Welcome to the Soybean Aphid pages at www.soybeans.umn.edu, accessed from the archived webpages at https://web.archive.org/web/20021002022447/http:/www.soybeans.umn.edu/crop/insects/aphid/aphid.htm

The soybean aphid (Aphis glycines) is an eastern Asian soybean pest that is rapidly invading the United States. A recent immigrant, it was first detected in nine midwestern states including Minnesotain the summer of 2000. The soybean aphid now occurs from Minnesota east to New York and south to Missouri and Kentucky. Significant aphid damage and soybean crop losses in 2000 were reported from Wisconsin, Illinois, and Michigan. In the summer of 2001, severe infestations were reported throughout southeastern Minnesota.

Biology
(Archived webpage):
https://web.archive.org/web/20021015234550/http://www.soybeans.umn.edu:80/crop/insects/aphid/aphid_biology.htm

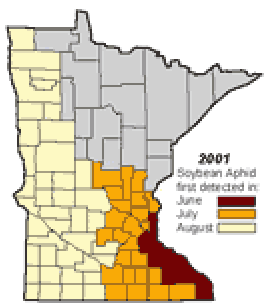
The soybean aphids life cycle is complicated, but typical of most aphids. The aphid splits its life cycle between a primary (or overwintering) host, a woody shrub called buckthorn, and its dominant summer host, soybeans.

Only females, which bear live young without sexual reproduction, are present in the summer. The wingless form (apterae) predominates. Overcrowding or reduction in soybean quality triggers production of the winged form (alates). Alates disperse to deposit live nymphs on other soybean plants within the field or in other fields. Females grow quickly and are capable of bearing their own young within 7 days; up to 15 generations per season can occur on soy-beans. Populations may double in as little as 2- 3 days. In the fall, winged males and females are produced that seek out buckthorn, where sexual reproduction occurs. Eggs overwinter on the buckthorn and hatch in the spring. Three generations are produced on newly expanding buckthorn leaves before the aphids migrate back to young soybeans.

Current & Historical Distribution
(Archived webpage):
https://web.archive.org/web/20021002070728/http://www.soybeans.umn.edu:80/crop/insects/aphid/aphid_distribution.htm

Spread of soybean aphid in Minnesota
R.C. Venette

Soybean aphid spread rapidly across Minnesota during the 2001 growing season. The map below depicts results of formal samples collected by the Minnesota Department of Agriculture or the University of Minnesota (counties without samples are shaded gray). Populations of the aphid were first detected in Houston county (in the far southeastern corner of the state) in mid-June. By the end of June, aphids were found in six more southeastern counties. In July, aphids spread into 23 south-central counties, and by the end of August soybean aphids were observed in an another 40 western counties. At the end of the growing season, soybean aphids were probably present in all major and minor soybean producing areas of the state.



Spread of Soybean Aphid in Minnesota

Mouse over map for larger Image

We estimate that soybean aphid spread across Minnesota at an average rate of 3.1-6.3 miles per day. However, this rate was not constant throughout the year. At times, the rate of spread was considerably slower or much faster than the average. From 12 June to approximately 26 June, the area affected by soybean aphid increased at a slow to moderate rate (from 0 to 5 miles per day). From 27 June to 3 July, aphids spread rapidly (approximately 8 miles per day). From 4 July to 31 July, aphids again spread at a slow to moderate rate (0 to 4 miles per day). However, from 1 August to 7 August, the rate of spread increased to slightly more than 6 miles per day. From 8 August through the end of the growing season, aphid spread continued at a moderate to slow pace.

We believe the fits and starts in aphid spread correspond with distinct changes in aphid populations. In late June and early July, alate (winged) soybean aphids left their overwintering host, buckthorn (Rhamnus spp), and began to colonize soybean. During this time, aphid movement between soybean fields was probably limited. In mid July, populations within fields continued to grow through the production of apterous (wingless) offspring with little to no movement of aphids between soybean fields. In late July and early August, as aphids became increasingly crowded on plants, alate aphids were produced and began to fly . A sample collected on 25 July indicated that approximately 80% of the aphids on a plant were alatoid nymphs that would be capable of flight in 2 - 3 days. A final flight is expected in September as aphids return to buckthorn to overwinter.

