Protecting Bees and Beneficial Insects in the MN Golf Industry

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Pollinators and Beneficial insects and the Golf Industry

In the February 2014 online article from the GCSAA (www.gcsaa.org/gcm-magazine/2014/february/gcm-february-2014-environmentally-friendly-golf) there is an online article on “Environmentally friendly golf: Reducing chemical use and adopting best management practices can make golf courses playable and environmentally friendly”. The article points out that managed honeybees and native pollinators can flourish on golf courses. Management of turf to remove weeds reduces the impact of systemic insecticides on any flowering weeds growing in turf. Management of pest insects on flower beds can use contact rather than systemic insecticides to protect beneficial insects and bees. Retrofitting the flower beds with plants that offer a season long display of flowers will conserve many beneficial insects that will help manage turf pests. The article goes on to discuss a research project funded by USGA on a golf course in Bethpage NY State Park that was a collaboration of Cornell University, the NY State IPM program, and the golf course and has continued for 13 years. A manual describing these practices serves as the backbone for training personnel from 29 New York state park golf courses in a pilot implementation program. The manual has also been used by superintendents attending training sessions in New York State and at the GCSAA educational seminar on reduced chemical golf course management during the past two years. Please check out the article.

In this article, I wanted to provide some basic information on the neonicotinoid issue with bees and provide a reference for what insecticides are toxic to bees.

We Need Pollinators To Makes Seed and Fruits

Honey bees and native bees, such as bumble bees, pollinate 30% of the plants that produce the vegetables, fruits, and nuts that we consume. More than 100 crops in North America require pollinators. Pollination by bees contributes over $18 billion worth of additional crop yields. In addition, bees pollinate native plants that require seed to sustain future populations. Both native bees and managed honey bees are in decline due to habitat loss, loss of high quality pollen (protein), loss of nectar plants, pathogens, and pesticide use.

Honey bee colonies in Europe and North America have faced some difficult problems for a long time. Beekeepers have been battling the devastating effects of a parasite of bees called the Varroa mite, which was introduced into Europe in the 1970's and in the US in 1980's and is very difficult to control. Honey bees are also faced with a number of diseases and viruses that compromise their immune systems and health in general. Since WWII, with the increase in monocultures and herbicide use, there has been a serious decrease in flowering plants that bees utilize.

Beginning in 2006 a yearly die-off of honey bee colonies occurred throughout the US. The cause of this mortality is still unknown but was coined, colony collapse disorder. Most researchers now agree that honey bee decline is due to multiple, interacting causes, including the effects of bee specific diseases and parasites, lack of floral resources that provide good bee nutrition, and lethal and sub-lethal effects of pesticides. It is known that insecticide use in general can take a toll on honey bees and native bees when the bees are exposed to high enough concentrations. However, it is unclear how much the neonicotinyl insecticides contribute to honey bee poor health or even mortality. Recent research indicates that bees exposed to relatively low doses of neonicotinyl insecticides (10 ppb) may have suppressed immune systems, which makes them more susceptible to some bee diseases. Research also shows that neonicotinoids can have multiple sublethal effects on bees, including disorientation, effects on learning and a reduction in pollen collection and storage. More research needs to be conducted to determine residue levels that bees are exposed to in agricultural and urban environments.

Neonicotinoid Insecticides May Harm Pollinators

- The class of neonicotinoids insecticides (imidacloprid, dinotefuran, clothianidin, and thiamethoxam) are highly toxic to honey bees and other pollinators. They are systemic, meaning that they are taken up by a plant's vascular system and expressed through pollen, nectar and guttation droplets on leaf tips from which bees forage and drink.
- Research has shown that sublethal exposure to neonicotinoid insecticides causes significant problems for bee health, including disruptions in

mobility, navigation, feeding, foraging, memory, learning, and overall hive activity.

- Pesticides are also suspected to affect honey bees' immune systems, making them more vulnerable to parasites and other pathogens.
- Seed treated crops usualy demonstrate less than 7.6 ppb in pollen or nectar. However, field treated crops and landscape plants use higher amounts of neonicotinoid insecticides.
- In landscape and greenhouses higher rates of neonicotinoids are used compared to seed treatments. A canola and corn seed seed is coated with 0.11 mg and 0.625 mg of imidacloprid. A 3 gallon pot in the nursery can have 300 mg applied according to the label. Some landscape applications of neonicotinoids can be reapplied many times.

Recent Regulatory Issues

- For two years starting in January 2014, the Commissioner of the European Union restricted the use of 3 neonicotinoids (clothianidin, imidacloprid and thiametoxam) for seed treatment, soil application and foliar treatment on plants that are attractive to bees. Also, new practices must be developed to reduce clouds of neonicotinyl dusk at planting of seed- treated crops..
- EPA granted a conditional registration to the neonicotinoid clothianidin in 2003 without a required field study on pollinators on the basis that this study would soon be received. However, this requirement has not been met. EPA continues to allow the use of clothianidin nine years after acknowledging that it had insufficient basis for for aloowing its use.
- In March 2012, commercial beekeepers from Minnesota and other states and environmental organizations filed an emergency legal petition with EPA to suspend use of clothianidin, asserting that EPA failed to fol-

low its own regulations by allowing clothianidin to be used without the required adequate pollinator field study.

