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NebGuide

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Protecting Bees When Using Insecticides

Bees are valuable pollinators and need to be protected when pesticides are applied, especially when plants are in bloom. Learn how to best protect them with tips for specific crops, chemicals, and application times.

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Bees are valuable pollinators of 95 crops grown in the United States. Bee-pollinated crops have a farm value of approximately $10 billion. Bees are as vital as soil fertility, irrigation, and pest control in the production of crops requiring bee pollination. Bees also are valuable pollinators of many wild plants that provide food and cover to wildlife, contribute to soil fertility and erosion control, and add beauty to our landscapes. Honey bees also contribute to our agricultural economy by producing $200 million of honey annually. While the honey crop is important to beekeepers, it is a small sum compared to the value of the crops which benefit from bee pollination.

Bees are insects that feed exclusively on nectar and pollen. They can be distinguished from other groups of insects by the presence of branched body hairs on the thorax and abdomen. There are approximately 3,500 species of bees in North America. Most bee species are solitary and nest in the ground or in cylindrical cavities such as hollow plant stems. Unmanaged bee species can be locally abundant if suitable nesting habitat and forage are available; however, their abundance is reduced by intensive agriculture and urban development. Bee species managed for pollination in the Midwest and their uses

Figure 1. Blooming weeds in ditches and field margins can be highly attractive to bees. They should be mowed prior to applying a pesticide to an adjacent crop. Smartweed in

include bumble bees (used in greenhouses to pollinate cucumbers and tomatoes), orchard mason bees (tree fruits), leafcutter bees (alfalfa seed production), and honey bees (a variety of crops).

irrigation ditches around corn fields can be highly attractive to bees.

Honey bees are the most important pollinator in the Midwest because they: 1) are easily managed, 2) can be transported, 3) can be managed for income from both honey production and pollination services, 4) maintain large populations throughout the growing season, and 5) visit and pollinate many plant species. Recently introduced parasitic bee mites (varroa and tracheal) have reduced the number of wild honey bee colonies and caused extensive losses in beekeeper-managed colonies. For further information on bee mites, refer to the NebGuide *Managing Varroa in the Midwest*, G96-1302.

Pollinator protection has always been an important consideration when planning strategies for controlling crop pests. The loss of native pollinators due to habitat reduction and the decline in honey bee colonies due to parasitic bee mites underscore the need to protect pollinators when controlling pests.

"Pesticide" is a general term used to describe a chemical designed to kill something. Pesticides are classified according to their target as follows: insects (insecticide), mites (miticide), weeds (herbicide), bacteria (bactericide) and fungi (fungicide). Many insecticides and miticides are toxic to bees. Pesticide labels carry specific statements to protect bees and should be carefully read prior to pesticide application. While this NebGuide focuses on protecting honey bee colonies managed by beekeepers, many of the recommendations will also protect other bee species.

Factors to Consider in Pollinator Protection Strategies

Plant Growth Stage

Almost all cases of bee poisoning result from insecticides being applied to blooming crops or being allowed to drift onto blooming crops or weeds. Therefore, insecticide applications usually are not recommended on blooming crops. When insecticide application to a blooming crop is permitted by the label, growers and applicators need to communicate with beekeepers and exercise all reasonable measures to lower the risk to bees.

Relative Toxicity of the Chemical

Pesticides vary in their toxicity to honey bees. Most fungicides and herbicides are not toxic to honey bees and can be used without endangering them. Some insecticides and miticides are not hazardous to bees and can be applied without risk of bee injury. For example, *Bacillus thuringiensis* (sold under the brand names: Dipel, MVP, Thuricide, Biobit, etc.) is a biological insecticide that is not toxic to bees. Insecticides that are moderately toxic to bees can be applied when bees are not actively foraging. Synthetic pyrethroid insecticides will kill bees present during application, but then, many of them exhibit repellency to bees. Bee losses caused by pyrethroids are usually moderate. Insecticides that are highly toxic to honey bees cannot be applied to blooming crops when bees are present without causing serious injury. *Appendix 1* provides relative toxicities for some insecticides and miticides used on Midwestern crops.

Choice of Formulation

Different formulations of the same insecticide often vary considerably in their toxicity to bees. Granular

insecticides generally are not hazardous to honey bees. Dust formulations (seldom used today on commercial field crops) are typically more hazardous than emulsifiable concentrates because they adhere to the bee's body hairs and are carried back to the beehive. Wettable powder and flowable formulations essentially dry to a dust-like form which foragers can carry to the hives. Likewise, microencapsulated insecticides can be collected by foragers along with pollen and carried back to the beehive. When honey bees are exposed to insecticides that kill foraging bees, honey production is reduced but colonies recover as young bees emerge. Exposure to dust, wettable powder, flowable, and microencapsulated formulations of insecticides can cause severe losses of both foraging bees and hive bees. In the worst cases, toxins may remain active in the hive for several months and prevent colonies from recovering from the injury.

