Insect Management in Soybean

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Producers should scout soybean fields on a regular basis to minimize insect pest damage and adopt integrated pest management (IPM) strategies, such as the use of economic thresholds and combining various control strategies (cultural control, host plant resistance, biological control).

Prior to the first detection of soybean aphid in the U.S. in 2000, soybean grown in the north-central U.S. rarely was damaged by insects; indeed, it was considered to be a low-risk crop when grown in rotation with corn or wheat. Since soybean aphid has become a chronic major insect pest of soybean, inputs for control of insect pests have increased dramatically.

Other insect pests that occasionally impact soybean include armyworms, bean leaf beetles, cutworms, foliage-feeding caterpillars, grasshoppers, potato leafhoppers, seed corn maggots, spider mites and wireworms. Significant progress with soybean IPM has been made and will continue into the future to aid successful soybean production. A growing-season calendar shows the soybean insect pest problems and the time of occurrence in the northern production area of North Dakota and Minnesota (Figure 5). Pictures of insects can be found in the photo section of this publication.

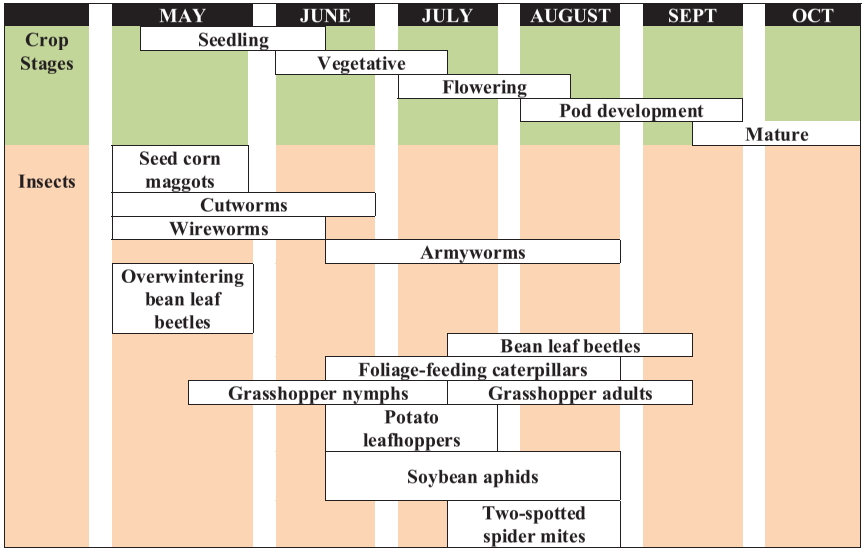

Figure 5. A growing season calendar indicating the time of occurrence of soybean insect pests.

Estimating Defoliation Damage

In soybean, field scouting to assess insect populations is based on the number of insects per foot of row, insects per plant, sweep net samples, or the level of defoliation. To determine the number of insects per foot of row, lay a strip of cloth in the inter-row space and shake plants over the cloth. Count the total number of insect pests per foot of row that fall on the cloth. If sampling narrow-row or drilled soybean, consider using a "Texas vertical beat sheet." The vertical beat sheet is made from a piece of galvanized metal flashing or similar stiff material 36 inches wide, 32 inches tall and crimped at the bottom to form a collecting trough 4 inches wide. Place the device next to the row and shake the plants against the vertical surface. Insects dislodged from plants collect in the trough, where they can be counted or collected.

The percent of defoliation is determined by estimating the amount of leaf tissue loss based on visual inspection of randomly selected plants. Examples provided (Figure 6) are guidelines for estimating loss for individual leaflets. Actual defoliation estimates made for pest management decisions are based on estimated leaf area lost over the entire plant.

The growth stage of the soybean plant is important when making pest management decisions. Under most conditions, moderate defoliation early in the season has little effect on final soybean yield. As plants reach the flowering and pod-filling

stages, defoliation poses a greater threat to yield. For example, research indicates that the soybean plant can sustain a 35 percent leaf loss prior to the pre-bloom period. From pod set to maturity, the plant can tolerate only a 20 percent defoliation level.