Current U.S. Distribution - During the 2000 growing season, soybean aphid (*Aphis glycines*) was first detected in the Upper Midwest. Aphids were reported on soybean from Wisconsin, Michigan, Minnesota, Illinois, Iowa, Missouri, Indiana, Ohio, and Kentucky.

In the 2001 growing season, soybean aphid has been detected already in Minnesota, Wisconsin, Iowa, Illinois, Michigan, Indiana, Kentucky, Ohio, and New York. Several more states are actively surveying fields for the aphid. The map below indicates counties where the aphid has been detected.

2001 Map of Counties (updated 2-15-02)

[map unavailable]

This map was generated with information provided by North Dakota State University, University of Minnesota, Minnesota Department of Agriculture, Iowa Department of Agriculture and Land Stewardship, Iowa State University, University of Missouri-Columbia, University of Wisconsin, Wisconsin Department of Agriculture, Trade, and Consumer Protection, University of Illinois, Purdue, Kentucky State University, Michigan State University, Ohio State University, Pennsylvania Department of Agriculture, Cornell, the North Central Pest Management Center, and the National Agricultural Pest Information System.

More detailed information on the distribution of the aphid throughout the US is available from: North Central-Integrated Pest Management. Results of surveys for soybean aphid in Minnesota are provided in updates from the Minnesota Department of Agriculture.

Historical Distribution - Despite claims to the contrary in the popular press, *the origin of soybean aphids in the US is not known*. Although China has been implicated as the source country, the aphid is common in soybean producing regions throughout Southeast Asia, eastern China, Russia, and northeastern Siberia (i.e., the Russian Far East). During the 1999-2000 growing season, the aphid was also detected for the first time in eastern Australia.

Historical Distribution Map

Scouting and Surveys
(Archived webpage):
https://web.archive.org/web/20021002172048/http://www.soybeans.umn.edu:80/crop/insects/aphid/aphid_scouting.htm

Scouting fields for soybean aphid based on the presence of plant damage or symptoms is not reliable. In severe infestations, soybean aphid may cause leaves to curl, trifoliates to yellow, and plants to become stunted. Unfortunately, such symptoms are also indicative of damage caused by soybean cyst nematode, nutrient deficiency, certain diseases, or moisture stress. Soybean aphid may also be present in a field without causing any symptoms, particularly early in an infestation.

Ladybeetles (Coccinelids) and ants are more useful indicators of the presence of soybean aphids. Ladybeetles are predators of soybean aphid and appear to be efficient at locating rare individuals. Although plants without ladybeetles may have aphids, soybean plants with ladybeetles are likely to have aphids. Ants obtain honeydew, a high sucrose solution, by tending the aphids. In exchange, ants may protect aphids from predators.

To characterize an infestation in a field, two measures are particularly useful: prevalence and severity. Prevalence describes the percentage of plants with at least one aphid. Severity describes the average number of aphids on an infested plant. Prevalence is best characterized by examining a large number of randomly-collected plants from a field and counting the number of aphids on each plant.

The University of Minnesota developed a survey protocol to detect small populations of soybean aphid and estimate the prevalence and severity of aphid infestations. The protocol suggests that an individual should collect 30 plants at random from a field (from at least 10 different locations). The entire plant is examined for the presence of aphids, beginning with the newest growth. If aphids are detected, a rating is provided to characterize the total number of aphids on a plant. More details about the survey and a data sheet are available on this pdf: Multi State Soybean Aphid Survey. This survey protocol is the standard procedure used by members of NC-502, a regional group of researchers organized to study soybean aphid.

If you detect soybean aphids in a field, contact your local extension agent.

Loss Assessment / Damage
(Archived webpage):
https://web.archive.org/web/20021002082856/http://www.soybeans.umn.edu:80/crop/insects/aphid/aphid_loss.htm

In Asia, soybean aphid is a significant pest where it damages plants both directly and indirectly (virus transmission). Seedlings seem particularly vulnerable. Feeding by soybean aphid on young plants (2-leaf stage) was reported to reduce yields by 2.7-51.8% depending on pest density. In addition, soybean aphid is a vector of several viruses, including soybean mosaic virus, which raises concerns about seed certification. More immediately, aphid feeding may reduce protein content in soybeans and further restrict access to foreign markets.