Residual Action

Residual activity of an insecticide is an important factor in determining its safety to pollinators. An insecticide which degrades within a few hours can generally be applied with minimal risk when bees are not actively foraging. Applying insecticides with extended residual activity more than eight hours when bees are not actively foraging will not prevent bee injury if bees visit the crop during the period of residual activity. Insecticides with extended residual activity merit extra precaution to prevent bee exposure. Penncap-M (microencapsulated methyl parathion) and Furadan F (flowable carbofuran) fall into this classification with residual times up to 8 and 14 days, respectively.

Drift

When the target crop is not blooming or is unattractive to bees, insecticide drift can cause significant bee poisoning if it reaches adjacent flowering crops or weeds. In general, sprays should not be applied if wind speed exceeds 10 mph and favors drift toward flowering crops or weeds. While pesticides should not be sprayed over colonies or allowed to drift onto them, drift over colonies rarely cause bee poisoning. When evaluating potential drift hazards, focus on drift to blooming plants.

Temperature

Temperature can have a substantial effect on the bee poisoning hazard. If temperatures after treatment are unusually low, insecticide residues can remain toxic to bees for much longer than if normal temperatures prevail. Conversely, if high temperatures occur during late evening or early morning, bees may forage during these times.

Distance from Treated Fields

Honey bee mortality usually decreases the further away colonies are from treated fields (i.e. the most severely damaged colonies are usually those closest to fields where insecticides are applied). Most foraging activity occurs within one to two miles of the hive; however, during periods of pollen or nectar shortage, bees forage at greater distances, and colonies up to five miles from the treated area can be injured.

Time of Application

Application timing is related to all the previously

mentioned factors. Again, the most critical factor is to control pests prior to bloom or after bloom is complete when possible. Evening application of a short-residual insecticide can greatly reduce the potential for bee injury.

Figure 2. Honey bee injury results when pesticides are applied or allowed to drift to blooming crops, wild plants or weeds. Almost all accidental injury can be avoided by taking precautions to avoid pesticide application or drift to blooming plants.

Lack of Communication

Reducing insecticide injury to honey bees requires communication and cooperation among beekeepers, farmers and applicators. It is important that beekeepers understand the cropping and pest management practices used by farmers near their apiaries. Likewise, insecticide applicators should be aware of apiary locations, have a basic understanding of honey bee behavior and which materials and application practices are hazardous to bees. It is unlikely that all bee poisonings can be avoided; however, in most cases, bee losses can be prevented by knowing the hazards and maintaining effective communication.

How Farmers, Gardeners and Applicators Can Reduce Risks of Honey Bee Injury

Do not treat fields in bloom. Be especially careful when treating crops, such as alfalfa, sunflowers and canola, which are highly attractive to bees. *Appendix 1* indicates honey bee activity in field crops and rangeland. Insecticide labels carry warning statements about application during bloom. Always read and follow the label.

Examine fields and field margins before spraying to determine if bees are foraging on flowering weeds. Milkweed, smartweed and dandelion are examples of common weeds that are highly attractive to honey bees. Where feasible, eliminate blooming weeds by mowing or tillage prior to insecticide application. While bright and colorful flowers are highly attractive to bees, some plants with inconspicuous blossoms such as dock, lambsquarter and ragweed also are visited. When examining areas for blooming plants, consider all blooming plants. It is also important to be aware that many plants only offer pollen and nectar for a few hours each day. Fields should be scouted for bees at the same time of day as the anticipated insecticide application.

Choose short residual products and low hazard formulations. If insecticides must be applied during the flowering period to save a crop, refer to *Appendix 1* and select the least hazardous option.

Avoid spray drift. Give careful attention to the position of blooming crops and weeds relative to wind speed and direction. Changing spray nozzles or reducing pressure can increase droplet size and reduce spray drift.

Apply insecticides when bees are not foraging. Some insecticides can be applied in late evening or early morning (i.e. from 8 p.m. to 6 a.m.) with relative safety. In the case of corn, bees collect pollen from tassels in the early morning and are not present in the afternoon or evening. Short residual materials applied from late afternoon until midnight do not pose a bee hazard in corn fields if blooming weeds are not present.

Adjust spray programs in relation to weather conditions. Reconsider the timing of insecticide application if unusually low temperatures are expected that night. Cool temperatures can delay the degradation process and cause residues to remain toxic to bees the following day. Stop applications when temperatures rise and bees re-enter the field in early morning.

