PURDUE UNIVERSITY

PURDUE EXTENSION

E-217-W

Field Crops

Department of Entomology

SOYBEAN APHID

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In 2000, a new insect, the soybean aphid, *Aphis glycines* Matsumura, was discovered in soybean fields in many areas of the Midwest, including Indiana. Researchers do not know how, when, or where this exotic species entered the US, but since its discovery it has caused significant damage to Indiana soybean fields in 2001 and 2003. This publication summarizes what we know about soybean aphid biology and provides recommendations for scouting and making treatment decisions.

The soybean aphid (**Fig. 1**) is a small yellow aphid with distinct black cornicles, often known as "tailpipes" (**Fig. 2**). Without careful inspection (10X magnification), they can be confused with other small arthropods living on soybean, including spider mites, thrips, and leafhoppers (**Figs. 3a, b, c**). Soybean aphid is native to Asia, and its current distribution includes China, Korea, Japan, the Philippines, Thailand, Vietnam, Australia, and Eastern Russia. In July of 2000, researchers in Wisconsin discovered aphids feeding on soybean, the first report of this species in North America. By the end of the 2000 growing season, soybean aphid was confirmed in eight Midwestern states. In Indiana, the aphid was found in low numbers on soybean in every county surveyed. The soybean aphid's present distribution extends throughout the Midwest, much of the Great Plains' states, and east to the Atlantic coast (**Fig. 4**).

Fig. 1. Soybean aphid on soybean leaf, winged and non-winged forms shown

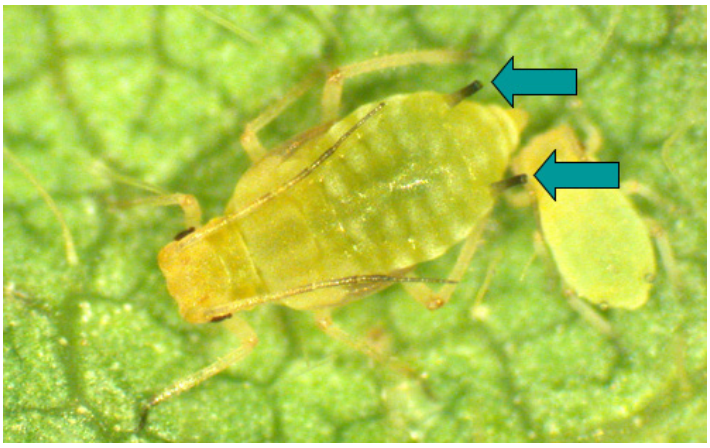

Fig. 2. Soybean aphid cornicles (*Photo Credit: Ho Jung Yoo, Purdue University*)

Damage and Symptoms

The soybean aphid feeds using needle-like, sucking mouthparts to remove plant sap (**Fig. 5**). Plant damage occurs as a consequence of large numbers of aphids removing significant amounts of water and nutrients from leaves and stems during feeding. This may cause leaf puckering, plant stunting, reduced pod and/or seed counts, and smaller seeds. Leaves on the bottom half of heavily infested plants can be covered with shed aphid skins resembling white powder (**Fig. 6**), and aphid honeydew, a sticky secretion produced by aphids when they feed, both of which are indications of aphid presence. Gray sooty mold, growing on the honeydew, also covers leaves giving the plants a charcoal color. Plants

Fig. 3a. Two spotted spider mites, b. soybean thrips, c. potato leafhopper nymphs

under stress from other factors (e.g., drought, late planting, disease, nutrient deficiency) during aphid colonization appear to promote rapid population growth and spread throughout fields.

Soybean Aphid Life Cycle

Soybean aphid has a very complicated life cycle (**Fig. 7**). In the US, as in Asia, it feeds and reproduces in the summer on soybean. The summer aphid population can be non-winged or winged (dispersal phase), but all are females. No males are present or needed for reproduction during this

