risk management activities conducted by state and federal agencies primarily focused on the acute toxicity of foliar applied insecticides to honey bees (*Apis mellifera* L.).

Current developments: Risk management in the US is undergoing a significant transformation. Regulatory agencies are working on improving risk assessment and mitigation. Concerns include acute and chronic effects of pesticides on multiple species of bees via multiple routes of exposure. Guidance on risk assessment for pollinators has been significantly updated to address several of these concerns. State and federal agencies, universities, registrants, non-governmental organizations, beekeepers, growers, applicators and others are becoming actively involved in risk management activities.

Future directions: Regulatory agencies in the US are increasing their involvement in activities to improve risk management for pollinators. Continued collaborative efforts between multiple stakeholders, including regulatory and non-regulatory approaches, should help improve our ability to protect pollinators from pesticides.

Key words: pesticide, pollinator, regulatory, risk management

1. Introduction

Washington State is located on the west coast of the United States, and insect pollinated crops are very important to agriculture in this region. Over 400,000 hectares (1,000,000 acres) of insect pollinated crops are grown on the west coast in the states of California (e.g. almonds), Oregon (e.g. berries), and Washington (e.g. tree fruits). This represents approx. 50% of the total area of insect pollinated crops that are grown in the US. The primary species of bee used for insect pollination is the honey bee, although other species of bees are important pollinators for some crops (such as alfalfa grown for seed).

The discussion includes examples of serious bee kill incidents, research on bee poisoning, and risk management activities in the US. However, it should not be considered as a comprehensive review.

2. Past Practices

2.1 History of Bee Poisoning in the US

Bee poisoning caused by exposure to pesticides is not a recent development in the US; it has been an issue for more than a century. Most serious bee kill incidents involved highly toxic insecticides (acute LD_{50} 2 micrograms or less) with extended residual toxicity (RT_{25} greater than 8 hours). Over

the last 140 years, at least 5 classes of insecticides have been involved in serious bee kill incidents in the US:

- Arsenical insecticides (1870's).
- Organophosphate insecticides (1940's).
- Organochlorine insecticides (1950's).
- N-methyl-carbamate insecticides (1960's).
- Neonicotinoid insecticides (2000's).

In the 1870's and 1880's, the first known honey bee kill incidents in the US were caused by the application of copper acetoarsenite (arsenical insecticide) on apple trees in the Northeast.

In 1921, the first known honey bee kill incidents in Washington were caused by the application of copper acetoarsenite (arsenical insecticide) on apple trees. As a result, Dr. A. L. Melander (Washington State College) recommended that application during bloom should be prohibited. This was a very reasonable suggestion, and it is the first known recommendation in Washington to protect pollinators from pesticides.

In the 1920's, there were serious honey bee kill incidents that were caused by the application of calcium arsenate (arsenical insecticide) on cotton in the South.

In the 1940's, there were serious honey bee kill incidents that were caused by the application of parathion (organophosphate insecticide).

In the 1950's, there were serious honey bee kill incidents that were caused by the application of dieldrin (organochlorine insecticide).

In the 1960's, there were serious honey bee kill incidents that were caused by the application of carbaryl (n-methyl-carbamate insecticide) on cotton in California and corn in Washington.

In the 1970's and 1990's, there were serious honey bee kill incidents involving the application of microencapsulated formulation of methyl parathion (organophosphate insecticide) on various crops, including apple trees. This formulation has particles that are similar in size to a grain of pollen, and can be very persistent in a honey bee colony.

In 2002, there were serious honey bee kill incidents in Washington that were related to the use of thiamethoxam (neonicotinoid insecticide) on pear trees.

2.2 Research on Bee Poisoning in the US

From the early 1950's to the early 1980's, a significant amount of the research on bee poisoning in the US was conducted by Dr. Carl A. Johansen at Washington State University (WSU) and Dr. E. Laurence Atkins at the University of California – Riverside. After Dr. Johansen retired, Dr. Daniel F. Mayer continued research on bee poisoning at WSU until the early 2000's. Research at WSU primarily involved 3 species of bees: the honey bee, alfalfa leafcutting bee (*Megachile rotundata* (F.)) and alkali bee (*Nomia melandaria* Cockerell).

One of the primary reasons that a lot of the early research on this issue was conducted at universities in Washington and California was the importance of insect pollinated crops that are grown in this region. A considerable amount of this research was cited in the book Pollinator Protection – A Bee & Pesticide Handbook[1], and some of this research was also cited by several of the EPA Ecological Effects Test Guidelines for Pollinators[2].