Potential Economic Impact: Average yield in the 10 North Central states in 1998 (last year data are available from the American Soybean Association SoyStats) was 43.5 bu/acre on a land base of 50 million acres. Using an average price of $5/bushel and using a 20% yield reduction (a reasonable estimate for this insect) would equate to an annual loss of 435 million bushels or $2.2 billion in the North Central Region alone. Fortunately, infestations detected in the US during the summer of 2000 did not cause anywhere near this level of damage although a 13% yield reduction was measured in replicated field plots in Wisconsin.

In the immediate future, we are equally concerned that overreaction to the presence of the aphid may unnecessarily increase production costs through insecticide application. Experience with other aphids on different crops indicates that aphid numbers must be relatively high before insecticide application is economically justified. We cannot estimate this level without detailed field studies.

Management
(Archived webpage):
https://web.archive.org/web/20020607030540/http://www.soybeans.umn.edu:80/crop/insects/aphid/aphid_management.htm

There are more questions than answers about soybean aphid management. We have not identified production factors that minimize the risk of aphid infestations. Aphid impacts on soybean yield, quality, and disease incidence in Minnesota are unknown. Yield losses probably reflect the cumulative effect of aphid numbers over time and soybean stage. No stage-specific thresholds have been developed for row or drilled soybeans, but several hundred aphids per plant during reproductive stages are likely to damage soybeans. Neither the short- nor long-term impacts of insecticide application have been studied in the U.S. As a result, farmers and their agricultural advisors will find it difficult to decide whether or not to spray, especially with low soybean prices. If you decide to apply an insecticide, record pre-treatment infestation levels, leave check strips, and check yields so you can learn from the situation.

What are my insecticide options?

The following insecticides are labeled for foliar application to soybeans. Three that specifically list Chinese aphids are Furadan 4F, Lorsban 4E, and Warrior T. Neither effectiveness nor economic benefit of these products has been studied. Carefully note re-entry and pre-harvest intervals listed below. Control may be more difficult when aphids are under leaflets, canopy is closed, and aphids have shifted to mid-canopy leaves and pods during reproductive stages. Ground application with high water volume (20 gallons per acre) is strongly recommended.

Warning: Insecticides may disrupt natural control of soybean aphids by predators and parasitic wasps, leading to aphid resurgence

Insecticide	Rate per acre	REI [1]	PHI [2]
Ambush 2E*	6.4 - 12.8 oz	12 hrs.	60 days
Arctic 3.2E*	4.0 8.0 oz	12 hrs.	60 days
Asana XL*	5.8 - 9.6 oz	12 hrs	21 days
dimethoate	(see labels)	48 hrs.	21 days
Furadan 4F*	0.50 pt	48 hrs.	21 days
Lannate*	0.75-1.5 pt	48 hrs.	14 days
Lorsban 4E*	1.0 - 2.0 pt	24 hrs.	28 days
Penncap-M*	2.0 - 3.0 pt	4 days	20 days
Pounce 3.2EC*	4.0 - 8.0 oz	12 hrs.	60 days
Warrior T*	3.2 - 3.84 oz	24 hrs.	45 days

* Restricted-use insecticide

[1] Restricted Entry Interval. Entry into treated field within this interval requires protective clothing and gear specified on label.
[2] Pre-harvest Interval. Do not apply insecticide during this period.

Insecticide Trial for Soybean Aphid,
Aphis glycines Matsumura, 2 August 2001
(Archived webpage):
https://web.archive.org/web/20021002071826/http://www.soybeans.umn.edu:80/crop/insects/aphid/aphid_insecticide_trial.htm

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Summary of Results

Nearly all registered products tested gave satisfactory control of the soybean aphid (Table 1). Two compounds, Pounce and Dimethoate, significantly underperformed other products and provided only 85 to near 90% control of the soybean aphid. In general, 95% control or above is needed to prevent resurgence of the aphid population following treatment. As with all aphid control, better results are achieved with high pressure and high volume. Here we used 42 psi and 30 gallons of spray solution per acre. An added advantage of our plots was the lack of a closed soybean canopy that allowed for good penetration of insecticide into the lower canopy. All products gave equivalent control of soybean aphids whether in the top or lower canopy (Tables 2 and 3).