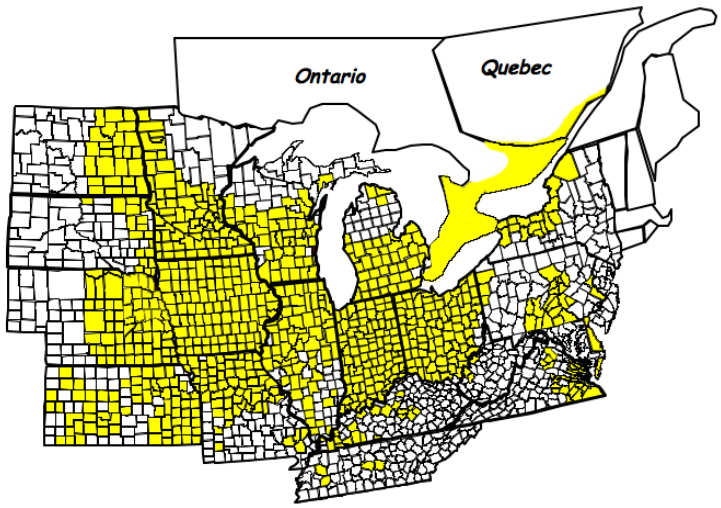

Fig. 4. Known soybean aphid distribution in the United States and Canada as of 2004

Fig. 5. Soybean aphid mouthparts

Fig. 6. Soybean aphids and shed skins

time period! The females reproduce parthenogenetically (egg development without fertilization). Females give birth to female offspring, so aphid numbers can increase dramatically on soybean in a short period of time.

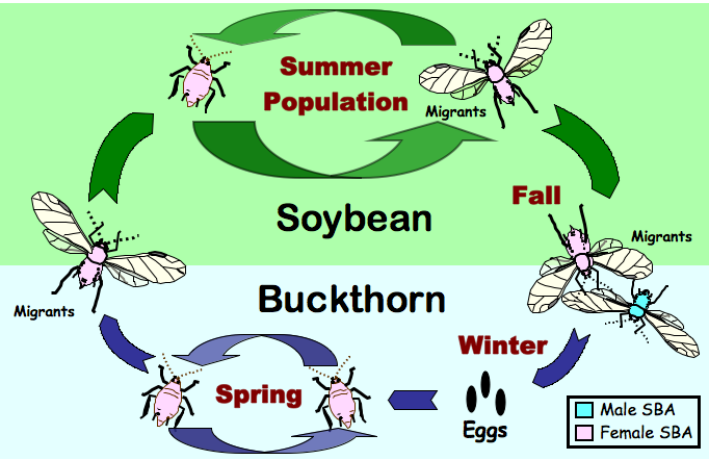

Fig. 7. Soybean aphid lifecycle

In the fall, as temperatures drop and daylight grows shorter, a generation of winged females and males are produced. Both migrate from soybean to their overwintering host plant Rhamnus, a shrubby tree also known as buckthorn (**Fig. 8**), where females mate and lay eggs. Eggs overwinter and hatch in the spring. Aphids emerging in the spring are females, which later produce winged offspring that migrate to soybean to establish new colonies. The abundance of buckthorn is much greater in the upper Midwest (north of Interstate 80) and this probably limits the spring and early summer populations in Indiana. By mid to late summer, if factors such as cooler temperatures favor aphid reproduction, local and migratory populations from areas of high density may quickly colonize and damage Indiana soybean. Winged migrating aphids may move long distances (across multiple states) "carried" by weather fronts.

Fig. 8. Overwintering host, buckthorn
(*Photo Credit: Missouri Botanical Garden*)

Scouting

Understanding aphid biology and soybean growth stages are critical to scouting fields on a timely basis. Migrating aphids from the upper Midwest may pose the greatest threat to Indiana's soybean crop. Being aware of high and damaging soybean aphid populations in the upper Midwest while monitoring weather patterns that may spread winged aphids is important. Purdue's weekly Pest&Crop newsletter, available for free download at <www.entm.purdue.edu/Entomology/ext/ext_newsletters.html> provides updates on soybean aphid and other pests in Indiana and throughout the Midwest.

Reproductive growth stages of the soybean are the most sensitive to stress and subsequent yield losses. At a minimum, fields should be scouted once weekly throughout flowering, pod-set/development, and seed-fill. In several random field locations, whole-plant aphid counts should be taken primarily from the undersides of leaves (**Fig. 9**). When aphids first colonize plants, they are most abundant in the newly formed leaves (**Fig. 10**), which are small and lighter green in color. As aphids multiply, they spread throughout the canopy. It has been estimated that by the time the aphids colonize the stems, the population has reached over 400 aphids per plant. Other important observations that should be recorded are soybean stress factors and the presence/absence of beneficial organisms.