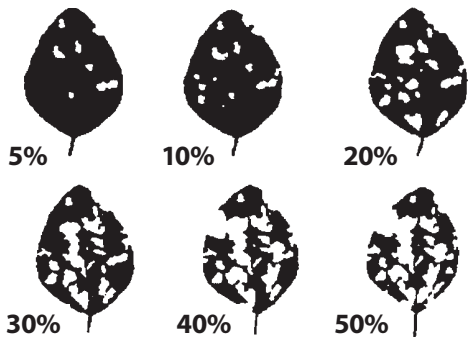

Figure 6. Soybean defoliation levels.

Armyworms [Lepidoptera: Noctuidae: *Pseudaletia unipuncta* (Haworth)]

Armyworms are greenish brown with longitudinal stripes. Full-grown larvae are smooth, striped and almost hairless. Armyworms feed for three to four weeks. When full grown, larvae are 1½ to 2 inches long. Armyworm larvae have six growth stages or instars. The final instar lasts about 10 days, and they consume large amounts of plant material during that time. Armyworms are inactive during the day, resting under plant trash, clumps of grass or lodged plants.

They feed at night or on cloudy days, crawling up on plants and consuming foliage. Due to their habit of feeding at night, armyworms may go undetected until significant damage has occurred.

Armyworms do not overwinter in the region. The moths migrate from southern states in late spring and early summer. This helps explain the sporadic infestations that occur. When moths arrive, they prefer to lay their eggs in moist, shady areas, usually where grasses have lodged. Infestations that develop within soybean fields often are due to grass weed problems.

Armyworms are more of a problem in small grains and corn. Damage to soybean can occur when the armyworms' usual host plants become exhausted due to feeding or dry conditions. When their food is depleted in the hatching site, the armyworms may move in large numbers or "armies," eating and destroying plants or crops in their path.

Threshold

Control of armyworms is recommended when 25 to 30 percent of the foliage is destroyed or if significant injury to pods is evident. Most often in soybean, infestations are due to migrating armyworms. Under these circumstances, treatment of a couple of swaths ahead of the migrating armyworms to establish a barrier strip and prevent further migration and injury may be all that is needed.

Bean Leaf Beetle [Coleoptera: Chrysomelidae: *Cerotoma trifurcata* (Förster)]

This beetle can vary in color from yellow to reddish brown and may have three to four black spots with a black border on the wing covers. Adults emerge from overwintering and move into bean fields as the seedlings emerge. The white larvae develop in the soil, feeding on the roots and nodules. New adults emerging from mid-July to August feed on foliage and pods.

Feeding injury to leaves appears as small round holes between the leaf veins. Late-season feeding on the foliage and pods by the new adults that emerge in August can be more important than early season feeding, especially if viruses are present. This may increase the risk of virus transmission and cause secondary fungal and bacterial infections (rotting and discoloration).

Bean leaf beetles are the vector of Bean Pod Mottle Virus. In 2007, Bean Pod Mottle Virus was detected in 6 percent of soybean fields sampled in southeastern North Dakota *(Source: B. Nelson, Department of Plant Pathology, NDSU)*.

Threshold

Due to low incidence of this insect in North Dakota, no local control guidelines have been developed. Based on information from other regions where these insects are a common pest, a sweep net is used to determine

if bean leaf beetles are present. Treatment would be recommended when three to seven beetles per sweep are found. Treatment thresholds based on defoliation are 50 percent defoliation during early vegetative, 40 percent defoliation during pre-bloom, 35 percent defoliation during bloom and 20 to 25 percent defoliation during pod set to fill.

Cutworms (Lepidoptera: Noctuidae)

Several cutworm species affect regional crops. The dingy cutworm, *Feltia jaculifera* (Guenée), overwinters as a partially grown larva and is one of the first cutworm species to cause problems during crop emergence from early to mid-May. The moth of the dingy cutworm is known to lay her eggs on sunflower heads from mid-July through September. Soybean and other crops following sunflower in rotation are at greatest risk of injury by this cutworm. Other cutworms, the redbacked, *Euxoa ochrogaster* (Guenée), and the darksided, *Euxoa messoria* (Harris), overwinter as eggs, which hatch in mid to late May. Eggs are laid in the fall and survive in weedy, wet and reduced- tillage areas. Feeding injury by these cutworms normally occurs in late May to early June.