We tested all products at the highest labeled rate. It is our opinion that those products that gave near 100% control could be used at the lowest labeled rate and still achieve satisfactory control (>95%). The key to good aphid control is less dependant upon rate than on using adequate spray volume (at least 20 gallons per acre) and high pressure (40-80 psi).

Description of Plot

Plants were in the R2 stage and were planted on the 10th of June (late planting) in 30 inch rows at the Rosemount Agricultural Research and Outreach Center, Rosemount, Minnesota. Plots were four rows, 25 feet long with three replications. Treatments were applied late afternoon on 2 August 2001 under calm, sunny conditions. Fulfill was applied the following morning because a non-ionic surfactant recommended for use with this product was not available on 2 August. Plots were sprayed with a tractor mounted CO2 powered sprayer using flat fan nozzels (TeeJet 11003) spaced every 15" and adjusted so that 100% overlap occurred six inches below the canopy. Spray volume was 30 gal/acre using 42 psi. Pre treatment aphid counts averaged ca. 200 per plant. Aphids were mostly found in the top 3 leaflets of the plant (61%). Plots were evaluated on 6 August 2001, 4 days after treatment (3 DAT for Fulfill) by counting the total number of aphids on each of ten plants per plot segregating counts into aphids in the top three nodes and the remaining nodes (average of 10 nodes per plant). Data were analyzed using SAS with data transformed to normalize mean and variance. Data reported are untransformed and represent the average number of aphids per plant. All products were tested at the maximum labeled rate.

Experimental compounds are indicated with an asterisk. Pretreatment aphid counts on 2 August averaged 162.6 per plant. Aphids in the control increased 2.4 fold four days following treatment.

Table 1. Mean number of aphids per plant, four days following treatment.

Treatment / Formulation	Rate (ounces of product per acre)	Mean Aphids per Plant	Mean Separation [1]	Percent Control
Untreated control		393.2	A----	---
Dimethoate 4 EC	16 (1 pint)	58.2	-B--	85.1
Pounce 3.2 EC	8.0 (1/2 pint)	40.1	-B--	89.8
Fulfill *[2] 50 WG	2.75	13.3	-BC-	96.6
Asana 0.66 EC	9.6	3.7	--CD	99.1
Warrior T 1EC	3.2	2.0	----D	99.5
Provado * 1.6F	3.75	1.6	----D	99.6
Actara * 25 WG	3.0	1.2	----D	99.7
Leverage * 2.7 L	3.75	1.1	----D	99.7
Furadan 4F	8.0 (1/2 pint)	0.03	----D	99.9
Penncap-M 2FM	48 (3 pints)	0.03	----D	99.9
Lorsban 4EC	32 (2 pints)	0.00	----D	100

1 Means followed by the same letter are not significantly different using the Ryan-Einot-Gabriel-Welsch Multiple Range Test.
2 Fulfill was applied on 3 August so counts represent 3 days after treatment

Table 2. Mean number of aphids per plant in the top three internodes, four days following treatment.

Treatment / Formulation	Rate (ounces of product per acre)	Mean Aphids per Plant	Mean Separation [1]	Percent Control
Untreated control		239.3	A----	---
Dimethoate 4 EC	16 (1 pint)	45.5	-B--	81.0
Pounce 3.2 EC	8.0 (1/2 pint)	12.4	--C-	94.8
Fulfill *[2] 50 WG	2.75	10.1	--C-	95.8
Asana 0.66 EC	9.6	2.2	----D	99.1
Warrior T 1EC	3.0	0.8	----D	99.7
Provado * 1.6F	3.2	0.8	----D	99.7
Actara * 25 WG	3.75	0.2	----D	99.9
Leverage * 2.7 L	3.75	0.1	----D	99.9
Lorsban 4EC	32 (2 pints)	0.03	----D	99.9
Penncap-M 2FM	48 (3 pints)	0.03	----D	99.9
Furadan 4F	8.0 (1/2 pint)	0.00	----D	100

1 Means followed by the same letter are not significantly different using the Ryan-Einot-Gabriel-Welsch Multiple Range Test.
2 Fulfill was applied on 3 August so counts represent 3 days after treatment

Table 3. Mean number of aphids per plant in the bottom 6-9 internodes, four days following treatment.

