

Soybean Aphids in Iowa—2007

by Marlin E. Rice, Matt O'Neal, and Palle Pedersen

Introduction

The soybean aphid (*Aphis glycines*) is a major pest for soybean growers in Iowa. Since the arrival of this Asian species to Iowa in 2000, significant outbreaks have occurred, most noticeably in 2003 when aphid populations exceeded 3,000 aphids per plant in many fields. During this year, Iowa soybean yields averaged 32 bushels per acre, a 16 bushel per acre (or a 32%) reduction from 2002. This yield reduction was partly due to the soybean aphid coupled with drought conditions. Approximately 3 million acres in Iowa were sprayed with insecticides to reduce these damaging populations, and a survey of 2,400 Iowa farmers indicated that yield losses reached 57.7 million bushels of soybeans. However, in 2004, very low soybean aphid populations occurred throughout Iowa, with only 50,000 acres treated for soybean aphids.

Despite this year-to-year variation, the soybean aphid remains a threat to cause economic damage to soybeans. This publication reviews what is currently known about the biology of the soybean aphid and suggests management strategies.

Origin of Soybean Aphid

The soybean aphid is native to eastern Asia, including China, Indonesia, and Japan, where it is an infrequent pest of soybeans. It was first detected in North America in Wisconsin in July 2000 and now occurs throughout all Midwestern soybean production states. It is not known how this insect entered the United States, but historical records of other aphid interceptions by the U.S. Department of Agriculture suggest that the soybean aphid most likely arrived from Asia, either carried by an international airline passenger or associated with horticultural cargo.

Distribution in Iowa

Since its discovery in northeastern Iowa in August 2000, the soybean aphid quickly spread across Iowa. Twelve months later, the aphid was detected in western Iowa in Woodbury County, and within two years, the aphid had been found in soybeans in every Iowa county.

Description of Soybean Aphid

The soybean aphid is the only aphid in North America that will develop large colonies on soybeans. Therefore, large clusters of aphids found on soybeans must be soybean aphids. There are both wingless and winged forms. Wingless soybean aphid adults are about $\frac{1}{16}$ inch in



Soybean aphids will colonize the upper stem and developing leaves on soybeans. (Marlin E. Rice)



Winged and wingless soybean aphids on a soybean leaflet. (David Voegtlin)

length, pale yellow or green, and have dark-tipped cornicles (tail pipes) near the end of the abdomen. The winged form has a shiny black head and thorax with a dark green abdomen and black cornicles. Aphids feed through piercing-sucking mouthparts.



Winged soybean aphid. (Marlin E. Rice)

Biology and Seasonal Cycle

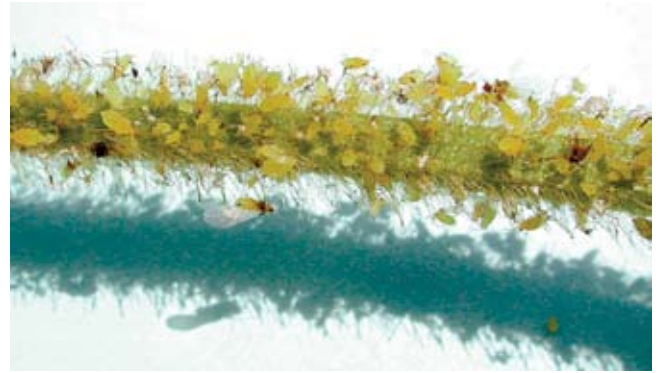
The seasonal cycle of soybean aphids is complex. Eggs are laid on buckthorn in the fall, overwinter there, and hatch in the spring, giving rise to wingless females. These wingless females on buckthorn reproduce without mating (asexually), and the young develop into winged females that migrate in search of soybean or possibly other host plants. There may be up to four generations on buckthorn in the spring. Females on soybean reproduce without mating and produce wingless daughters that continue the cycle. During the summer, winged aphids may develop during any generation on soybean, which puts much of Iowa soybean at risk because the aphids are easily carried by winds to areas even where the aphid may not have overwintered locally.

The soybean aphid may have 15 to 18 generations on soybean plants. Soybean aphid reproduction is affected by temperature. The optimum temperatures for reproduction and longevity are 72 to 77 °F with the relative humidity below 78 percent. Under optimum conditions maintained in a laboratory environment, soybean aphids have the potential to double their populations within 2 to 3 days. When temperatures exceed 81 °F, the developmental time is lengthened.

However, in soybean fields, soybean aphids experience less than ideal conditions.

Estimates of soybean aphid population growth in Iowa suggest that doubling time is on the order of 9 to 13 days. A temperature-based forecast is available on the World Wide Web (see Additional Information on page 16); note that this forecast is derived from a mathematical model based on data of soybean aphid growth from laboratory-based conditions.

In late summer, the wingless females produce young aphids that develop into both winged females and males. These winged aphids migrate back to buckthorn, where they reproduce sexually. These mated females subsequently lay eggs, beginning a new seasonal cycle that passes through the winter.



Soybean aphids clustering on a soybean stem. (Marlin E. Rice)



A large colony of soybean aphids often consists of white, shed skins and brownish carcasses killed by fungal pathogens. (Marlin E. Rice)



Soybean aphids will lay eggs near bud scales on limbs of buckthorn. (David Voegtlin)

The first detection of soybean aphids in Iowa has typically occurred near Decorah in northeastern Iowa on seedling soybean plants (V1–V2 stage) during early to mid-June. But in 2006, the first soybean aphids were found on May 31 near Ames.