Most damage by cutworms occurs when soybean plants are in the early stages of development. Damage consists of young plants being chewed off slightly below or at ground level. Some cutworm feeding injury may occur on foliage. Cutworms feed

primarily at night. When checking soybean fields for cutworms during the day, dig into the soil an inch or two around recently damaged plants; there you can find the gray to gray-brown larvae.

Threshold

Economic thresholds for cutworm treatment decisions are not well-established. Treatment guidelines used through the years include this one: Treatment should occur when one cutworm or more is found per 3 feet of row and the larvae are small (less than ¾ inch long). Another guideline is treatment should occur when 20 percent of plants are cut or when gaps of 1 foot or more exist in the plant row. When making a final decision, consider that surviving soybean plants are able to compensate for early stand reductions because of the plant's long growth period and branching ability.

Foliage-feeding Caterpillars (Lepidoptera)

Green Cloverworm, Cabbage Looper, Velvetbean Caterpillar, Thistle Caterpillar and Alfalfa Webworm

Populations of these caterpillars have been negligible in North Dakota and little treatment to control them has been required. Sampling for these insects is accomplished through the use of a drop cloth or a vertical beat sheet placed between two rows of plants. The larvae are dislodged from the plants and counted on the cloth or collection tray to arrive at an estimate of the number per row feet.

Green cloverworm [Nymphalidae: *Vanessa cardui* (Linnaeus)]

These caterpillars are green with two narrow white stripes down the side. When mature, the worms are 1¼ inches long. These caterpillars have only three pairs of fleshy prolegs on the abdomen, plus the pair on the back tip. When moving, the worms arch the middle of the body, or "loop." Young worms scrape leaf tissue, creating a transparent skin, or "window," on the leaf surface. Older cloverworms eat holes in the leaves.

Cabbage looper [Noctuidae: *Trichoplusia ni* (Hübner)]

These caterpillars are light to dark green with lighter-colored stripes along the side and on the top, running the length of the body. When mature, the worms are 1½ inches long. These caterpillars have only two pairs of fleshy prolegs on the abdomen, plus the pair on the back tip. When moving, the caterpillars also arch the middle of the body, or "loop." These worms feed on leaves on the interior and lower portion of the plant. As defoliation occurs, worms feed higher in the plant. Feeding injury is similar to the cloverworm.

Velvetbean caterpillar [Noctuidae: *Anticarsia gemmatalis* (Hübner)]

This insect does not overwinter in the region. Instead, moths migrate from southern locations. These caterpillars have dark lines bordered by

lighter-colored, narrower lines running the length of the body. The background color ranges from a pale yellow-green to brown or black. These larvae have four pairs of fleshy prolegs to distinguish them from the cloverworm and the looper. Young velvetbean caterpillars feed on the underside of leaves in the upper portion of the plant. Older larvae consume the entire leaf except for the leaf veins.

Thistle caterpillar [Nymphalidae: *Vanessa cardui* (Linnaeus)]

This insect is the larva of the butterfly known as the painted lady. This butterfly does not overwinter in the region but migrates from southern locations each spring. These caterpillars are brown to black with yellow stripes along each side of the body. They are covered with spiny scoli (fleshy structures) that give the caterpillar a prickly appearance. Full-grown larvae are about 1½ inches long. The caterpillars feed on the leaves, webbing them together at the feeding site.

Alfalfa webworm [Crambidae: *Loxostege cereralis* (Zeller)]

These larvae are 1 inch long when fully grown. They are greenish to nearly black with a light stripe that runs down the middle of the back. They have three dark spots, each with hairs, on the side of each segment. These larvae feed for about three-plus weeks. Infestations are characterized by light webbing over the leaves. Beneath the web is where the larvae feed,

consuming the leaves. These larvae move very rapidly, forward or backward, when disturbed.

Threshold

Control of these different caterpillars normally is not warranted until greater than 30 percent of the foliage is destroyed prior to bloom, or when 20 percent of the foliage is destroyed after bloom, pod set or fill has been reached. This usually requires an average infestation of four to eight larvae per row foot.