Treatment / Formulation	Rate (ounces of	Mean Aphids	Mean Separation [1]	Percent Control

	product per acre)	per Plant		
Untreated control		152.8	A----	---
Pounce 3.2 EC	8.0 (1/2 pint)	27.7	-B--	81.9
Dimethoate 4 EC	16 (1 pint)	12.7	-BC-	91.6
Fulfill *[2] 50 WG	2.75	3.2	--CD	97.9
Asana 0.66 EC	9.6	1.5	--CD	99.0
Provado * 1.6F	3.75	1.3	--CD	99.1
Warrior T 1EC	3.2	1.2	--CD	99.2
Leverage * 2.7 L	3.75	1.0	----D	99.3
Actara * 25 WG	3.0	0.4	----D	99.7
Furadan 4F	8.0 (1/2 pint)	0.03	----D	99.9
Penncap-M 2FM	48 (3 pints)	0.0	----D	100
Lorsban 4EC	32 (2 pints)	0.0	----D	100

1 Means followed by the same letter are not significantly different using the Ryan-Einot-Gabriel-Welsch Multiple Range Test.
2 Fulfill was applied on 3 August so counts represent 3 days after treatment

Research Objectives in Minnesota
(Archived webpage):
https://web.archive.org/web/20021002123314/http://www.soybeans.umn.edu:80/crop/insects/aphid/aphid_objectives.htm

(Provided by Erin Hodgson)

Although many questions remain unanswered about this new pest, our team wanted to focus on several spatial aspects and possible site-specific pest management solutions. Our project wanted to determine the within-field spatial distribution of soybean aphid in commercial fields using GPS (Global Positioning Systems) and GIS (Geographic Information Systems) technologies over a growing season. Soybean fields in Houston County, MN, were scouted to determine possible sampling sites. Two fields, 15 acres each, were systematically designed in a regularly spaced point pattern. Ten plants were randomly selected near each point (80 points per field) and assessed for soybean aphid and predator incidence, soybean aphid density, and number of alates and mummies. Both fields will be sampled every 7 – 10 days until soybean aphids migrate to overwintering hosts. Sample points were located using a differentially corrected AshTechâ BRG2 GPS unit, and soybean aphid populations will be mapped in ArcViewâ, a GIS program.

Our second objective was to evaluate the impact of row spacing and time-of-infestation on soybean yields and aphid density, distribution, and dispersal. We designed 36 plots (25' x 20') for three artificial infestations using two row spacings. A completely randomized design with four replications using eight 7" row plots, eight 30" row plots and eight 30" row control plots in combination with early (beginning of vegetative growth), middle (beginning of flowering) and late (beginning of pod fill) infestations. Each plot was infested by randomly clipping 60 soybean plants with 1 – 50 soybean aphids/plant directly to the plot plants (Fig. X). Soybean yield, aphid density and movement over a growing season, disease and leaf area index will be measured.

Before treatment options are considered, we believe it is imperative to carefully assess the risks soybean aphid poses to individual localities throughout the region. Fundamentally, a risk assessment for soybean aphid predicts the likelihood of the aphid being present at a density that would cause economic losses. The scale of the assessment can vary from individual fields to counties, states, or regions. Critical questions include: where can soybean aphid overwinter and become established; when does it move from overwintering sites to soybean; how will current and future production practices affect the dynamics of the pest; and what sampling strategies are needed to confirm the presence of the pest and contribute to integrated pest management (IPM) decisions? Answers to these questions will allow us to focus early-season monitoring activities, design region-wide monitoring networks, identify areas where outbreaks of the pest are most likely, and implement IPM tactics.

2001 Field Observations
(Archived webpage):
https://web.archive.org/web/20021002171142/http://www.soybeans.umn.edu:80/crop/insects/aphid/aphid_observations.htm

In accordance with a regional sampling protocol, six counties in southeastern Minnesota had been surveyed as of June 2001 and identified as having soybean aphid. Soybean aphid occurred on soybean plants in early growth stages (V1 - V3). These preliminary surveys reveal no consistent pattern of soybean preference (row spacing, date of planting, plant variety, soil type), but fields with the aphid always seemed to be adjacent to wooded areas. Wooded areas included several species of buckthorn (*Rhamnus spp*.), the suspected overwintering host of soybean aphid. Fields surveyed on 12 June averaged soybean aphid on 10 – 15% of the plants (V1 average). Samples taken with a vacuum (Stihl BG 55) did not accurately reflect soybean aphid populations and is not recommended for a field survey. After a heavy rainfall in Minnesota, fields were re-surveyed 15 June and the populations had dropped to 1 – 2% of plants infested. This indicates rainfall may cause a significant reduction of soybean aphid populations, especially when first migrating to early vegetative soybean.

