Safety and Use of Neonicotinoid Insecticides in Turfgrass

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As evidence mounts, there is growing concern that neonicotinioid insecticides may play a role in the declining health of pollinators and other wildlife across North America. A string of unfortunate and widely publicized events, including the death of 25 thousand bumble bees foraging on neonicotinoid-treated linden trees, have placed this class of insecticides at the center of the debate surrounding pollinator decline. Although the USEPA is not currently banning or restricting the use of neonicotinoids, these products have been slated for a rigorous registration review process. To ensure that these products remain available for use in turfgrass, some commonsense measures, aimed at minimizing their potential negative environmental impacts, may be warranted.

The main concern of regulators (and the general public) revolves around the widespread use of neonicotinoids as seed treatments. Currently, the majority of corn and soybean seeds planted in the Midwest are coated with a mixture of neonicotinoids and fungicides aimed at "protecting against a suite of yield-limiting pests". Unfortunately, there is little evidence to support the efficacy of these products when used in this capacity. In fact, the USEPA recently reported that neonicotinoid seed treatments likely provide $0 in benefits to soybean growers. Despite the fact that turf and ornamental systems comprise only about 4% of the current usage of neonicotinoids in the U.S., they are still the most widely used insecticides in turfgrass systems and they are extremely toxic to bees (Table 1). Products containing the neonicotinoids clothianidin, dinotefuran, imidacloprid, and thiamethoxam represent a very useful set of chemistries for controlling several key turfgrass arthropod pests. However, their breadth of use does carry with it some risk of pollinator exposure. In order to minimize the potential environmental impacts associated with the use of these products in turfgrass, consider the following suggestions:

1) Don't treat areas where pollinators are likely to forage

Pollinators forage for nectar and pollen on a wide range of flowering plants, including some of our most common turfgrass weeds. If flowering weeds such as dandelion or white clover are present and flowering at noticeable levels:

- Avoid treating these areas with neonicotinoids. This is consistent with most insecticide labels that advise against applications to blooming, nectar-producing plants that attract pollinators
- Remove weeds with an herbicide. Effective weed control should be a prerequisite for using neonicotinoid insecticides in turfgrass.
- Mow the turf immediately before spraying any insecticide. Mowing will remove ≥ 90% of the flowers and reduce pollinator foraging. When neonicotinoids are used, it is important to mow frequently enough to keep these blooms from returning as neonicotinoids may be taken up from the soil and moved systemically throughout the plant for an extended period of time.

2) Maintain buffers

Managed landscapes are usually composed of large turfgrass areas with landscape beds present in various arrangements throughout. These beds often contain flowering plants that are attractive to a variety of pollinators. Although the boundaries between landscape beds and turf are usually well defined above ground, the intermingling of plant roots may create a much softer boundary in the soil. Therefore, systemically active neonicotinoid insecticides applied to protect the turf could inadvertently be taken up by flowering plants within adjacent landscape plantings. It may be advantageous to leave a buffer strip of 2-3 feet between the treated turf and the margin of the landscape bed to minimize the potential for unintended uptake by the roots of flowering ornamentals. There is no scientific evidence supporting this idea, but common sense indicates it is a possibility and there doesn't appear to be a serious downside to maintaining such buffers until research indicates otherwise. Research in the Turfgrass Entomology and Applied Ecology Laboratory at Purdue University is currently underway

to examine the potential for neonicotinoid applications in turfgrass to contaminate the flowers and foliage of non-target ornamental plants and to determine the capacity of untreated buffer strips to reduce this potential.

3) Wait until petal fall

Neonicotinoids may sometimes be required to control insect pests of flowering landscape trees. When alternatives are not available, it is advisable to wait until flower petals fall before applying these products. After petal fall, pollinators will not be attracted to these plants. Unfortunately the potential for these products to persist in the flowers of trees one year after application is not known. For more information on the safe use of neonicotinoids to protect woody plants, see "*Neonicotinoid facts for the landscape industry*"

4) Embrace Alternatives

Although there appears to be no immediate threat of losing neonicotinoids from our insect management arsenal, there are plenty of time-tested alternatives available for use against our key turfgrass insect pests. See table 2 for a list of turfgrass insect pests controlled by neonicotinoids and table 3 for a list of available alternatives.

