Economic Impact of Soybean Aphids on Yields and Optimal Insecticide Timing Effectiveness

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Soybean Aphid

- Originated in Asia
- Yield losses exceeding 50%
  (X.B. Wang et al. 1994 - China)

- Found in WI in 2000
- High populations

Soybean Aphid Damage

- Feed on plant sap.
- Initially feed on the youngest trifoliates.
- Aggregate on undersides of leaves and stems.
- Move down the plant as the season progresses.

- Leaf yellowing, cupping.
- Can be confused w/herbicide or virus.
- Reduced canopy and stand height.
- Important disease vector.

A problem for growers in the Midwest?

Preliminary yield loss estimates from 2000 showed a yield loss of 6-8 bushels per acre in WI. (Arlington, WI - D.B. Hogg and J.L. Wedberg 2000).

Objective #1

Quantify the economic impact of the Soybean aphid on soybeans grown in Wisconsin.

Develop a working threshold that will allow soybean producers to assess aphid populations and make intelligent decisions regarding control measures.

Objective #2

Determine the optimal timing for a single spray application of a broad spectrum insecticide applied to soybeans to control aphids.

Methods

- Small plot experiments were set up in two locations
  (Arlington, WI and Rock County, WI)

- Early (May 9) and late (June 11) planting at Arlington and early planting only (May 9) at Rock County.

The middle rows of all plots were harvested.

Economic Threshold Study

- Increasing rates of insecticides were applied to
  5 treatments to provide differential control of aphid populations.

Treatments:

Multiple spray – “aphid free” Warrior (?-cyhalothrin) 0.030 or Lorsban (chlorpyrifos) 0.50 lbs aia

High rate – Warrior (?-cyhalothrin) 0.030 lbs aia

Med rate – Warrior (?-cyhalothrin) 0.025 lbs aia

Low rate – Warrior (?-cyhalothrin) 0.015 lbs aia

Unsprayed check

Sampling Method

- Samples were 20 plants per plot

- Rating System 1-7 Scale:

1 = 0 Aphids / Plant
2 = 1-10 Aphids / Plant
3 = 11-25 Aphids / Plant
4 = 26-50 Aphids / Plant
5 = 51-100 Aphids / Plant
6 =101-200 Aphids / Plant
7 = > 200 / Plant

Threshold Study
Sampling Results: Rock Co. Early Planting

Treatment	Spray Dates	Rating 7/13 R1	Rating 7/27 R3	Rating 8/10 R4	Rating 8/20 R5
Check	-	2.18 AB	2.61 A	3.23 AB	1.66 A
Low Rate	7/26	2.35 A	1.94 B	3.11 B	1.77 A
Med Rate	7/26	2.30 AB	1.79 BC	3.25 A	1.87 A
High Rate	7/26	1.88 B	1.53 C	3.18 AB	1.65 A
Multiple Spray	6/11, 6/28, 7/6, 7/12, 7/16, 7/26, 8/9	1.02 C	1.14 D	0.64 C	0.61 B

Threshold Study
Sampling Results: Arlington Early Planting

Treatment	Spray Dates	Rating 7/11 R1	Rating 7/25 R3	Rating 8/1 R4	Rating 8/16 R6
Check	-	3.15 A	3.38 A	2.92 A	6.52 A
Low Rate	7/26	3.22 A	3.67 A	2.15 B	6.67 A
Med Rate	7/26	3.38 A	3.25 A	1.66 C	6.55 A
High Rate	7/26	3.74 A	3.43 A	1.48 C	3.30 B
Multiple Spray	6/11, 6/28, 7/6, 7/12, 7/16, 7/26, 8/9	1.01 B	2.23 B	1.38 C	1.78 C

Threshold Study
Sampling Results: Arlington Late Planting

Treatment	Spray Dates	Rating 7/11 V4-R1	Rating 7/25 R2	Rating 8/1 R5	Rating 8/16 R6
Check	-	1.57 AB	5.53 AB	5.04 A	6.98 A
Low Rate	7/26	1.65 A	6.91 A	3.34 B	6.98 A
Med Rate	7/26	1.59 AB	7.00 A	3.00 B	6.97 A
High Rate	7/26	1.71 A	6.89 A	2.33 BC	4.37 B
Multiple Spray	6/11, 6/28, 7/6, 7/12, 7/16, 7/26, 8/9	1.29 B	5.17 B	1.63 C	2.08 C

Results:
Threshold Study Yields

Treatment	Arlington (Early Plant)	Arlington (Late Plant)	Rock Co. (Early Plant)
Multiple Spray	62.4 AB	55.9 A	75.5 A
High Rate Spray	60.3 ABC	52.6 AB	75.9 A
Medium Rate Spray	57.9 BC	49.8 BC	75.5 A
Low Rate Spray	63.3 A	48.1 C	75.7 A
Unsprayed Check	56.5 C	47.2 C	75.3 A
LSD a=0.05	4.83	4.10	4.87

Relating Aphid Counts to Yield Loss

- **Rock County: Aphid sample ratings peaked at 3.25 in on 8 Aug**
  No significant yield differences.