2.3 Risk Management in the US

In the early 1900's, several states (including Washington) adopted laws to regulate pesticides.

In 1910, the first federal law regulating pesticides was adopted.

In 1970, the United States Environmental Protection Agency (USEPA) was created, and their requirements for pollinator protection were largely based on the requirements that had been developed by the United States Department of Agriculture (USDA).

Risk management for pollinators tended to focus on acute toxicity of foliar applied insecticides on agricultural crops to honey bees. Systemic insecticides were not a major concern, and there was relatively little information available on the effects of pesticides on non-*Apis* species of bees.

In 2000, the USEPA developed a draft Pesticide Registration (PR) Notice, in response to concerns with the existing risk management requirements for pollinators[3]. The draft PR Notice was never finalized, due (in part) to a lack of consensus among the stakeholders. Some stakeholders felt that the proposal was not protective enough, while others felt that the proposal was too strict.

On several occasions, state agencies adopted state-specific requirements to protect pollinators, in response to bee kill incidents in their respective states. For example, the WSDA adopted requirements to restrict the use of thiamethoxam on pome fruits in Washington.

3. Current Developments in Risk Management

Currently, risk management for pollinators is undergoing a significant transformation. Regulatory agencies worldwide are working on improving risk assessment and mitigation. Concerns with pesticides include:

- Acute and chronic effects.
- Adult and larval effects.
- Sensitivity of different species of bees.
- Multiple routes of exposure.
- Synergism (esp. fungicides, insecticides, and miticides).
- Interaction with pathogens.

In addition, there are a number of concerns with adverse effects caused by the use of nitroguanidine neonicotinoid insecticides (clothianidin, dinotefuran, imidacloprid and thiamethoxam) on agricultural crops and ornamental sites (foliar and systemic), as well as seed treatments (dust).

3.1 Risk Management Activities Involving the USEPA

In 2011, the Society of Environmental Toxicology and Chemistry (SETAC) held a Pellston workshop on pesticide risk assessment for pollinators. The SETAC workshop was intended to provide a comprehensive review of the best available science on risk assessment, and to identify areas where additional research was needed. The SETAC workshop was organized into 5 workgroups to discuss different aspects of risk assessment, and included 48 participants from 5 continents. It is noteworthy that many of participants at the SETAC workshop are participants at the ICPPR Symposium. In 2014, the proceedings of the SETAC workshop were published[4].

In 2012, the USEPA, Health Canada and California Department of Pesticide Regulation developed a White Paper in support of the proposed risk assessment process for bees. The guidance was strongly influenced by the SETAC workshop, addressed many of the concerns noted above, and used a tiered approach for risk assessment. In 2014, the guidance on risk assessment for pollinators was published[5].

In 2012, the USDA and USEPA sponsored a National Stakeholders Conference on Honey Bee Health. The conference report concluded that there were multiple factors (including pesticides) that were contributing to the decline in honey bee health. In 2013, the conference report was published[6].

In 2012-2014, the Pesticide Program Dialog Committee (PPDC) Pollinator Protection Workgroup was asked to provide suggestions to the USEPA for improvements to the risk management process. Some of the significant suggestions were:

- Improve the clarity of pollinator protection statements on pesticide labels (i.e. replace the term 'visiting' with 'foraging').
- Develop guidance for state and federal agencies on conducting bee kill investigations.

- Provide better public access to residual time to 25% bee mortality (RT_{25}) data that was submitted to the USEPA.
- Develop a website for regional information on best management practices (BMPs) to protect pollinators from pesticides.

In 2013, the USEPA implemented one of the suggestions when the label requirements for the nitroguanidine neonicotinoid insecticides were revised. The revised labels included different requirements for different crops and sites, and included a reference to the Pesticide Environmental Stewardship (PEP) website. The PEP website is coordinated by North Carolina State University, includes contributors from numerous organizations and universities, and includes pollinator protection information for different regions (including BMPs).

The other three suggestions noted above have also been implemented by the USEPA.

3.2 Risk Management Activities Involving Other Agencies and Organizations

In addition to the activities that involved the USEPA, it should be noted that state and federal agencies, universities, registrants, non-governmental organizations, beekeepers, growers, applicators and others are becoming actively involved in numerous risk management activities. Several of these activities are collaborative efforts involving multiple stakeholders.