Host Plants

The primary host is a small woody tree called buckthorn (*Rhamnus cathartica* and *Rhamnus alnifolia*). Soybean aphids prefer seedling or sapling trees on which to lay their eggs in the fall. Eliminating buckthorn might seem to be a logical approach to reducing soybean aphid populations, but this is impractical. Buckthorn grows widely across Iowa in wooded areas and river bottoms and has been planted in shelterbelts as windbreaks.



Soybean aphids will lay eggs on buckthorn during the fall. The eggs will overwinter here. (Marlin E. Rice)

Soybean is a secondary host because the aphids do not reproduce sexually on this plant. Additional secondary hosts include crimson clover (*Trifolium incarnatum*) and red clover (*T. pretense*). These are excellent hosts for soybean aphids and will support high levels of aphid reproduction. To a lesser extent, berseem clover (*T. alexandrinum*) and kura clover (*T. ambiguum*) will support aphid reproduction, while white clover

(*T. repens*), white sweet clover (*Melilotus alba*), and yellow sweet clover (*Melilotus officinalis*) can support low levels of reproduction, but they are extremely poor hosts for the soybean aphid. Furthermore, horse nettle has been observed as a summer host for soybean aphids. In summary, these observations suggest that these plants may serve as a “bridge” for soybean aphids to persist after leaving buckthorn but before soybeans are available.

Injury Symptoms in Soybean

In low numbers, soybean aphids can feed on soybeans and cause little or no damage. Large populations can result in visual evidence of damage. Honeydew, a sticky and shiny liquid excreted by the aphids as a by-product from ingesting large amounts of plant juices, accumulates on the top surface of leaves.

Excessive honeydew permits the growth of sooty mold, turning the leaves dark and interfering with photosynthesis in the plant. Heavily infested plants may be stunted. Plants that become stunted during the early reproductive growth stages of soybean may have reduced pod set and seed counts, resulting in lower yields.

Feeding by soybean aphids causes flowers and small pods to abort, reducing the number of pods per



Soybean aphids excrete large amounts of sticky honeydew that falls on leaves below them. Sooty mold grows on the honeydew and turns the leaves black. (Marlin E. Rice)

plant. Feeding also competes with the soybean plant for nutrients, which reduces the number of soybeans per pod and, less frequently, the size of soybeans. Therefore, protecting plants during the flowering stages (R1–R2) and green-bean pod stages (R5–R6) helps protect soybean yield. These soybean stages typically occur from early July into early August in Iowa.

Transmission of Viruses

The soybean aphid can transmit several viruses, including alfalfa mosaic virus, bean yellow mosaic virus, and soybean mosaic virus. The soybean aphid is an efficient transmitter of soybean mosaic virus, requiring only 5 to 30 minutes of feeding time for efficient transmission. Soybean mosaic virus is of primary concern in Iowa because it can cause significant yield loss. No estimates are available of how much yield loss is due to soybean mosaic virus. This virus may be more important when it occurs in plants that also are infected with bean pod mottle virus that is transmitted by the bean leaf beetle. Plant-expressed symptoms of these two viruses are similar and are not easily separated visually from each other in the field.



Soybean mosaic virus is transmitted by the soybean aphid. Although a diagnosis cannot be made based on visual symptoms alone, the impact of the virus can produce injury seen in the picture above. Yield loss due to the virus has not been fully studied in Iowa and management plans for preventing the transmission of the virus have not been developed. However, managing the direct feeding damage of the aphid to soybeans can prevent yield losses.

Natural Enemies of Soybean Aphids

The soybean aphid is attacked by three types of natural enemies—predators, parasitoids, and pathogens. Below is a review of these as they currently occur in Iowa soybean fields.

In order of importance, predators are currently the most abundant and have the ability to delay and suppress aphid outbreaks. Lady beetles (especially the multicolored Asian lady beetle, *Harmonia axyridis*), insidious flower bugs, syrphids, and other beneficial insects occur in Iowa soybean fields and will eat aphids (see photos, page 5, top). The multicolored Asian lady beetle is capable of eating as many as 200 soybean aphids a day.



The multicolored Asian lady beetle is a major predator of soybean aphids. (Marlin E. Rice)

The insidious flower bug (*Orius insidiosus*) is a small predatory insect that can feed on 19 aphids per day. Although this is less than what lady beetles eat, *Orius* are present before soybean aphids arrive and thus are thought to help delay if not prevent aphids from establishing in soybean fields. In general, all of these predators can suppress soybean aphid population growth in June and early July when fields have small aphid populations. Once aphids fully infest a field (80% or more of plants with aphids) and populations reach 250 aphids per plant, the impact of these predators is limited and populations are likely to increase (see Economic Threshold on page 8).

Aphids are attacked by small wasps that lay eggs within them (see photos, page 5, bottom left). These eggs hatch inside the aphid, feed on them, and emerge from the aphid as an adult wasp. An aphid that is attacked in this way is called parasitized and looks puffy and opaque—referred to

as a mummy. In North America, a limited number of wasps will attack the soybean aphid in this way. In Asia, there are several species of wasp that parasitize soybean aphids and may be responsible for the aphids' limited pest status in that part of the world. Efforts to import a limited number of these species to North America are in progress, with the release of one species, *Binodoxys communis*, during the 2007 growing season.

