Overview

The soybean aphid (*Aphis glycines*) is the only aphid in North America able to develop large colonies on soybeans. It was first identified as a pest in North America in 2000. Since then, it has established itself as the most significant soybean pest in the north-central region.

Although infestation can be sporadic and unpredictable, this aphid has demonstrated the capacity to cause significant yield loss if not managed properly. When present in large numbers (several hundred per plant) their feeding can impact plant growth and cause stunting, leaf yellowing, reduced pod set, and reduced seed size and quality.

The risk of yield loss is greatest when aphid populations peak during the R1-to-R4 growth
stages. During these stages, blooms and young pods are most susceptible to stress. Damage from aphid feeding also increases when growing conditions are less than optimum.

Present and future tools to manage soybean aphids

Management of the soybean aphid is an active area of research in the north-central region.

Growers now have an extensive toolbox of strategies to work with, including

- **Well-established scouting procedures** and an economic threshold (ET) or action threshold of 250 *soybean aphids per plant* with *more than 80% of plants infested* and *aphid populations increasing*. The ET works well in R1 (beginning bloom) through R5 (beginning seed) soybeans. Spraying at or beyond R6 has not been documented to increase yield.
- **Host plant-resistant varieties** – host plant resistance is a complementary tool to manage soybean aphid. Aphid-resistant varieties have the potential to simultaneously reduce insecticide use and associated production costs, and also preserve natural enemies in soybean.
- **Biological control** – the soybean aphid would be a far more damaging pest were it not for natural enemies which provide biological control. Be aware of and preserve natural enemies such as lacewings and lady beetles that keep aphids in check.
- **Insecticides** – many effective foliar insecticide products are available for soybean aphid control. Insecticidal seed treatments are not likely to effectively manage soybean aphids.
- **IPM** – integrating aphid host resistance with monitoring soybean aphids and treating with foliar-applied insecticide only when the economic threshold was reached is the most effective strategy for aphid management.

Life Cycle

The soybean aphid has a complicated life cycle that is completed on two very different plant species: soybean and common buckthorn.

**Winter**
Soybean aphids overwinter as eggs on common buckthorn (*Rhamnus cathartica*). In the early spring, two wingless generations are produced on buckthorn, followed by a winged generation that flies in search of soybean.

Although winged aphids are not strong flyers, they can move long distances by gliding passively along jet streams. Spring migration usually occurs during soybean emergence. Soybean located near buckthorn stands is more likely to get colonized by spring migrants.
Summer
In the summer, the aphid population on soybean consists of females that give birth to live young females. These female nymphs mature in 5-7 days and begin producing their own young. Cycles of live births can result in 15 generations per season. Under favorable conditions, populations can double in just a few days.

Researchers at the University of Minnesota have determined that daily temperature is a good predictor as to how quickly aphid populations increase. Population growth will be fastest at temperatures between 75-80°F. Population growth will slow, stop, and may even decrease when temperatures are hot (greater than 90°F).

The female nymphs do not have wings, but can produce winged aphids when conditions become crowded. Winged aphids may stay in the same field, fly to nearby fields, or migrate longer distances up to 6 miles per day.

Late summer and fall flight
In late summer, aphids mature into winged females and migrate back to buckthorn. They mate with winged males and lay eggs. According to David Voigtlin at the Illinois Natural History Survey, the number of aphids at fall flight may be a good predictor of next year’s early population.

Scouting

The soybean aphid is the only aphid in North America that will develop large, persistent colonies on soybean. However, other common soybean arthropods may be confused with soybean aphid, so it is important to correctly identify soybean aphid to prevent unnecessary insecticide applications.

Reliable treatment decisions for soybean aphid start with field estimates of aphid densities obtained by counting the number of aphids per plant. Soybean fields should be scouted on a regular basis because soybean aphid populations can increase rapidly, particularly when winged aphids migrate within and between fields.

Early-season scouting (May through mid-July) should focus on fields that have histories of early colonization by soybean aphids, particularly early-planted fields and fields near buckthorn, *Rhamnus* sp., the overwintering host of soybean aphid.

More fields should be scouted as soybean aphid populations develop throughout the growing season and plants begin to enter reproductive stages. There may not be a need to visit every field every week, but enough fields should be checked to detect increasing aphid populations that require weekly sampling.
Take note of the presence of winged aphids and alatoid nymphs (with wing pads), high predator activity, and/or diseased aphids. These are all signs that the population may be in decline and/or may leave the field shortly. Scout these same fields again within a few days to note if populations are increasing or decreasing.