The Bee Informed Partnership is supported by the USDA - National Institute of Food and Agriculture. It conducts national surveys of honey bee colony losses and colony management, and provides emergency response sampling kits for beekeepers. There are regional tech transfer teams at four universities: Oregon State University, University of California, University of Florida, and University of Minnesota.

In 2008, DriftWatch was developed as a specialty crop registry (including locations of crops and apiaries) by Purdue University. DriftWatch is a voluntary communication tool for growers, beekeepers, and applicators, and is managed by a non-profit company (FieldWatch). As of 2014, there are twelve states in the US and one province in Canada that are participating in DriftWatch.

Industry has become increasingly involved in risk management activities, including:

- In 2013, the American Seed Treatment Association and Crop Life America developed a brochure for growers – The Guide to Seed Treatment Stewardship[7].
- In 2013 and 2014, Bayer has sponsored a Bee Care Tour to encourage discussion on pesticides and pollinators at several universities.
- Bayer is also establishing a North American Bee Care Center.
- In 2012, Bayer, the Coalition for Urban/Rural Environmental Stewardship, and Syngenta supported the development of a brochure - Pollinator and Pesticide Stewardship.
- Syngenta is also supporting establishment of habitat for bees.

In 2014, a group of stakeholders, including Mississippi State University, developed the Mississippi Honey Bee Stewardship Program. A key component of the program in Mississippi was improving communication. One of the methods developed was a small flag with yellow and black stripes to make it easier for aerial applicators to see where apiaries were located.

For the last several years, the North American Pollinator Protection Campaign has been developing training on protecting pollinators for pesticide applicators. The training should be completed in the near future, and it includes a PowerPoint presentation, video, and workbook.

In 2014, a group of stakeholders, including the North Dakota Department of Agriculture, developed the North Dakota Pollinator Plan[8]. A key component of the plan in North Dakota was the development of BMPs for applicators, beekeepers and growers.

In 2013, the Oregon Department of Agriculture investigated several bumble bee kill incidents involving the use of dinotefuran and imidacloprid on linden trees (an ornamental site). As a result,

the ODA prohibited the use of dinotefuran and imidacloprid on linden trees in Oregon, and developed two brochures to educate the public about this issue[9].

In 2013, the Oregon State University revised the extension publication - How to Reduce Bee Poisoning from Pesticides[10]. This publication is primarily intended for use by growers and beekeepers in the Pacific Northwest and California, and was initially developed by WSU in 1960.

In 2013, the Corn Dust Research Consortium was administered by the Pollinator Partnership. The CDRC is a multi-stakeholder coalition that secured funding for research to explore the potential exposure routes of honey bees to seed treatment dust as well as potential options to mitigate exposure. The research was conducted at three universities in the US and Canada: University of Guelph, Iowa State University, and Ohio State University. In 2014, the CDRC issued a preliminary report with 38 recommendations[11].

In 2014, the USDA and the Xerces Society developed a publication for growers – Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators Using Integrated Pest Management and Other Conservation Practices[12].

In 2013, the WSDA received a request from the Thurston County Commissioners to restrict the sales of neonicotinoid insecticides to homeowners, in response to beekeeper concerns. As part of our response, WSDA developed a brochure for homeowners regarding pesticide use on ornamental plants – 10 Ways to Protect Bees from Pesticides[13].

In 2014, a Presidential Memorandum was published - Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators[14]. The memorandum established a Pollinator Health Task Force that will develop a National Pollinator Health Strategy, and will develop plans to enhance pollinator habitat.

4. Future Actions and Directions

4.1 Future Actions

Here are a few of the significant future activities involving risk management for insect pollinators in the US:

- American Association of Pesticide Control Officials – Finalize guidance for state lead agencies on the development of Managed Pollinator Protection Plans.
- PPDC Pollinator Protection Workgroup – Provide additional suggestions to the USEPA regarding risk management.
- USDA – Finalize publication on the relative attractiveness of crop plants to bees.
- USEPA – Review Managed Pollinator Protection Plans developed by state lead agencies, and complete registration review of the neonicotinoid insecticides.

4.2 Future Directions

The USEPA will implement appropriate risk management for new active ingredients and pesticides undergoing registration review based on the more comprehensive risk assessment process that has been developed. Any assumptions and uncertainties should be clearly identified.

Collaborative efforts between multiple stakeholders, including regulatory and non-regulatory methods, will continue to be important. Efforts will include applicator training, BMPs, communication, label requirements, and Managed Pollinator Protection Plans. Research on effectiveness of risk mitigation, improved bee kill incident reporting, and monitoring of sentinel honey bee colonies could also be useful.

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