Soybean aphid reduces yields:
Harvest results from insecticide strip trials
(Archived webpage):
https://web.archive.org/web/20021002191151/http://www.soybeans.umn.edu:80/crop/insects/aphid/studyresults.htm

Soybean aphid appeared in almost all soybean producing areas of Minnesota. In response, several growers and their agronomic advisors conducted on-farm strip trials to evaluate the benefits of insecticide application on aphid populations and soybean yields. Agronomists, ag chemical dealers, DSMs and seed dealers have generously agreed to share their results with us.

These data are intended to provide a preliminary indication of the impact of soybean aphid on soybean production. However, because information from aphid-free checks is not available, the true impact of soybean aphid is likely to be greater than what we have presented here. This information should not be used to evaluate the efficacy of insecticides. Because of limited knowledge about soybean aphid, growers, crop advisors, and university researchers were forced to make "seat-of-the-pants" decisions about whether to spray. In some cases, these decisions may have come too early or too late.

The following map and table provide simple comparisons of treated and untreated strips of soybeans. Simply click on a number to see a table that provides the planting date, insecticide used, application date, and yields (bu/A) for treated and check strips in that area. Unless noted otherwise, treated strips received one insecticide application.

Trial	Planting Date	Insecticide	Application Date	Yield-Treated (bu/A)	Yield-Check (bu/A)	Yield Difference (bu/A)
1	5/15/01	Lorsban	8/11/01	50.9	50.7	0.2
2	5/15/01	Warrior	8/7/01	45.6	40.5	5.1
3	5/16/01	Lorsban	7/26/01	27.1	14.6	12.5
4	5/10/01	Baythroid	7/30/01	47.1	31.0	16.1
5	5/16/01	Lorsban	8/6/01	57.5	58.4	-0.9
6	5/14/01	Lorsban	7/27/01	39.7	27.0	12.6
7	5/13/01	Dimethoate	7/25/2001	42.9	45.4	-2.6
8	5/18/01	Warrior	7/27/2001	43.7	39.5	4.3
9	6/10/01	Warrior	7/24/2001	37.2	34.7	2.5
10	5/18/2001	Lorsban	7/27/2001	50.6	42.6	8.1

11	5/19/2001	Warrior	7/12/2001	54.4	48.5	5.9
12	5/20/2001	Warrior T	7/10/2001	0.0	0.0	0.0
13	5/14/2001	Warrior T	8/2/2001	52.1	45.5	6.6
14	5/16/2001	Lorsban 4E	8/8/2001	52.0	47.9	4.1
15	6/30/2001	Dimethoate	8/8/2001	33.0	26.5	6.5
16	5/29/2001	Warrior T	7/27/2001	36.5	22.7	13.8
17	6/8/2001	Warrior T	8/14/2001	50.9	46.0	4.9
18	1/0/1900	Warrior T	8/2/2001	56.2	39.7	16.5
19	5/30/2001	Warrior T	8/2/2001	46.6	38.2	8.4
20	5/20/2001	Warrior T	8/20/2001	43.1	46.0	-2.9
21	1/0/1900	Warrior T	8/3/2001	51.2	48.6	2.6
22	5/19/2001	Warrior T	8/6/2001	41.3	32.3	9.0
23	5/19/2001	Warrior T	8/6/2001	51.7	45.3	6.4
24	5/11/2001	Warrior T	8/3/2001	57.3	48.6	8.7

Last Updated on 11/7/2001

If you choose to use this information, please cite the source as: Ostlie, K. (Editor). 2001. Soybean aphid reduces yields: Harvest results from insecticide strip trials. University of Minnesota, St. Paul. http://www.soybeans.umn.edu/crop/insects/aphid/studyresults.htm