Fungal pathogens also reduce soybean aphid populations. A fungal epidemic was observed in Wisconsin in 2000 and was believed partly responsible for the decline in late-season aphid densities. These outbreaks are not as common in Iowa; the reasons why are not clear—possibly due to regional climate differences that prevent these fungal pathogens from persisting in late July and August.



Clockwise from bottom left, Asian lady bird beetle (MALB), *Harmonia axyridis*, on the underside of buckthorn leaves infested with soybean aphids; MALB feeding on a winged soybean aphid; an adult *Orius* feeding on a winged soybean aphid. The center picture is an adult flower fly, syrphid, which feeds on aphids in the immature, maggot stage. (W. Ohnesorg, Marlin E. Rice, Matt O'Neal, and www.biosurvey.ou.edu/okwild/misc/toxmarg.html)



Parasitoid inserting an egg ("stinging") an aphid (right inset) and later an adult wasp emerging from the aphid.



Parasitic wasps will lay an egg inside a soybean aphid, which kills the aphid and causes the formation of a mummy. (Marlin E. Rice)



Parasitized aphids (mummies) on a soybean plant. (Matt O'Neal)



Flower fly maggots feeding on soybean aphids. (Matt O'Neal)



An adult flower fly. (Marlin E. Rice)

Year-to-Year Population Variation

The soybean aphid has been in Iowa since the summer of 2000. Since invading the state, the population on soybean has gone through dramatic high and low cycles. These cycles have included high populations (>2,000 aphids/plant) in 2001, 2003, and 2005, followed by very low populations (<250 aphids/plant) in 2002, 2004, and 2006. This phenomenon is not limited to Iowa and has been observed across the Midwest.

Insight into this year-to-year variability of soybean aphids in North America comes from a network of suction traps. David Voegtlin, an aphid taxonomist at the Illinois Natural History Survey, established the network in 2001 soon after soybean aphids were first reported in North America. Soybean aphids were trapped as they flew between soybean fields during the summer and then in the early fall as they migrated back to buckthorn. Winged soybean aphids were collected in these 20-foot-tall suction traps placed across Illinois at nine locations from May through October.



This aphid suction trap, located at the Northeast Research and Demonstration Farm near Nashua, is one of four traps across Iowa that is used to collect and monitor winged aphid flight activity. (Marlin E. Rice)

During the early stages of the soybean aphids' invasion of North America, Voegtlin reported a remarkable trend (Figure 1). In general, more soybean aphids were caught in suction traps during the fall before a growing season when outbreaks were common during July and August (2003, 2005). This is interesting because soybean aphids make migratory flights during the fall to buckthorn, their overwintering host. Curiously, during the fall of those outbreak years (2003 and 2005), very few, if any, aphids were collected. Based on this trend, the relative abundance of the fall flight may predict the potential for outbreaks in the coming growing season.

In 2005, we established four suction traps in Iowa (Figure 2). During the 2005 growing season, we observed large numbers of winged aphids early in July and a few in September. However, in 2006, we observed fewer soybean aphids in the summer with the greatest amount caught in September. It is not clear if this is an indication of a significant fall flight and overwintering of soybean aphids in Iowa. Visit www.ncipmc.org/traps for weekly updates during the growing season beginning in May. This site also has data for all other participating states with a link to each individual suction trap.

Although the current year-to-year trend in soybean aphid outbreaks appears strong, the interactions of factors responsible for these wide population swings are not well known. Predators, such as the multicolored Asian lady beetle and insidious flower bug, feed on aphids during the summer and eggs on buckthorn in the fall. This predation

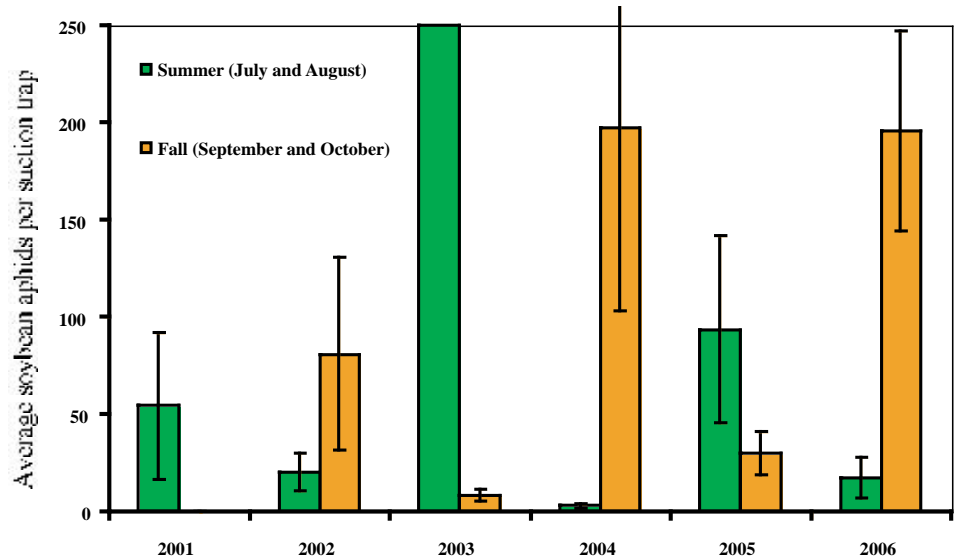


Figure 1. Winged soybean aphids captured from nine suction traps in Illinois during the summer and fall when the soybean aphid migrates back to buckthorn, its overwintering host. Note that during the summer of 2003, captures were 4,854 per trap, exceeding the range of the y-axis.