Grasshoppers (Orthoptera: Acrididae)

In the northern Great Plains, grasshopper egg hatch normally begins in late April to early May. Most grasshoppers emerge from eggs deposited in uncultivated ground. Soybean growers should expect to find grasshoppers feeding first along soybean field margins adjacent to noncrop sites where the nymphs are hatching. Later infestations may develop when grasshopper adults migrate from harvested small-grain fields. Grasshoppers will feed upon leaves and pods, chewing holes in them. A result of these migrations is soybean fields becoming sites for significant egg laying.

Threshold

The threatening rating is considered the action threshold for grasshoppers. For example, grasshopper control is advised whenever 50 or more small nymphs per square yard can be found in adjacent, noncrop areas, or when 30 or more nymphs per square yard can be found within the field. When 20 or more adults per square yard are found in field margins or eight to 14 adults per square yard are occurring in the crop, treatment would be justified. Because estimating the number of grasshoppers per square yard is difficult when population densities are high, pest managers can count grasshoppers collected from four 180-degree sweeps when using a 15-inch sweep net and use that value as an estimate for the number of adult (or nymph) grasshoppers per square yard. Many of the grasshopper infestations in soybean will be heaviest on field margins. Treating these areas early may lessen the total number of grasshoppers successfully entering a field.

Soybean plants are most sensitive to defoliation during pod development (growth stages R4 to R6). During this time, plants can tolerate only up to 20 percent defoliation. Of greater concern is direct feeding damage to pods and seeds. Grasshoppers are able to chew directly through the pod walls and damage seed. If more than 5 to 10 percent of the pods are injured by grasshoppers, an insecticide application is recommended.

Grasshopper thresholds.

	Nymphs (young grasshoppers)		Adults	
Rating	Margin	Field	Margin	Field
	per square yard			
Light	25-35	15-23	10-20	3-7
Threatening	50-75	30-45	21-40	8-14
Severe	100-150	60-90	41-80	15-28
Very severe	200+	120	80+	28+

Potato Leafhopper [Hemiptera: Cicadellidae: *Empoasca fabae* (Harris)]

The adult is wedge-shaped and pale green. Adults are very active, jumping or flying when disturbed. Nymphs are wingless. Both adults and nymphs run backwards or sideways rapidly when disturbed. Nymphs feed on the underside of the leaf, usually completing their growth on the leaves near where they hatched. Large numbers of adults may appear early in the season, but their presence is dependent on migration from the south and east.

Soybean plants with moderate to dense pubescence, or plant hairs, are tolerant to leafhopper infestations. The short plant hairs form a barrier that discourages leafhoppers from feeding and laying eggs on plant tissue. When feeding does occur, damage by leafhoppers is referred to as "hopper-burn." Foliage becomes dwarfed, crinkled and curled. Small triangular brown areas appear at the tips of leaves, gradually spreading around the entire leaf

margin. Potential damage to soybean by potato leafhopper is not fully understood. Damage is more likely when drier growing conditions occur.

Threshold

The threshold for spray decisions is based on an average of five leafhoppers per plant in the vegetative stages and nine leafhoppers per plant in early bloom stages.

Soybean Aphid [Hemiptera: Aphididae: *Aphis glycines* (Matsumura)]

Soybean aphid first was detected in the U.S. in 2000 and spread through soybean production areas in the north-central U.S., including North Dakota, in 2001. Since its introduction, soybean aphid has become a major insect pest of soybean throughout the Midwest.

Foliar insecticides are the primary management tactic for aphid control. However, multiple years of research have shown that natural enemies often can keep soybean aphids below the economic threshold in nonoutbreak years. Another nonchemical management tactic that shows promise for controlling soybean aphid is the use of genetically based aphid-resistant soybean lines.

Soybean aphid is light yellow with black cornicles (tail pipes) and a pale-colored cauda (tail projection). As with other aphids, soybean aphid is small, about ⅛ inch. Nymphs (or young) are smaller yet.

Aphids suck plant sap. When infestations are large, infested leaves are wilted or curled. Aphids excrete honeydew, a sweet substance that accumulates on surfaces of lower leaves and promotes the growth of sooty mold. Soybean aphid colonizes tender leaves and branches from early vegetative through reproductive plant stages. Later, as vegetative plant growth slows, the aphids slow their reproductive rate, move down to the middle and lower part of the plant and feed on the undersides of leaves. Toward the end of the season, the colonies again begin to increase in number rapidly. These increases are followed by a migration to the overwintering host, buckthorn.