Fig. 9. Soybean aphids on underside of leaf

Fig. 10. Newest soybean growth
(note lighter green color)

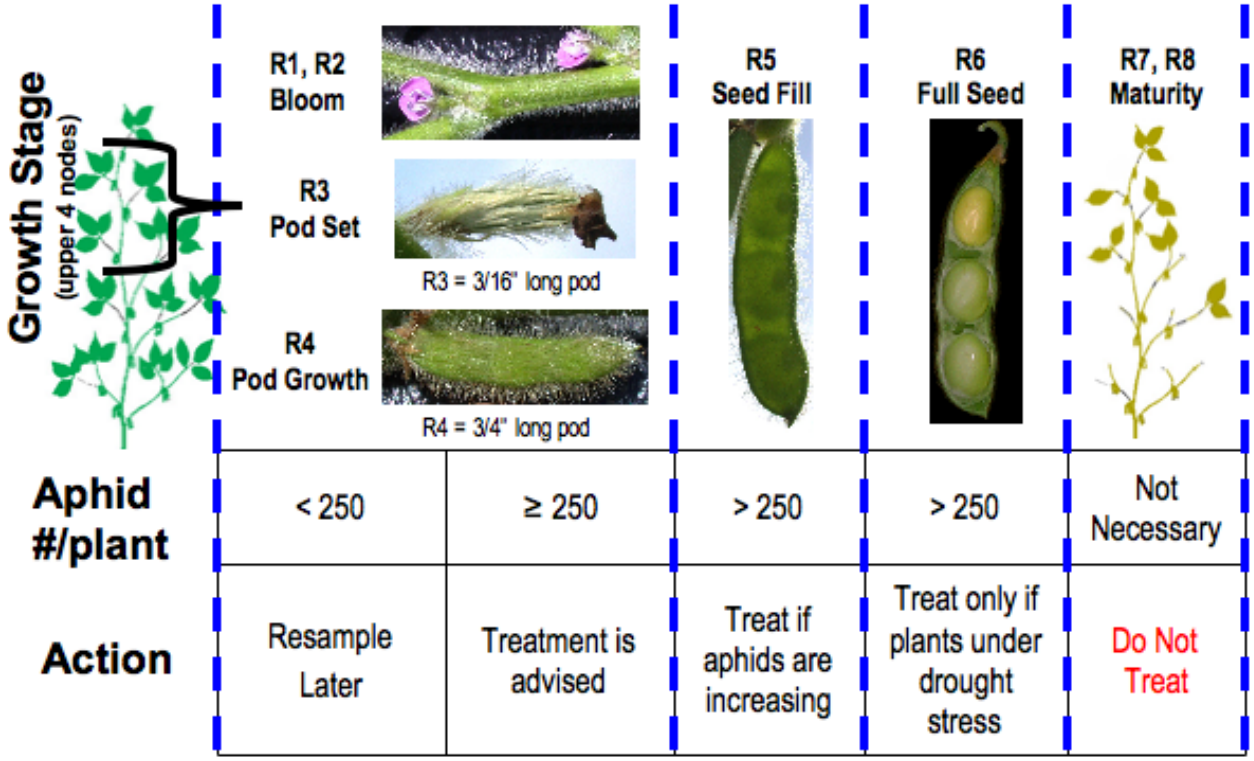

Fig. 11. Treatment threshold guide

Treatment Guidelines

Three variables must be assessed to determine if control of soybean aphid is necessary (**Fig. 11**):

1) aphids/plant,
2) soybean growth stage, and
3) soybean stress factors

Should you find an average of 250 or more aphids per plant during the early soybean reproductive stages (R1-R4), treatment is justified. During the pod-fill stages (R5-R6) aphid control has less impact on yield protection unless aphid numbers continue to increase and/or soybean fields are under drought stress. Do not treat soybean beyond the R6 stage of growth.

Natural Enemies

A striking feature of a soybean aphid infestation in soybean is the large number of beneficial organisms. Predatory insects (**Figs. 12 a, b, c, d**), especially lady beetles, pirate bugs, lacewings, and syrphid fly larvae become very abundant in most infested fields. Pirate bugs can also prevent or delay soybean aphid growth early in the season if colonization by soybean aphid remains low. However, once aphid levels reach over 100 per plant, predators may not be able to keep ahead of the aphid's reproductive capability. Fungal pathogens (**Fig. 13**) can infect and kill aphids when high temperature and humidity are present. All of these biocontrol agents have the potential to dramatically reduce aphid numbers to below economic levels, but this may not occur soon enough to prevent damage to soybean.