Contact local beekeepers and obtain locations of bee yards. Nebraska state law requires that apiaries be

clearly identified with the name, address and phone number of the beekeeper. Identification may appear on one or more colonies, or a separate sign may be posted in the apiary. The Nebraska Department of Agriculture (402-471-2394) maintains a list of apiary locations and can help identify the owner. If colonies are present in an area that will be sprayed with a bee-toxic insecticide, contact beekeepers in time for them to protect or move the colonies. Many pesticide applications pose minimal risk to bees, and beekeepers may choose to accept some risk rather than move colonies. Notify beekeepers as far in advance as possible.

Read the pesticide label. Carefully follow listed precautions with regard to bee safety.

Maintain bee forage areas. Intensive agriculture often increases bee dependence on cultivated crops for forage. Encouraging bee forage plants in wild or uncultivated areas will reduce bee dependence on crop plants that may require pesticide treatments. Plants recommended for uncultivated areas include sweet clover, white Dutch clover, alfalfa, purple vetch, birdsfoot trefoil, and partridge pea. Most trees and shrubs are beneficial to bees. The most attractive include linden, black locust, honey locust, Russian olive, wild plums, elderberries, red maples, willows, and honeysuckle. Soil conservation, natural resource and game managers usually are eager to help establish plantings that benefit bees. These areas also conserve soil and provide valuable habitat for plant and wildlife conservation programs.

Steps Beekeepers Can Take to Protect Their Colonies

Choose low hazard apiary locations. Do not place bees adjacent to crops likely to be sprayed with an insecticide.

Know the risks. Many crop pests can be controlled without endangering bees. Attend crop pest management training sessions to stay informed about crop pests and control measures used by growers and applicators. These sessions also provide an opportunity to establish communication links with growers and applicators.

Maintain positive working relationships with applicators. Risk management decisions can best be made when both parties understand each other's needs. A communication link should be established prior to the spray season rather than during peak activity when both parties are busy.

Register apiaries and post identification. Register your apiaries with the State Department of Agriculture, Agricultural Stabilization and Conservation Service or any other agency that helps applicators contact beekeepers. Post your name, address and telephone number in a conspicuous place in your apiaries.

Be prepared to protect colonies if necessary. Frequently, pests can be controlled without putting honey bees at risks. If pest control measures are necessary that carry unacceptable risks, know the options for protecting colonies and be prepared to implement them. Options for protecting bees include:

1. Briefly confine bees to their hive with wet cloth when products with short residual activity are applied. This measure is only feasible if a small number of colonies are involved and if the confinement period is brief and early in the morning. *Caution! This measure can result in colony injury due to overheating and should be used with care.*
2. Disrupt foraging activity temporarily when short residual materials are applied by removing colony covers and offsetting boxes so as to increase colony exposure. This will result in a temporary reduction in foraging. Most bees will remain in the hive to protect their stores and to maintain temperature and humidity in the exposed nest. After a few hours to one day, colonies

will adjust to the change and resume foraging. This method is safer than confining colonies but is not recommended if bees are located in or adjacent to fields that will be treated.

3. Move bees to another location at least four miles from the treated area when highly toxic products with extended residual activity are applied to blooming crops. Moving populous colonies during hot weather can result in considerable bee mortality and should be avoided if possible. Moves should be made in the early morning when temperatures are cool and the bees are least active.

Provide educational resources to growers and applicators. There are many ways to alleviate bee poisoning. Often, severe losses can be avoided by relatively simple modifications of pest control programs. Talk with growers and applicators about how to reduce bee injury and provide them with reference materials, such as this NebGuide, on protecting bees.

Appendix 1. Relative toxicities of selected insecticides and miticides to honey bees.			
	Length of residual toxic effect in hours or days.		*Length of residual toxic effect in hours or days.*
Do not apply to blooming crops or weeds		**Apply during late evening or early morning**	
Cygon (dimethoate)	3 days	Ambush (permethrin)	1-2 days, safened by repellency under arid conditions
Furadan F (carbofuran)	7-14 days	Ammo (cypermethrin)	Less than 2 hours
Guthion (azinphos-methyl)	2.5 days	Asana (esfenvalerate)	1 day, safened by repellency under arid conditions
Lorsban EC (chlorpyrifos)	4-6 days	Dyfonate EC (fonofos)	3 hours
Malathion ULV (8 fl oz/acre or more)	5.5 days	Lannate LS (methomyl)	2 hours +
Orthene (acephate)	3 days	Metasystox-R (oxydemetonmethyl)	Less than 2 hours
Penncap-M (methyl parathion)	5-8 days	methoxychlor (DMDT, Marlate)	2 hours
Sevin WP (carbaryl)	3-7 days	Pounce (permethrin)	1-2 days, safened by repellency under arid conditions
Temik G (aldicarb)	Apply at least 4 weeks before bloom	Systox (demeton)	Less than 2 hours
Apply only during late evening		**Apply at any time with reasonable safety to bees**	
Dibrom EC (naled)	16 hours	Comite (propargite)	Kelthane (dicofol)
Malathion EC	2-6 hours	Dimilin (diflubenzuron)	margosan (neem oil)
Pydrin (fenvalerate)	6 hours	Dipel (Bacillus	nicotine sulfate