Threshold

The guidelines for making soybean aphid treatment decisions are:

- Begin scouting soybean fields at the V3 to V4 stage to determine if soybean aphids are present in fields. No treatment is recommended at this time and is discouraged so that insecticides do not reduce the presence of predators and parasites.
- The critical growth stages for making most soybean aphid treatment decisions are the late vegetative to early reproductive stages (V*n* to R3). Assessing aphid populations at these stages is critical.
- **Economic threshold from R1 (first flower) to R5 (beginning seed) is 250 aphids/plant AND when populations are increasing actively in 80 percent of the field.** At R6 (full seed), no insecticide

treatment is recommended. Research trials throughout the north-central states have not demonstrated a yield benefit for soybean aphid management at the R6 and later stages.

Seedcorn Maggot [Diptera: Anthomyiidae: *Delia platura* (Meigen)]

Seedcorn maggots attack soybean seed, preventing sprouting or weakening the seedlings. The yellowish-white maggot is found burrowing in the seed, emerging stem or the cotyledon leaves. Damage to the seedlings results in a condition called "snakeheads," or plants without cotyledon leaves.

Adult flies emerge in the spring when soil temperatures reach 50 F. They deposit eggs in soil with abundant organic matter and decaying crop residue or on the seed or seedling. Injury from seedcorn maggots is usually most severe during wet, cold springs and in fields with high organic matter soils. When cool, wet conditions occur during planting, the slow germination and emergence of the seedling extends the period of time it is vulnerable to feeding by the maggot.

Threshold

When conditions are wet and cool or when planting into high crop residue conditions, insecticide seed treatments provide the best defense against injury.

Two-spotted Spider Mites (Acari: Tetranychidae: *Tetranychus urticae* Koch)

Adult spider mites are small (less than 0.2 inch) and greenish white to orange-red, and have two dorsal spots and four pairs of legs. Nymphs are smaller than adults and have three to four pairs of legs. Magnification is necessary to see mites. Host plants for spider mites include soybean, dry bean, alfalfa, corn, vegetables, ornamentals and trees. Mites overwinter as eggs on vegetation. The life cycle of spider mites can be completed in only five to 14 days, with fastest development rates occurring above 91 F. Each female lives for 30 days, and she produces about 300 eggs during her lifetime. In hot, dry weather, natural fungal diseases of mites are slowed and populations can increase from a few individuals to millions within a few generations. Mites thrive on stressed plants that are nutrient rich.

Leaf injury symptoms appear as stippling first and then progress to yellowing, browning or bronzing as feeding injury increases and eventually leaf drop. Feeding injury causes water loss from the plant and reduces the photosynthetic ability of the plant. In severe cases, premature leaf senescence and pod shattering, and even plant death, can occur. When severe mite infestations occur during late vegetative and early reproductive growth, a 40 to 60 percent yield loss between treated and untreated soybean has been demonstrated in other north-central states. Be sure to scout during full-pod (R4) through

beginning-seed (R5) stages because these crop stages are the most important contributors to soybean yield. Spider mites can cause yield reduction as long as green pods are present.

When scouting for spider mites, look on the underside of leaves and lower foliage at the field edges first for tiny mites and fine spiderlike webbing. A quick sampling procedure to determine whether mites are present is to hold a piece of white paper below leaves, then tap them to dislodge the mites. The mites appear as tiny dust specks; however, they will move slowly after being knocked off the leaf. Dislodged predatory mites will move faster than the two-spotted spider mite.

Another sampling measure involves pulling up plants and examining the underside of the leaves from the bottom of the plants upward. When spider mites need to move due to diminishing food supply, they climb to the top of plants and are dispersed by the wind through "ballooning," so they can spread quickly within a field or to adjacent fields.

Infestations typically are first noted near field edges and fields near alfalfa (a preferred host). Products labeled for mite control often do not give adequate control and the population of mites may rebound quickly to pretreatment levels or higher. When rain and humidity are present, natural reductions in mite populations occur due to infection by a fungal pathogen. Conditions that are good for the development of the pathogen are temperatures cooler

than 85 F, with at least 90 percent relative humidity for 12 to 24 hours. Mites usually become a problem when hot, dry weather occurs. When a production area has low rainfall, the region can become a "hot spot" for mite injury and a source of mites migrating to neighboring areas.