Fig. 12a. Asian ladybeetle and larva

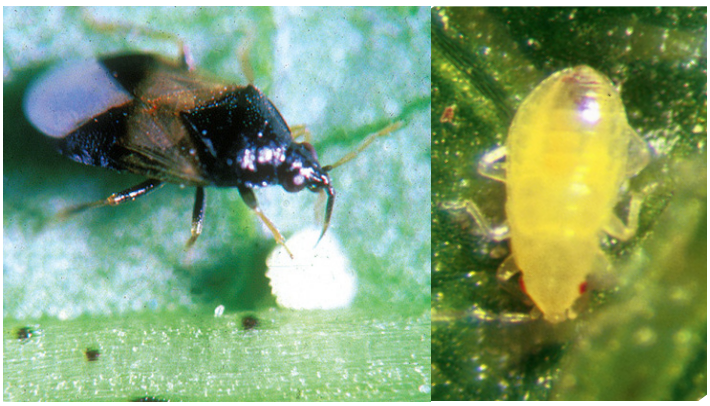

Fig. 12b. Pirate bug adult (*Photo credit: J.R. Ruberson*) and nymph

Fig. 12c. Lacewing larva

Fig. 12d. Syrphid fly larva *(see arrow)*

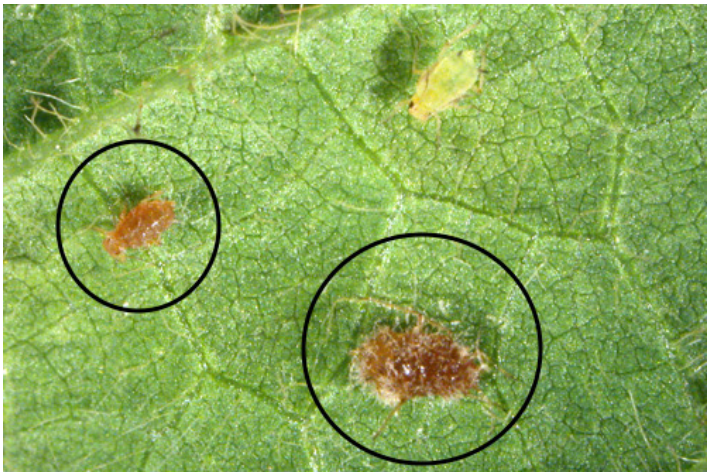

Fig. 13. Diseased aphids (circled) compared to healthy one

Soybean Aphid Control

Specific insecticide products labeled for soybean aphid control are listed in Extension Publication E-77, Soybean Insect Control Recommendations, which can be viewed and downloaded at <http://extension.entm.purdue.edu/publications/E-77.pdf>. University trials have shown that insecticides with organophosphate and synthetic pyrethroid chemistries have different control characteristics. In general, the organophosphates exhibit a faster kill of aphids, but shorter residual activity in the field, whereas synthetic pyrethroids are slower in reducing the population, but keep aphids in check longer.

Thorough coverage and canopy penetration is necessary when spraying soybean for aphids. For ground driven sprayers, this requires high carrier volume (20 gallons/acre or more) and nozzles producing a fine to medium droplet size in order to control aphids that are on the undersides of leaves and in the lower canopy. Research trials have shown that aerial application, if applied with at least 5 gallons of total spray volume per acre is satisfactory, though efficacy is generally less than with ground application.

Tank mixing insecticides for soybean aphid control with post-applied herbicides is not advisable. The optimum timing for controlling weeds and aphids will not likely be the same. Insecticide products will give at best two weeks of efficacy, so timing is critical. Timely post applied herbicides in early to mid summer will likely miss the aphid colonization period and negatively impact beneficial insects when they are building up populations. Waiting until aphids appear in mid to late summer to apply herbicides will result in poor weed control. In addition, spray application methods differ for post-applied herbicides and insecticides, the latter needing deep canopy penetration.

On the other hand, should a control be needed for a threatening fungal disease (e.g., Asian soybean rust) when soybean aphid reach treatable levels, tank mixing of insecticides and fungicides would be recommended. Both fungicides and insecticides require canopy coverage and penetration with higher sprayer volume and finer particle size. Be sure, however, to determine if the fungicide and insecticides are compatible.

Insecticide seed treatments for soybean are available. These are from a newer class of insecticides called nicotinoids. These insecticides are translocated throughout the growing seedlings to protect the above and below ground portions of the plant from chewing and sucking insects. Laboratory and field trials have shown protection from soybean aphid up to one month from the date of planting with these. Unfortunately, by mid summer when aphid populations are expected to build in Indiana, the efficacy of these insecticides are gone.

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