Bees and Beneficial Insects are Important in Integrated Pest Management (IPM)

Introduction to IPM

The conservation of beneficial insects, that includes bees, insect predators, parasitic wasps, and butterflies, is an essential part of Integrated Pest management (IPM) programs. IPM promotes multiple tactics to manage pests and to suppress the population size below levels that will damage the plant. IPM tactics include cultural control, sanitation, biological control, using insecticides friendly to beneficial insects, and finally the use of conventional insecticides. IPM recognizes that the few remaining pest insects will support beneficial predators and parasitic wasps. When scouting plants for pest insects, check for populations of both pest and beneficial insects, such as lady beetles and bees. If beneficial insects are present, wait to spray insecticides to see if the beneficial insects control the pest insects or use specific insecticides that only target the pest insects. Use spot treatments of contact insecticides, not systemic insecticides. Flowers that open after systemic insecticides are sprayed can contain the insecticide residue for months. Flowers that open after spraying with contact insecticides do not contain insecticide residue and leaves are toxic to pest insects for 1-3 weeks only. Use contact insecticides, such as bifenthrin, cyfluthrin, azadirachtin, and spinosad.

There are few systemic insecticides, while there are many systemic herbicides and fungicides. Systemic, neonicotinoid insecticides are the most

widely used insecticides in the world, due to their low mammalian toxicity and the ability of the insecticide to move systemically from soil into the entire plant, including pollen and nectar. Treatment methods include seed treatments, foliar sprays, soil (granular and liquid) applications, trunk drenches, and trunk-injections. Flowers that open after systemic insecticides are sprayed can contain the insecticide residue for many months in both the leaves and pollen and nectar.

There are six neonicotinoid active ingredients, imidacloprid, dinotefuran, thiamethoxam, and clothianidin, of which acetamiprid and thiacloprid are the least toxic to bees. There is another systemic insecticide, fipronil that is used around structures that is also toxic to bees. You will find these active ingredients listed on the insecticide label in small print.
Neonicotinoid systemic insecticides have been implicated in the decline of bees, butterflies, and other beneficial insects. The European Union banned the use of neonicotinoid insecticides from 2014-2016 on crops and plants that bee's visit. The concern was the residue in pollen and nectar and their negative effects on survival and foraging behavior of bees. The neonicotinyl class of insecticides is highly toxic to bees and kills bees at around 180 ppb in flower nectar or pollen. However, sublethal doses of neonicotinyl insecticide starting around 10 ppb, cause bees to lose navigation and foraging skills. The longevity and amount of the neonicotinoid in the pollen and nectar will depend on application method, concentration applied, and binding capacity of the soil.

The use of neonicotinyl insecticides as trunk injections and soil drenches for ash trees is important to slow the spread of the exotic, invasive Emerald Ash Borer and other invasive pests. As bees do not collect ash pollen in quantities, the risk to bee pollinators is low. In contrast, the use of neonicotinyl insecticides on flowering garden plants, shrubs and trees, including linden and basswood trees can kill bees and beneficial insects that utilize the flowers for pollen and nectar. It is wise to avoid using systemic neonicotinyl insecticides on flowering plants that bees visit regularly. Instead use spot treatments of contact insecticides.

For managing Japanese beetles and other white grub species a new insecticide called chlorantraniliprole is available under different trade names; for consumers the product is called Grub-Ex and for professional applicators the product is called Acelepryn. It has very low toxicity to bees and is reported to work very well in soil for white grubs. On foliage, Japanese beetles adults can be killed with spot treatments of bifenthrin on the adult beetles when they aggregate on foliage in early morning and evening; other formulations may contain neonicotinoid insecticides (see the table below under imidacloprid). For instance, the professional formaulation Triple Crown, Discus, and Allectus are combinations of a neonicotinoid and pyrethroid insecticide.

The new EPA bee icon and bee advisory box on insecticide labels:

EPA has added new language to neonicotinyl insecticide products (imidacloprid, dinotefuran, thiamethoxam, and clothianidin) to protect bees and other insect pollinators. The bee icon above signals that the pesticide has potential to harm bees. The language in the new bee advisory box explains application restrictions to protect bees:

PROTECTION OF POLLINATORS APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE

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Bee and other insect pollinators can be exposed to the product from:
1. Direct contact during foliar application or contact with residues on plant surfaces after foliar application.
2. Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar application.

When using this product take steps to:
1. Minimize exposure when bees are foraging on pollinator attractive plants around the application site.
2. Minimize drift of this product onto beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills.