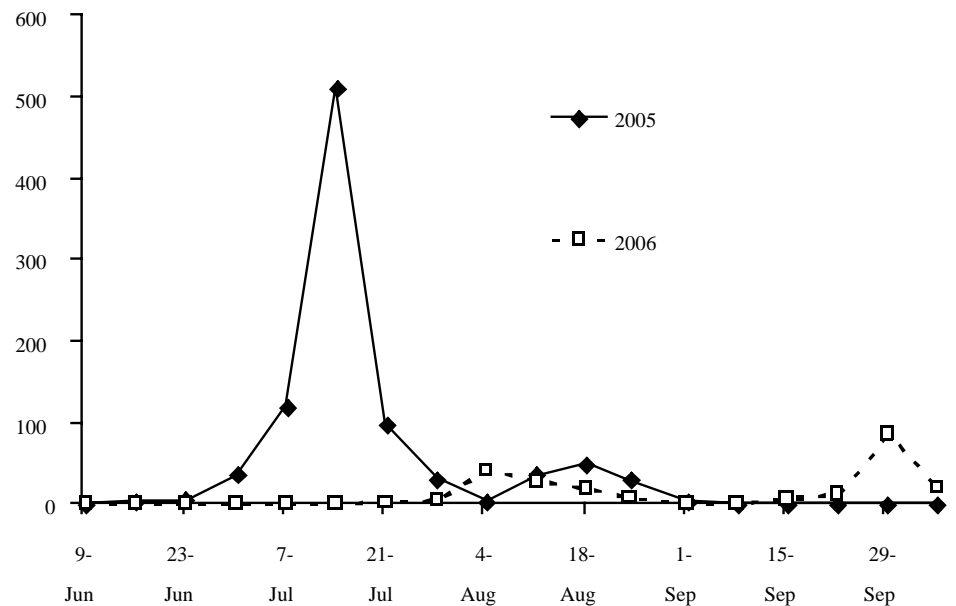


Figure 2. Seasonal abundance of winged soybean aphids collected in suction traps deployed in Iowa during 2005 and 2006. Note that in 2005, soybean plots near the suction traps reached their peak populations during August.

on eggs may significantly reduce the soybean aphid population the following spring and be partly responsible for the population cycles during the last four years. Furthermore, environmental conditions, such as strong rainstorms in early summer, can knock down populations

while long periods of dry weather during July and August can facilitate population growth. Thus, successful management of the soybean aphid requires timely scouting of populations within a given field.



One of four suction traps set up in Iowa in 2005 for soybean aphid sampling. The traps are approximately 20 feet tall to collect winged aphids that are migrating from buckthorn to soybean and back. At this size, the traps are unlikely to collect aphids that fly from one soybean plant to another. Traps will run from May through October during the 2007 growing season.

Take special note of winged aphids or “broad-shouldered” nymphs that are beginning to develop wings and are nearing the adult stage. If most of the aphids are winged or nearing this stage, they will leave the plant, or maybe the field, and an insecticide may not be needed because the population will rapidly decline. Check for parasitized aphids (called mummies). Do not spray the field if a majority of the aphids have turned to mummies.



Aphids attacked by a parasitic wasp larva transform into a “mummy” and die. The adult wasp then emerges through a circular hole chewed in the back end of the aphid. (Marlin E. Rice)



Large colonies of soybean aphids contain several thousand individuals per leaflet. (Marlin E. Rice)

Management Considerations

Do not use insecticides when small populations of soybean aphids are first found in the field. Such an approach can result in limited yield protection. Natural enemies can help suppress small aphid populations. Determine if the aphid population is increasing or decreasing. Conditions that favor an increase in soybean aphids are:

- potassium-deficient soils,
- cool temperatures,
- absence of beneficial insects, and
- plants under drought stress.

Economic Threshold

Two concepts are very important in integrated pest management for understanding pest and yield loss relationships. These are the economic injury level and the economic threshold. The economic injury level is the lowest population of insects that will cause economic damage, i.e., yield loss that equals the cost of control. In 2003, a preliminary economic injury level of 1,000 aphids per plant were reported based on research from the University of Minnesota. Since then, data from additional states, including Iowa, have refined both with the economic injury level at 654 aphids per plant during the R1–R5 growth stages for 30-inch-row soybeans.

The economic threshold is a similar concept, but it is the pest density at which management action should be taken to prevent an increasing pest population from reaching the economic injury level. Based on data from multiple states over several years, the suggested economic threshold is approximately 250 aphids per plant.

The economic threshold of 250 aphids per plant and increasing is the number that should be used to justify an insecticide application to a soybean field. This economic threshold incorporates a 5- to 7-day lead time before the aphid population would be expected to pass the economic injury level—and cause economic damage. Populations that average less than 250 aphids per plant should not be sprayed; there is little to no evidence that populations below 250 aphids result in yield loss.

Fields with small aphid populations should be scouted every 2–3 days to determine if they reach the economic threshold. Heavy rains and beneficial insects may reduce low or moderate populations. Insecticides are most likely the only option for control once the population reaches the economic threshold. Control aphid populations before the symptoms of heavy honeydew, sooty mold, and stunted plants appear in the field. An insecticide may still be of value after these conditions occur, but the optimum time for treatment has passed. The benefit of any insecticide application is reduced after soybeans reach the R5.5 growth stage.