		thuringiensis)	
Sevin XLR (carbaryl)	8 hours + (1.5 lb. per acre or less)	Dyfonate G (fonofos)	Plictran (cyhexatin)
Thimet EC (phorate)	5 hours	Furadan G (carbofuran)	
Thiodan (endosulfan)	8 hours		
Information on products not included in this appendix can be found on the pesticide label.			

Appendix 2. Honey bee activity in field crops and rangeland.

Wheat and Small Grains	Bees are not likely to be present in wheat or other small grains unless flowering weeds, such as wild mustards, are present.
Corn	A 1995 study found that corn's contribution to the pollen loads of honey bees was relatively small at five study sites in intensive corn production areas of Nebraska. During the pollen shed period, corn pollen constituted 0 to 9 percent of the pollen recovered from colonies with an average of 2.1 percent for all sites. Bees typically collect corn pollen in the early morning hours when pollen is shed and should not be present in large numbers after 1 p.m. Products with extended residual activity that are applied in the afternoon or evening can be picked up by foragers the next day and cause serious injury to colonies. While bees collect some corn pollen, other plants, including blooming weeds in field margins and irrigation ditches, provide most of the pollen and nectar that honey bees collect during corn pollination. Mowing blooming weeds in field margins and ditches before applying an insecticide will substantially reduce the risk of honey bee injury; however, it is best to remove bees from the area before treating pollinating corn with Penncap-M (encapsulated methyl parathion),
Sugar Beets	Bees will not be present unless flowering weeds are in the field.
Alfalfa	Alfalfa blossoms are among the most preferred by honey bees, which are likely to be present from the onset of flowering until it ends. Bees are necessary to pollinate this crop when grown for seed. Bees also will forage on weeds, such as dandelions and mustards, in pre-bloom alfalfa particularly in mature or thin stands. Blooming alfalfa should always be mowed prior to spraying for alfalfa weevil control. Mowing both protects pollinators and improves the efficiency of control measures.
Soybeans	Soybean flowers are attractive to foraging bees and, in some areas, may be a primary source of nectar. Pre- and post-bloom insecticides applications are unlikely to cause bee poisoning. Avoid spraying blooming weeds in the field or field margins.
Pastures and Rangeland	Some honey bee colonies are located in rangeland areas, usually along shelter belts. Pastures will attract foraging honey bees when flowering plants are present. Pastures with legumes, such as sweet clover, alfalfa, white Dutch clover and vetch are highly attractive to bees. Bees usually will be present throughout the day

	Furadan F (flowable carbofuran), or any other product with extended residual activity since bees collect some corn pollen. Moving bees in mid-summer is expensive, labor intensive and may result in bee mortality due to overheating during confinement. Beekeepers need to evaluate their risk before moving bees. Good communication with growers and applicators is essential.
Grain Sorghum	Bees forage in sorghum fields when the grain heads are shedding pollen. Sorghum is not a preferred pollen source, but bees may be present in large numbers if other sources are not available. A 1995 Nebraska study found that sorghum's contribution to the pollen loads of honey bees was highly variable at the five sites examined. It ranged from 34 percent to less than 1 percent in the study. The variability probably reflects the availability of competing bloom. Most bee activity on sorghum flowers will occur early in the morning, especially when dew is present. Dew facilitates collection of the dry, powdery pollen of sorghum and other wind-pollinated plants.
	when blooming plants are present.
Vetch	Bees are essential to pollinate this crop, and they are likely to be present throughout flowering.
Sunflowers	Sunflowers are very attractive to honey bees. Expect them to be present throughout the bloom period at all hours of the day. Honey bee pollination increases yields and bees are usually present near fields.
Field (Dry) Beans	Honey bees visit dry beans sparingly; however when many Beans honey bee colonies are in the area, bees can be abundant in dry bean fields. Bean fields should be scouted for bee activity if bloom is present.
Sweet Clover	Sweet clover is probably the most attractive honey bee forage plant. The plant is common along roadways, in wildlife habitat areas, and in pastures and rangeland. Honey bees will be active in sweet clover throughout bloom and are necessary if the crop is grown for seed.

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