Install native and heirloom plants that bee's visit
Avoid treating flowering plants that bees utilize with systemic, neonicotinoids. Bees prefer to feed on native plants and heirloom "garden" varieties of plants. Some perennials very attractive to bees are: Potentilla, pussy willows, all flowering crabapple, apple, pear, hawthorn, and serviceberry, Delphinium, Campanula, Liatris blazing star, Echinacea cone flower, Se-

dum, Penstemon, Digitalis foxglove, honeysuckle, Salvia nemorsa Maynight, Salvia verticillata Purple Rain, Nepeta catnip and catmint, Sedum, Angelica gigas Korean Angelica, Solidago goldenrod, New England aster, Verbascum, Scabious, Viburnum, and Rosa rugosa hybrids. Some annual bedding plants very attractive to bees are fennel, basal, dill, rosemary, thyme, lavender, heather, Salvia, Tithonia Mexican sunflower, Asclepias Mexican tropical, Buddleia, Gaillardia, Ganzania, Verbena, Portulaca, Lantana, Lobelia, Ageratum, Alyssum, Verbena bonariensis, Echinops globe thistle, and snapdragons.

There are numerous lists identifying plants attractive to bees. Some lists only contain native plants, while other lists contain heirloom "garden" varieties of plants:

1. The University of MN bee lab bulletin, Plants for Minnesota bees http://www.beelab.umn.edu/prod/groups/cfans/@pub/@cfans/@bees/documents/article/cfans_article_451478.pdf

2. Pollinator plants Midwest region http://www.xerces.org/wp-content/uploads/2014/09/MidwestPlantList_web.pdf

3. CUES: Pollinator Conservation, plants for bees and other pollinators www.entomology.umn.edu/cues/pollinators/plants.html

4. CUES: Poster, Save the bees plant flowers and trees http://www.entomology.umn.edu/cues/pollinators/plantsposter.pdf

5. CUES: Bulletin, Plants for butterfly gardening www.extension.umn.edu/garden/yard-garden/landscaping/butterfly-gardening/

6. CUES: bulletin, Plants that provide pollen and nectar for beneficial insects www.entomology.umn.edu/cues/gervais/keytable.htm

Toxicity of turf, landscape, and nursery insecticides to bees						
Chemical class	Examples of common names	Examples of trade names	Toxicity			
			Non	Low	Mod	High
Carbamates	carbaryl, methomyl	Sevin, Lannate				x
Neonicotinoids	Imidacloprid (I) thiamethoxam (T) clothianidin (C) dinotefuran (D) imid+bifenthrin (I,B)	Nurrsery/landscape Merit, Marathon, Flagship, Meridian, Arena, Aloft, Safari, Allectus, Field crops Gaucho (I), Poncho (C), Cruiser(T) (seed treatments), Admire/Provado (I), Venom (C), Platinum (T)				x
	Acetamiprid (A), thiacloprid (T)	Tristar (A), Assail (A), Calypso (T)		x		
Organophosphates	acephate, chlorpyrifos, dimethoate, malathion, phosmet	Orthene, Dursban/Lorsban, Dimethoate, Malathion, Imidan				x
Pyrethroids	bifenthrin, cyfluthrin, fenpropathrin, lambda-cyhalothrin, permethrin	Attain/Talstar, Tempo, Decathalon, Tame, Scimitar, Astro				x
Botanical	pyrethrum/pyrethrins azadirachtin, neem oil	Pyganic, Azatin, Ornazin, Triact				x
Insect growth regulators	diflubenzuron tebufenozide	Adept, Dimilin, Confirm			x	
	azadirachtin buprofezin pyriproxyfen	Aza-Direct, Azatin, Ornazin, Talus Distance		x		
	novaluron	Pedestal				x
	cyromazine	Citation				x
Juvenile hormone	s-kinoprene	Enstar II		x		
Diamides	chlorantraniliprole	Acelypryn		x	x	
Macrocyclic lactones	abamectin/avermectin, emamectin benzoate	Avid, Tree-Age				x
Miticides	acequinocyl, extoxazole, fenpyroximate, fenbutatin-oxide	Shuttle, TetraSan, Akari,Vendex	x			
	clofentezine, hexythiazox	Ovation, Hexagon		x	x	
	bifenazate	Floramite			x	
	pyridaben	Sanmite				x
Spinosyns	spinosad	Conserve/Entrust, less toxic dried		x		
Tetronic acids	spiromesifen	Judo, Kontos				
GABA-gated chloride channel	fipronil	Fipronil, Termidor,				x
Pyridine carboxamide	flonicamid	Aria, sucking mouthparts only	x			
Pyridine azomethines	pymetrozine	Endeavor, sucking mouthparts only	x			
Other insecticides	*Bacillus thuringiensis,*	Bt/Dipel, Carpovirusine/Cyd-X	x			
	flonicamid, potassium salts of fatty acids	Aria, M-Pede		x		
	horticultural mineral oils	Monterey			x