Small colonies of soybean aphids often occur on the underside of leaves early in the season. The aphid colony on the left leaflet contains about 115 aphids. (Marlin E. Rice)



Plants heavily infested with soybean aphids can become stunted and dark from sooty mold. (Marlin E. Rice)

Scouting Recommendations

Scouting must be conducted to determine if aphid populations are reaching the economic threshold. Begin scouting for soybean aphids the middle of June, especially in northeastern Iowa. Check the upper two or three trifoliolate leaves and stem for aphids first. Aphids are most likely to concentrate in the plant terminal early in the growing season. Scout five locations per 20 acres. Also, look for ants or lady beetles on the soybean plant—they are good indicators of the presence of aphids. Lady beetles feed on aphids while ants tend the aphids and “milk” them for honeydew. Regular field scouting should occur weekly until plants reach the mid-seed stage (R5.5) or the field is sprayed.

When aphids are found, estimate the population size per plant. Count all the aphids on several leaves and plant terminal to establish what 100 or 250 aphids look like and then use this as a mental reference for gauging populations on other plants.

A quicker scouting method, called speed scouting, has been developed at the University of Minnesota. See Additional Information on page 16 regarding how to employ speed scouting—including a training video game. Speed scouting uses the number of infested plants (40 or more aphids per plant = an infested plant) as a guide for determining whether an insecticide application is justified. This is not a new threshold but rather a sampling tool that helps determine if the soybean aphid population within a field is above the 250 aphid per plant threshold.

In 2005, small plot trials were conducted at multiple locations in three states within the North Central Region of the United States (Iowa, Minnesota, and Wisconsin). Results indicated no significant yield difference when using speed scouting compared to whole-plant counts based on an economic threshold of 250 aphids per plant. In general, speed scouting made the same treatment decision as whole-plant counts 82 percent of the time; the remaining 18 percent were situations where whole plant counts indicated that the field did not require an insecticide application, but speed scouting suggested that an insecticide application was required. In our test in Iowa, speed scouting tends to be a more conservative sampling plan since



Soybean aphids are often associated with ants. The ants benefit from the relationship by feeding on the honeydew excreted by the aphids. It is thought that the aphids also benefit, as the ants may provide some protection from insect predators. The presence of ants may help in scouting for aphids, especially early in the growing season when aphid infestations have yet to reach large numbers. (Marlin E. Rice)

the decision to apply an insecticide often occurred before aphid densities exceeded the economic threshold. Regardless of sampling method, soybean aphid management should rely on multiple samples over time to assess population growth rates to avoid unnecessary foliar applications.

Insecticide Considerations

Insecticide timing. Insecticide applications made during the early soybean reproductive stages (R1–R4) have shown larger and more consistent yield protection than applications made later in the growing season. On-farm strip-trial data from several Midwestern states in 2003 indicate fields sprayed in early August had larger yield gains than fields sprayed in mid-August. For each day delay in spraying during 2003 after August 1, an average of 0.5–0.6 bushel was lost daily. Fields sprayed in late August and early September often showed no yield response to the insecticide

application because most of the aphid damage had occurred by this time. In contrast, in northeastern Iowa in 2002, aphid populations increased earlier in the season and some fields sprayed twice during mid- and late July benefited from both treatments in significant yield increases.

Insecticide application. Aphids can be effectively killed with either ground or aerial application; however, the following three elements of insecticide coverage are required for optimum control (98% kill or higher): increased application pressure, increased carrier (water) per acre, and small droplet size. Complete coverage of a soybean plant is essential for optimum aphid control, especially because soybean aphids feed on the underside of leaves and often in the upper third of the plant canopy. If coverage is poor or an insecticide does not give effective control, then the remaining aphids

will reproduce and the population may reach the economic threshold again.

Insecticide selection. Optimal soybean aphid control and yield protection depends both on product selection and timing of the application. A preferred insecticide would be one that provided the greatest efficacy (percent of killed aphids) with the most residual activity (extended control) and the least environmental impact (mortality of beneficial insects) at the least cost to the producer. There are no perfect insecticides, but there are performance traits that may help determine product selection.

Several insecticides are labeled for soybean aphid (or Chinese aphid on some labels). These are listed in Table 1. This is not a comprehensive list as additions may occur after printing. Read and follow all label directions, and take special note of the preharvest interval, which determines how many days must pass between the insecticide application and legal harvest.

Insecticide evaluation. In 2005, we selected several foliar insecticides for evaluation of their capacity to manage soybean aphids (Table 2), including insecticides applied directly to the seed. This experiment was planted on 22 May and foliar insecticides were applied on 2 August when aphids reached approximately 200 aphids per plant. In general, foliar-applied insecticides provided the best protection against soybean aphids (Figure 3) with little difference between insecticides of either the organophosphate or pyrethroid chemical classes. In terms of yield

protection, foliar-applied insecticides had the highest yields with no difference among the organophosphate or pyrethroid insecticides (Figure 4). There was limited yield protection from insecticide-treated soybean seeds that did not receive a foliar insecticide.

Our 2005 insecticide evaluations suggest that organophosphates and pyrethroids vary little in their ability to protect soybeans from soybean aphids. However, there may be conditions that favor one class over another.

- Warrior®, a pyrethroid insecticide, has provided consistent control among the pyrethroids in many university insecticide trials. Pyrethroid insecticide performance is enhanced during cool temperatures. Under dry conditions, growers are discouraged from using pyrethroids as these tend to flair spider mites.