Background Reading

For additional information, please see the October 2014 edition of Golf Course Management:
http://www.gcsaa.org/gcm-magazine/2014/october/neonicotinoid-insecticides-and-pollinators-what-s-all-the-buzz-about

Table 1. Ecotoxicology of several common turfgrass insecticides in different animal systems. LD_{50} represents amount of material per unit body mass (mg/kg) or individual (μg/bee) required to kill 50% of a test population. LC_{50} represents the concentration of material in water required to kill 50% of a test population.

Insecticide (trade name/company)	Insecticide Class	Toxicity*			
		Mammal LD_{50} (mg/kg)[a]	Bird LD_{50} (mg/kg)[a]	Fish LC_{50} (mg/liter)[b]	Honey Bee LD_{50} (μg/bee)[c]
Clothianidin (Arena/Nufarm; others)	Neonicotinyl	>500	430	104	0.004
Dinotefuran (Zylam/PBI-Gordon)	Neonicotinyl	>2,000	>2,000	>100	>0.023
Imidacloprid (Merit/Bayer; others)	Neonicotinyl	424	152	211	0.0037
Thiamethoxam (Meridian/Syngenta)	Neonicotinyl	>1,563	576	>125	0.005
Beta-cyfluthrin (Tempo/Bayer)	Pyrethroid	>77	>2,000	0.000068	0.001
Bifenthrin (Talstar/FMC)	Pyrethroid	54.5	1,800	0.00026	0.1
Carbaryl (Sevin/Bayer)	Carbamate	614	>2,000	2.6	0.14
Chlopyrifos (Dursban/Dow)	Organophosphate	64	13.3	0.0013	0.059
Chlorantraniliprole (Acelepryn/Syngenta)	Diamide	>5,000	>2,250	>12	>4
Cyantraniliprole (Ference/Syngenta)	Diamide	>5,000	>2,250	>11.1	0.116
Lambda-cyhalothrin (Scimitar/Syngenta)	Pyrethroid	56	>3,950	0.00021	0.038
Spinosad (Conserve/Dow)	Biorational	>5,000	>2,250	2.69	0.024
Trichlorfon (Dylox/Bayer)	Organophosphate	212	>36.8	0.7	>0.4

* Toxicity refers only to active ingredient and does not account for formulation. Data from IUPAC.

[a] LD_{50} for mammals and birds represents acute oral toxicity.

[b] LC_{50} for fish represents acute 96-hour toxicity.

[c] LD_{50} for honey bees may represent either acute contact or oral toxicity.

Table 2. Neonicotinoid insecticides labeled for use in turfgrass and common arthropod pests controlled.

Insecticide (trade name/company)	Insecticide Class	Arthropod Pests					
		White Grubs	Greenbug Aphid	Billbugs	Caterpillars	Chinch Bugs	Crane Flies
Clothianidin (Arena/Nufarm; others)	Neonicotinyl	X		X	X	X	X
Dinotefuran (Zylam/PBI-Gordon)	Neonicotinyl			X	X	X	X
Imidacloprid (Merit/Bayer; others)	Neonicotinyl	X	X	X			
Thiamethoxam (Meridian/Syngenta)	Neonicotinyl	X	X	X	X[a]	X	X

* Always consult label directions for specific timing and application recommendations.
[a] Labeled for use against sod webworms, but not cutworms or armyworms.

Table 3. Alternatives to neonicotinoid insecticides labeled for use in turfgrass and common arthropod pests controlled.

Insecticide (trade name/company)	Insecticide Class	Arthropod Pests					
		White Grubs	Greenbug Aphid	Billbugs	Caterpillars	Chinch Bugs	Crane Flies
Beta-cyfluthrin (Tempo/Bayer)	Pyrethroid			X	X	X	
Bifenthrin (Talstar/FMC)	Pyrethroid			X	X	X	X
Carbaryl (Sevin/Bayer)	Carbamate	X		X	X	X	X
Chlopyrifos[a] (Dursban/Dow)	Organophosphate			X	X	X	X
Chlorantraniliprole (Acelepryn/Syngenta)	Diamide	X		X	X		X
Cyantraniliprole (Ference/Syngenta)	Diamide	X		X	X		X
Lambda-cyhalothrin (Scimitar/Syngenta)	Pyrethroid			X	X		
Spinosad (Conserve/Dow)	Biorational				X		
Trichlorfon (Dylox/Bayer)	Organophosphate	X		X	X	X	

* Always consult label directions for specific timing and application recommendations.
[a] For use only on turfgrass grown for sod or seed.