**Distribution**

Soybean aphid is native to eastern Asia where soybean was first domesticated. Its native range includes China, Indonesia, Japan, Korea, Malaysia, the Philippines, Taiwan, and Thailand. Soybean aphid is a sporadic pest in China but is not considered an economic problem throughout most of Asia.

The first soybean aphid colonies in North America were confirmed in North America during 2000. Soybean aphid expanded its range rapidly and is now found in most soybean growing areas of North America and Canada.

Aphid populations are known to be highly variable from field to field, and from year to year.

**Management**

**Scout once a week**

- Begin scouting in late June or early July, no later than the R1 (beginning bloom) soybean growth stage. Continue through pod fill.
- Check 20 to 30 plants per field, covering 80% of the field.
- Pay particular attention to late-planted fields, fields near buckthorn (*Rhamnus sp.*) or fields under moisture stress. Examine the entire plant, particularly the new growth at the top and side branches.

**Use an economic threshold (ET) of 250 aphids per plant if populations are actively increasing.**

- This economic threshold, also called the “action threshold” at which treatment is initiated, should be based on an average of 250 aphids per plant over 20-30 plants sampled throughout the field. It’s a good, robust threshold developed using multiple years of data from multiple states in the Midwest.
- Do not adjust the 250 threshold down. It was created in the presence of damage by
other insects, like Japanese and bean leaf beetles, so it doesn’t need to be adjusted for other pests. It was created with data taken during the biggest aphid outbreak years (2003, 2005), so it doesn’t have to be adjusted because it’s a “big aphid year.”

- The 250 threshold gives you five to seven days lead time to take action, or even to see populations drop from fungal infection or a heavy rain.
- Most critical, 250 is below the damage boundary – the lowest point where yield loss is detected. Experience shows that about 400 to 500 aphids per plant are needed before yield loss can even be detected by a yield monitor or in research trials. In the decade since the establishment of ET for soybean aphid, university-based research has continued to reconfirm the ET and the relationship between aphid populations and crop loss. Although crop and input prices have changed, no consistent economic gain can be found with a reduced ET for soybean aphid.
- The 250 threshold has worked well in R1 (beginning bloom) through R5 (beginning seed) soybeans. Spraying at or beyond R6 has not been documented to increase yield. Look at Soybean Development Stages and Soybean Aphid Thresholds (a pdf file) for good photo close-ups of growth stages at R1- R8 and soybean action thresholds, and A Visual Guide to Counting Aphids for aid in estimating aphid densities.

Regular field visits are required to determine if soybean aphid populations are increasing.

- To determine if an aphid population is actively increasing, check over several visits. Heavy rains, aphid fungal infections and active predators and parasites commonly reduce aphid populations.
- Conditions that favor aphid population growth are cool temperatures, plant stress, particularly drought stress.
- Check for mummies (parasitized aphids) and for winged females. Do not spray if mummies are numerous, or if a majority of the aphids are winged or developing wings, an indication that the aphids will soon leave the field.

Consider the insecticide choices for your situation.

- Pyrethroids (Warrior, Mustang Max, Asana, Baythroid) have a long residual, and work best at temperatures below 90°F. Organophosphate products (Lorsban) have a fuming action, and may work well in heavy canopies or at high temperatures.
- If you treat, hit the aphids hard and only once. Maximize coverage in pressure and gallons per acre. A proportion of the aphid population is already on the lowest leaves of the plant and those aphids are hard to reach unless coverage is good.
• Do not use half rates and or a concoction of multiple products. Tank mixes of insecticide, fungicide and/or herbicide are not generally recommended. Soybean aphid, disease and weed pests do not all appear at the same time at economically damaging levels so a single tank mix, while convenient, will not provide satisfactory control of all three pest types. Most important, sprayer specifications such as water volume, nozzle type (droplet size), and pressure must be optimized for each pest situation.
• Adding insecticide to early-season glyphosate application as “insurance” is not recommended.

Leave an unsprayed check strip
An unsprayed check strip will allow you to compare against sprayed areas to determine the performance of the insecticide and the value of the treatment.

Communicate treatment plans to beekeepers
Spraying at early reproductive stages poses a threat to bees. In areas with concern about honey bees, read insecticide labels carefully to determine risk to bees and take necessary precautions (for example, do not apply during hours in which bees are actively foraging).