Aerial application of insecticides is one approach to controlling soybean aphids. (Marlin E. Rice)

- Lorsban®, an organophosphate insecticide, exhibits a vapor action, especially during high temperatures. This can improve coverage in tall plant canopies or narrow-row or drilled soybeans. Although organophosphates have activity against adult spider, users should be aware that there is limited activity against spider mite eggs. Fields should be scouted after (3+ days) application to ensure sufficient spider mite control. As always, follow label guidelines for appropriate use.



Brian Lang, ISU Extension field agronomist, examines the differences in soybean plant height in late July 2001. The rows on the right were sprayed for soybean aphids, and the rows on the left were unsprayed. (Marlin E. Rice)

Table 1. Insecticides labeled for soybean aphids as of March 2007.

Product	Formulation	Active Ingredient	Chemical Class	Rate	PHI
Asana XL*	4 E	Esfenvalerate	Pyrethroid	5.8–9.6 fl oz/acre	21 days
Baythroid* ¹	4 E	Cyfluthrin	Pyrethroid	2.0–2.8 fl oz/acre	45 days
Baythroid XL*	L	Beta-Cyfluthrin	Pyrethroid	2.0–2.8 fl oz/acre	45 days
Capture 2 EC-CAL*	EC	Bifenthrin	Pyrethroid	2.1–6.4 fl oz/acre	3 days
Cheminova Acephate 90SP	SP	Acephate	Organophosphate	.83–1.1 lbs/acre	14 days
Cruiser ¹	5 FS	Thiamethoxam	Neonicotinoid	1.28 fl oz/100 lbs seed	seed appl.
Cruiser Maxx	5 FS	Thiamethoxam	Neonicotinoid	3 fl oz/100 lbs seed	seed appl.
Delta Gold*	1.5 EC	Deltamethrin	Pyrethroid	1.5–1.9 fl oz/acre	21 days
Dimate 4EC	EC	Dimethoate	Organophosphate	1 pt/acre	21 days
Dimethoate 4E*	4 E	Dimethoate	Organophosphate	1 pt/acre	21 days
Gaucho* ¹	WS	Imidacloprid	Neonicotinoid	2 fl oz/100 lbs seed	seed appl.
Lannate LV*	L	Methomyl	Carbamate	1/2–1 pt/acre	14 days
Lorsban* ¹	4 E	Chlorpyrifos	Organophosphate	1–2 pts/acre	28 days
Mustang*	1.5 EW	Zeta-Cypermethrin	Pyrethroid	3–4.3 fl oz/acre	21 days
Mustang MAX*	2 S	Zeta-Cypermethrin	Pyrethroid	2.8–4 fl oz/acre	21 days
Nufos 4E*	4 E	Chlorpyrifos	Organophosphate	1–2 pts/acre	28 days
Orthene 90 S	S	Acephate	Organophosphate	.83–1.1 lbs/acre	14 days
PennCap-M*	ME	Methyl Parathion	Organophosphate	1–3 pts/acre	20 days
Proaxis* ¹	0.5 E	Gamma-Cyhalothrin	Pyrethroid	1.92–3.20 fl oz/acre	30 days
Warrior* ¹		Lambda-Cyhalothrin	Pyrethroid	1.9–3.20 fl oz/acre	21 days
Yuma*	4 E	Chlorpyrifos	Organophosphate	1–2 pts/acre	28 days

*Restricted-use insecticide

¹Products were tested in replicated strip trials in Floyd County, Iowa, during 2005 (Figures 3 and 4).

Table 2. Insecticides tested in 2005 soybean aphid efficacy trials.

Product	Formulation	Active Ingredient	Chemical Class	Rate
Lorsban ¹ *	4 E	chlorpyrifos	organophosphate	16 fl oz/acre
Proaxis ¹	0.5 E	gamma-cyhalothrin	pyrethroid	3.2 fl oz/acre
Decis ¹	1.5 E	deltamethrin	pyrethroid	1.9 fl oz/acre
Lorsban + Baythroid ¹ *	4 E 2 E	chlorpyrifos + cyfluthrin	Tank-mix (see individual entries)	16 fl oz/acre 2 fl oz/acre
Warrior ¹ *	1 SC	lambda-cyhalothrin	pyrethroid	3.2 fl oz/acre
Baythroid ¹ *	2 E	cyfluthrin	pyrethroid	2.8 fl oz/acre
Fulfill ^{1,2}	50 WG	pymetrozine	NA	2.3 fl oz/acre
Trimax ^{1,2}	4 E	imidacloprid	nicotinoid	1.5 fl oz/acre
Cruiser ^{1,3}	5 FS	thiamethoxam	nicotinoid	100 g/100 Kg seed
Cruiser ^{1,3}	5 FS	thiamethoxam	nicotinoid	50 g/100 Kg seed
Gaucho ^{1,3}	480 F	imidacloprid	nicotinoid	62.5 g/100 Kg seed

*Restricted-use insecticide

¹Products were tested in a replicated strip trials in Floyd County, Iowa (Figures 3 and 4).

²Fulfill and Trimax are not labeled for use on soybeans in Iowa.

³Rate of seed treatments is given as grams product/kilogram seed (1 Kg = 2.4 lbs).