Threshold

Deciding whether to treat is difficult. No specific threshold has been developed for two-spotted spider mite in soybean. Sample plants at least 100 feet into the field and walk in a "U" pattern, sampling two plants per location at 20 different locations. Assess mite damage using the following scale from the University of Minnesota:

0 - No spider mites or injury observed.

1 - Minor stippling on lower leaves, no premature yellowing observed.

2 - Stippling common on lower leaves, small areas or scattered plants with yellowing.

3 - Heavy stippling on lower leaves with some stippling progressing into middle canopy. Mites present in middle canopy with scattered colonies in upper canopy. Lower leaf yellowing is common. Small areas with lower leaf loss may occur **(Spray Threshold)**.

4 - Lower leaf yellowing readily apparent. Leaf drop common. Stippling, webbing and mites common in middle canopy. Mites and minor stippling present in upper canopy **(Economic Loss)**.

5 - Lower leaf loss common, yellowing or browning moving up plant into middle canopy, stippling and distortion of upper leaves common. Mites present in high levels in middle and lower canopy.

If spider mites are above the threshold while significant pod or seed fill still needs to occur, we recommend an organophosphate insecticide (for example, Lorsban, Dimethoate) instead of a pyrethroid insecticide. Pyrethroids for example, Asana, Baythroid, Decis, Mustang Max, Proaxis, Warrior) tend to flare (increase) mite populations seven to 10 days after application. Reasons for an increase in mite populations include disruption of the natural enemies that control spider mites (predatory mites), increased movement of mites out of fields and increased reproductive rates of female mites.

Early detection facilitates timely and effective rescue treatments. Current insecticides for soybean provide short-term protection, about seven days, from mites and do not kill mite eggs. Fields will need to be monitored continually for resurging populations.

The efficacy of an insecticide can be improved significantly with sufficient coverage (greater than 18 gallons/acre of water) and application at high pressure to penetrate foliage. However, under dry conditions, mites usually will occur throughout the field, and spot treatments are not effective in controlling mites and unlikely to prevent the infestation from spreading. Insecticides labeled for mite control have a

21- (Dimethoate) to 30-day (Cobalt) harvest interval. Consequently, if infested fields still have green seeds but seeds are filling, accepting some yield loss from mites and not treating may be better than treating and being unable to meet the labeled harvest interval.

IPM for soybean aphids and spider mites

When scouting soybean fields, consider which insect pests (soybean aphid and spider mites) are present and their population levels. If the heat and drought stress continues, soybean has an increased risk for spider mites and reduced risk for soybean aphids (increased mortality and decreased reproductive rate due to hot temperatures greater than 90 F). If heavy rains occur, mite and aphid populations can collapse. Mite infestations often are concentrated early in field edges, and spot treatment can be feasible and more economical. However, under dry conditions, mites usually will occur throughout the field, and spot treatments are unlikely to prevent the infestation from spreading. Early detection facilitates timely and effective rescue treatments.

Wireworms (Coleoptera: Elateridae)

Wireworms are most likely to be problems when soybean follows pasture or grassland. Infestations often are found in coarse-textured soils (sandy loam) where moisture is abundant, perhaps in low spots of fields.

Thresholds

Producers have no easy way to estimate wireworm infestations. Two methods are used:

Soil Sampling

Sample 20 well-spaced, 1-square-foot sites to a depth of 4 to 6 inches for every 40 acres being planted. If you find an average of one wireworm per square foot, treatment would be justified.

Solar Bait Trap

In September, establish bait trap stations for two to three weeks before a freeze. Place bait stations randomly through the field, making sure you represent all areas of the field. You should have 10 to 12 stations per 40-acre field. Place 1 cup of wheat and 1 cup of shelled corn in a 4- to 6-inch-deep hole. Cover the grain with soil and then an 18-inch-square piece of clear plastic. Dig up the grain. If you find an average of one or more wireworm larvae per station, treatment would be justified.

Seed Treatment

Insecticide seed treatments should be applied either as commercial or on-farm application for managing wireworms in soybean.

Insecticides labeled for soybean insects pest in North Dakota (sorted by insecticide class and active ingredient).