These recommendations are the cooperative effort of researchers throughout the North Central states, funded with soybean checkoff dollars through the North Central Soybean Research Program and other state checkoff programs.

Biological Control

Aphids are slow-moving, succulent, and generally poorly protected from predators. Therefore, they have many natural enemies. The soybean aphid is only a sporadic pest in most of it’s native range in China, Japan, and Korea because of the presence of parasites and predators that keep them in check.

The soybean aphid would be a far more damaging pest were it not for naturally-occurring biological control. For example, in a recent study of 22 locations in the north central region, more than 50% of aphid-infested fields were kept below threshold level by predators.

Even though the soybean aphid is a recently-identified pest in North America, aphid predators and parasites are already present in soybean fields and have the ability to delay or prevent severe outbreaks.

Strategies to maximize biological control
Entomologists are working on a multi-pronged approach to maximize the impact of biological control in soybean fields, including:

- **Importation of specialist natural enemies** to augment resident natural enemy populations. This is called "classical biological control", in which the native range of an introduced pest is explored to identify natural enemies for importation into the United States. A major advantage of this form of biological control is that once it is established, it is free of charge to growers.
- **Implementing ways to maximizing the effectiveness of natural enemies already present**, by maintaining a favorable environment for beneficials and considering the abundance of natural enemies in treatment decision-making. Read more about conserving natural enemies»
- **Integrating biological control with other management strategies.** Treatment thresholds may need adjusting to account for the contribution of host resistance and beneficials.

**Resources**

**Biological Control of Insects and Mites: An introduction to beneficial natural enemies and their use in pest management**
*University of Wisconsin Cooperative Extension Publication A3842, 2018*

**Biology and Economics of Recommendations for Insecticide-Based Management of Soybean Aphid**
*Plant Health Progress, 2016*

**Biology of the soybean aphid, Aphis glycines, in the United States**
*Journal of Integrated Pest Management, 2011*

**Economic threshold for soybean aphid**
*Journal of Economic Entomology 100:1258-67, 2007*

**The Effectiveness of Neonicotinoid Seed Treatments in Soybean**
*Purdue University, 2016*
https://www.edustore.purdue.edu/item.asp?Item_Number=E-268-W#.VpAR51J7gxI

**Evidence for Soybean Aphid (Hemiptera: Aphididae) Resistance to Pyrethroid**
Insecticides in the Upper Midwestern United States
*Journal of Economic Entomology, 2017 (abstract)*

Host Plant Resistance for Soybean Aphid
*Erin Hodgeson, Iowa State University, 2014*
http://www.plantmanagementnetwork.org/edcenter/seminars/soybean/HostPlantResistance/

Management of Insecticide-resistant Soybean Aphids
*University of Minnesota Extension, Iowa State University Extension, North Dakota State University Extension, South Dakota State University Extension, 2018*

Management of Insecticide-resistant Soybean Aphids 2019

Management Recommendations for Soybean Aphid in the United States
*Journal of Integrated Pest Management, 2012*

Measuring the Benefit of Biological Control for Single Gene and Pyramided Host Plant Resistance for Aphis glycines Management
*Journal of Economic Entomology, 2012*

*Journal of Economic Entomology, 2014*

Scouting for Soybean Aphid
*University of Minnesota, 2015*

Scouting Soybean Aphids
*University of Wisconsin, 2013*
https://www.youtube.com/watch?v=gZTzbroDnws

Soybean Aphid
Update on Soybean Aphid Biological Control
Thelma Heidel-Baker, Iowa State University, 2014
http://www.plantmanagementnetwork.org/edcenter/seminars/soybean/BiologicalControl/

Soybean Aphid Field Guide, 2nd edition
North Central Soybean Research Program, Minnesota Soybean Promotion Board, and Iowa State University Extension, 2018
https://store.extension.iastate.edu/product/12817

Soybean Aphid Management Using Neonicotinoid-Treated Seed
Christian Krupke, Purdue University, 2014
http://www.plantmanagementnetwork.org/edcenter/seminars/soybean/NeonicotinoidTreatedSeed/

A Visual Guide to Counting Soybean Aphid
North Central Soybean Research Program, 2014

Visual Guide to the Number of Soybean Aphids per Leaflet
University of Wisconsin