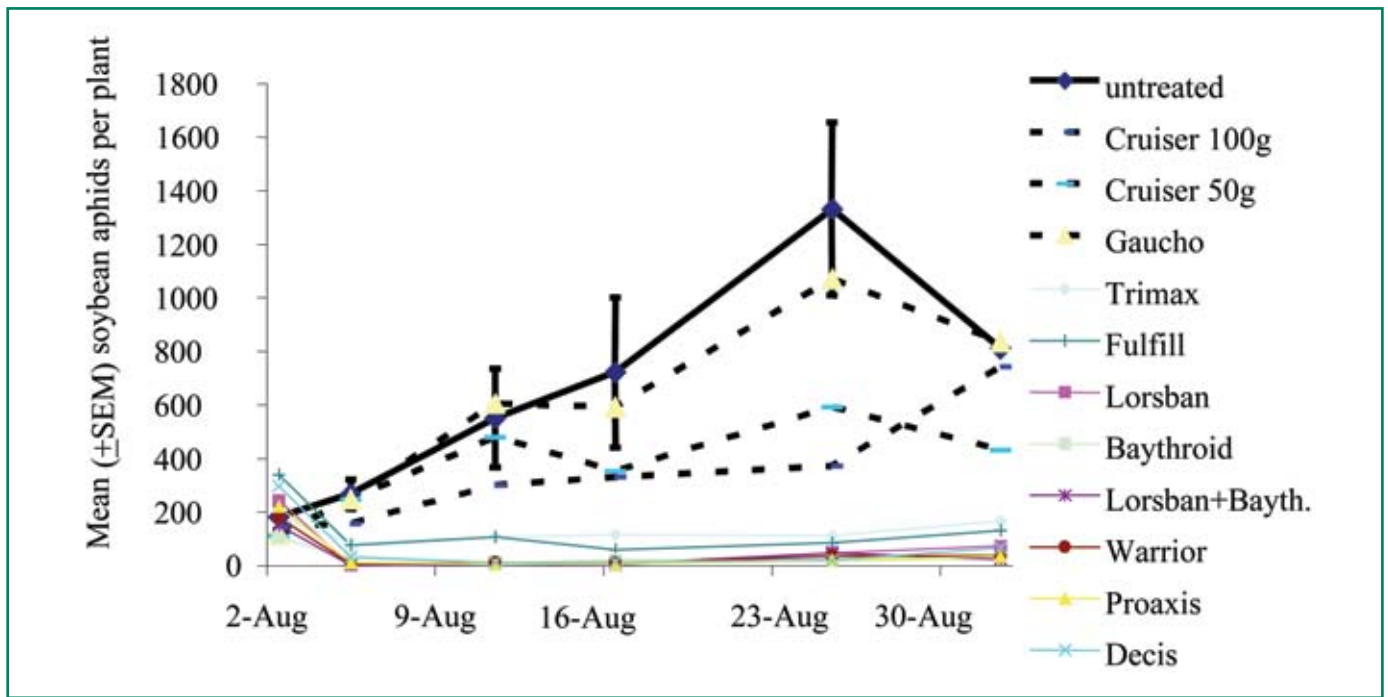


Figure 3. Impact of different insecticides on the soybean aphid populations. Soybeans were planted on 22 May and foliar insecticides were applied on 2 August. The untreated plots are denoted with a solid black line, seed treatments with dotted lines, and thin-colored lines are used for the eight foliar-applied insecticides.

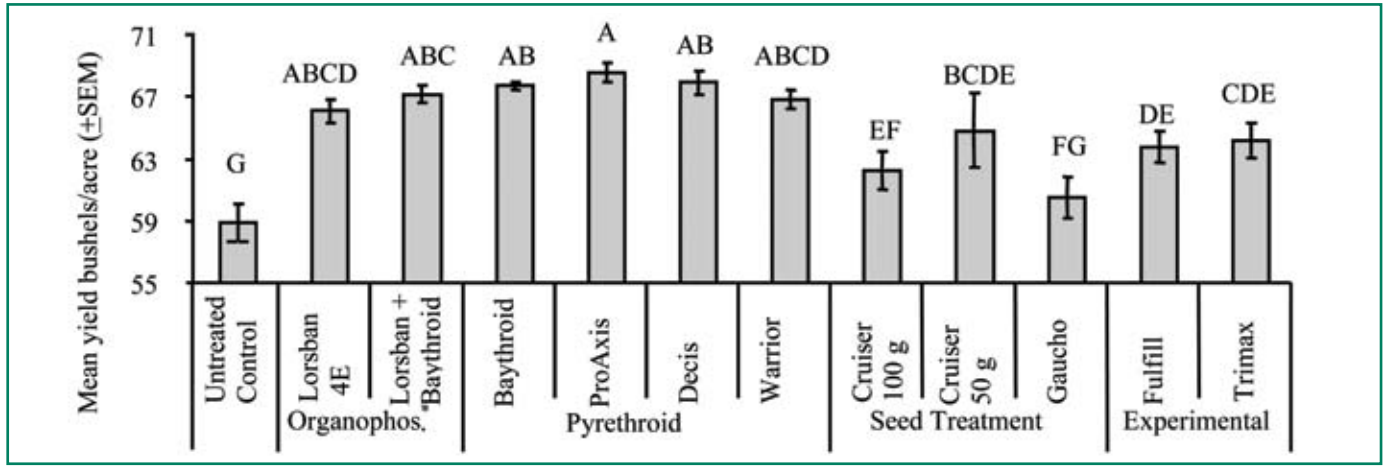


Figure 4. Impact of different insecticides grouped by mode of action on soybean yield. Foliar insecticides were applied on 2 August 2005. Means labeled with a unique letter were significantly different ($P = 0.05$).

*Lorsban + Baythroid is a tank mix consisting of an organophosphate (Lorsban) and a pyrethroid (Baythroid).