Insecticide class	Active ingredient	Product[1]	Preharvest interval (days)	Targeted insects
Carbamate	carbaryl	Sevin	21	armyworm, cutworms, bean leaf beetle, foliage feeding caterpillars, grasshoppers, potato leafhopper
	methomyl	Lannate LV+	14	bean leaf beetle, foliage feeding caterpillars, soybean aphid
	thiodicarb	Larvin brand 3.2+	28	armyworm, cutworms, bean leaf beetle, foliage feeding caterpillars
Insect growth regulator	diflubenzuron	Dimilin	21	armyworm, foliage feeding caterpillars, grasshoppers
	methoxyfenozide	Inteprid	14	armyworm, foliage feeding caterpillars
Microbial	*Bacillus thuringiensis*	Dipel DF	None	armyworm, foliage feeding caterpillars
	spinetoram	Radiant SC	28	armyworm, foliage feeding caterpillars
	spinosad	Tracer	28	armyworm, foliage feeding caterpillars

Neonicotinoid	imidacloprid	Nuprid 1.6 F, MANA Alias 4F	7	bean leaf beetle, potato leafhopper, soybean aphid
	imidacloprid seed treatment	Gaucho 600 and generics	—	bean leaf beetle, seed corn maggot, wireworms
	thiamethoxam seed treatment	Cruiser seed treatment	—	seed corn maggot, wireworms, bean leaf beetle
Neonicotinoid + pyrethroid	imidacloprid + cyfluthrin	Leverage+	45	bean leaf beetle, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid
Organophosphate	acephate	Orthene	14	armyworm, bean leaf beetle, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid
	chlorpyrifos	Lorsban 4E+, Lorsban Advanced+, Advanced Chlorpyrifos 4E+, XNufos 4E+, Hatchet 4E+, Nufos 4E+, Warhawk 4E+, Yuma 4E+, and generics	28	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid, spider mites
	dimethoate	Digon 400, Dimethoate 4E, 4EC, 400, Dimethoate 2.67 EC, Dimate 4E,4EC	21	bean leaf beetle, grasshoppers, potato leafhopper, spider mites
	methyl parathion	Penncap M+	30	bean leaf beetle, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid

Insecticide class	Active ingredient	Product[1]	Preharvest interval (days)	Targeted insects
Organophosphate + pyrethroid	chlorphyrifos + gamma-cyhalothrin	Cobalt+	30	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid, spider mites
Pyrethroid	beta-cyfluthrin	Baythroid XL+	45	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid
	bifenthrin	Bifenture 2E+, Brigade 2E+, Discipline 2E+, Fanfare 2E+, Sniper 2E+, Tundra EC+, and generics	18	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid, spider mites
	bifenthrin + zeta-cypermethrin	Hero+	21	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid, spider mites
	deltamethrin	Delta Gold+	21	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid
	esfenvalerate	Asana+, Adjourn+ and generics	21	bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid

	gamma-cyhalothin	Proaxis+	45	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid
	lambda-cyhalothrin	Warrior II+, Silencer+, Grizzly Z+, Kaiso 24 WG+ and generics	30 (Kaiso = 45)	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid, spider mites
	permethrin	Pounce 3.2 EC+, Ambush+, Arctic 3.2 EC+, and generics	60	cutworms, bean leaf beetle, foliage feeding caterpillars, potato leafhopper
	zeta-cypermethrin	Mustang Max EC+, Respect+	21	armyworm, bean leaf beetle, cutworms, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid
Pyrethroid + neonicotinoid	lambda-cyhalothrin + thiamethoxam	Endigo ZC+	30	armyworm, bean leaf beetle, foliage feeding caterpillars, grasshoppers, potato leafhopper, soybean aphid

+Restricted-use insecticide.

[1] Always read and follow the manufacturer's directions before using the product and always use the labeled rates. Mention of any trade names does not imply the North Dakota State University Extension Service's or author' endorsement of one product versus another or discrimination against any other product not listed. Please consult the current edition of the "North Dakota Field Crop Insect Management Guide," NDSU Extension Service publication E-1143, for more information and restrictions on insecticides labeled in soybeans (*www.ag.ndsu.edu/pubs/plantsci/pests/e1143w1.htm*).