If an insecticide is sprayed, a small, unsprayed test strip left in the field will help to determine the real value and performance of the insecticide treatment. The soybean aphid appears to rebound from some insecticides and a high level (98%) of control is desired. High water volume, high pressure, and a nozzle that produces a small droplet size also have been suggested as ways to improve soybean aphid control, especially in fields with a dense plant canopy.

Seed treatments. Thiamethoxam (Cruiser®) and Imidicloprid (Gaucho®) are labeled for use in soybeans. These are commercially applied to the seed before planting and are both members of the neonicotinoid insecticide class. These insecticides are systemic, meaning that they are absorbed into the plants, and have a tendency to concentrate in the actively growing areas on the plant (new leaves and root tips). When soybean aphids feed on the plant, they ingest the insecticide.

Testing of these products across the Midwest has shown performance against soybean aphids in the early vegetative growth stages. However, both products have limited residual activity to protect older, reproductive stage plants (see Figures 1 and 2).

Tank mixing insecticides with herbicides. Tank mixing an aphid insecticide with a glyphosate application for weed control in glyphosate-resistant soybeans seems like a logical approach to reduce costs. However, it is impractical because of timing and application issues. The optimum time for controlling soybean aphids has been between mid- to late July and early August; the optimum time for glyphosate in soybean is when the weeds are less than 4 inches tall, which is most likely to be in June. Insecticides applied in June do not have residual activity long enough to significantly suppress later soybean aphids. Also, early-season insecticide applications may backlash by reducing the numbers of natural enemies that help suppress aphid populations.

The application of an insecticide/herbicide tank mix presents additional problems. Glyphosate is typically applied with decreased pressure and large droplet size to prevent drift problems. Research conducted at Iowa State University shows that under such conditions, the insecticide performance is decreased—more aphids remain on the plants than if they were sprayed with higher pressure, more water volume, and smaller droplets.

Given these concerns, we recommend growers avoid tank mixing an insecticide and herbicide for application during June.

Tank mixing insecticides with fungicides. The potential arrival of Asian soybean rust in Iowa has increased interest in fungicide applications to soybeans. The timing and application method of fungicides against soybean rust may overlap with the management of soybean aphids. Like insecticides, fungicides require complete plant coverage and are applied at high pressure and small droplet size. Currently, there are no known adverse interactions between fungicides labeled for use against soybean rust and insecticides labeled for soybean aphid. However, many fungicides are toxic to fungi that attack aphids and their use could lead to an increasing aphid population. Currently registered soybean fungicides (Bravo®, Bumper®, Folicur®, Headline®, Laredo®, Quadris®, Propimax®, Stratego®, and Tilt®) used in the laboratory have reduced the infectivity of fungi that kill aphids by 28 to 100 percent. Farmers who apply fungicides for soybean rust control should closely monitor aphid populations in their fields.



An early infestation of soybean aphids in northeast Iowa was documented on July 11, 2003. A check plot (left) with soybean aphid populations more than 2,500 per plant is shown next to an insecticide seed treated plot (right) with soybean aphid populations of about 100 per plant. (Palle Pedersen)

Preventive Tactics

In addition to insecticides, some preventive tactics may help reduce aphid problems. Early planting was thought to allow soybeans to escape or delay aphid population buildup and virus disease; however, results have been inconsistent. Additionally, early planting encourages bean leaf beetle colonization and subsequent bean pod mottle virus infection, so adjusting planting date should be considered carefully before implementation.

Planting seed of resistant plants also may be an option for future management programs. Although resistant plants have been identified for some commercial sources based on laboratory testing, these varieties have yet to be tested for aphid resistance in the field. However, several species of wild perennial soybeans highly resistant to both the soybean aphid and soybean mosaic virus have been found. The germplasm from these highly resistant accessions is being incorporated into ongoing soybean breeding programs and will play a more important role in future pest management efforts.

Prognosis for Iowa

The soybean aphid is firmly established as a pest of soybean in Iowa. After a brief seven years of experience with the pest and observing its damage potential, it would seem reasonable to expect economic damage to occur somewhere in Iowa every year. The damage is likely to be greater during years when drought and other stresses occur in soybeans. Preemptive field scouting and the timely application of control measures when the aphid population reaches the economic threshold are necessary steps to successfully manage the insect and prevent economic damage.



The insidious flower bug can be a major predator of soybean aphids in the Midwest. (Marlin E. Rice)



Flower fly larvae can help reduce pest populations by feeding on aphids. (Marlin E. Rice)



Additional Information

For more information on soybean aphids, consult the Web sites below or, in Iowa, contact Marlin Rice at 515-294-1101.

Additional information mentioned in this publication can be found at:

- Speed sampling for aphids
A copy of a speed sampling worksheet can be found at www.soybeans.umn.edu/crop/insects/aphid/aphid_sampling.htm
- A training exercise can be found at:
www.ent.iastate.edu/soybeanaphid/speedscouting
- Aphid estimator (a temperature-based estimate of population growth)
www.soybeans.umn.edu/crop/insects/aphid/aphid_sagemodel.htm
- Suction trap network (current and archived data from 2001)
www.ipm.uiuc.edu/fieldcrops/insects/soybean_aphids/suction_trap_network/index.html
- Pest Information Platform for Extension and Education (PIPE)
(soybean aphid national monitoring network)
www2.sbrusa.net/cgi-bin/sbr/public.cgi?pest=soybean_aphid

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