- **Early Planted experiment at Arlington: High aphid populations at the end of the growing season.**
- **Yield losses up to ~ 6 bushels per acre (Mult. Spray vs Unsprayed).**

- **Late Planted experiment at Arlington: Highest aphid populations.**
- **Multiple spray and High Rate treatments provided the best control of aphid numbers and showed the highest yields.**
  Yield losses up to ~ 9 bushels per acre (Mult. Spray vs Unsprayed).

Insecticide Spray Timing Study

- Insecticide sprays were applied at different times throughout the growing season based on plant stage.
- Aphid numbers were sampled and yields were compared among the treatments.

Treatments:

Multiple spray – “aphid free” Warrior (?-cyhalothrin) 0.030 or Lorsban (chlorpyrifos) 0.50 lbs aia

Spray V0-V1 Stage – Lorsban (chlorpyrifos) 0.50 lbs aia

Spray V2-V3 Stage – Lorsban (chlorpyrifos) 0.50 lbs aia

Spray R1-R2 Stage – Lorsban (chlorpyrifos) 0.50 lbs aia

Spray R3-R4 Stage – Lorsban (chlorpyrifos) 0.50 lbs aia

Unsprayed check

Spray Timing Study
Sampling Results: Rock Co. Early Planting

Treatment	Spray Dates	Rating 7/13	Rating 7/27	Rating 8/10	Rating 8/20
Check	-	1.99 A	2.23 A	3.25 A	1.11 A
Spray V0-V1	6/26	1.93 A	2.38 A	2.16 AB	0.91 A
Spray V2-V3	7/6	1.83 A	2.31 A	2.66 A	1.00 A
Spray R1-R2	7/10	1.10 B	2.29 A	2.55 A	1.06 A
Spray R3-R4	8/9	1.80 A	2.49 A	2.00 AB	0.81 A
Multiple Spray	6/26, 7/6, 7/10, 7/16, 7/26, 7/31, 8/9	1.16 B	1.35 B	1.05 B	0.64 A

Spray Timing Study
Sampling Results: Arlington Early Planting

Treatment	Spray Dates	Rating 7/11	Rating 7/25	Rating 8/8	Rating 8/17
Check	-	2.59 A	2.69 A	6.98 A	6.83 A
Spray V0-V1	6/11	2.60 A	3.04 A	6.96 A	6.44 A
Spray V2-V3	7/6	1.73 A	2.90 A	6.98 A	6.29 A
Spray R1-R2	7/12	1.86 A	2.91 A	6.95 A	4.70 A
Spray R3-R4	8/9	2.28 A	2.90 A	6.99 A	5.70 A
Multiple Spray	6/11, 6/26, 7/6, 7/12, 7/16, 7/26, 8/9	1.44 A	2.59 A	5.50 B	5.45 A

Spray Timing Study
Sampling Results: Arlington Late Planting

Treatment	Spray Dates	Rating 7/11	Rating 7/25	Rating 8/8	Rating 8/16
Check	-	1.35 ABC	6.71 A	6.95 A	5.25 A
Spray V0-V1	6/11	1.50 A	6.66 A	7.00 A	5.25 A
Spray V2-V3	7/6	1.25 BC	6.75 A	7.00 A	5.25 A
Spray R1-R2	7/12	1.48 AB	6.69 A	6.00 B	2.63 AB
Spray R3-R4	8/9	1.36 ABC	6.68 A	6.94 A	5.05 A
Multiple Spray	6/11, 6/26, 7/6, 7/12, 7/16, 7/26, 8/9	1.23 C	5.01 B	5.70 C	2.23 B

Results:
Spray Timing Study Yields

Treatment	Arlington (Early Plant)	Arlington (Late Plant)	Rock Co. (Early Plant)
Multiple Spray	65.2 A	54.3 A	76.3 A
Spray V0-V1	57.6 B	47.7 AB	74.9 A
Spray V2-V3	53.5 B	42.8 BC	76.9 A
Spray R1-R2	53.5 B	53.0 A *	74.0 A
Spray R3-R4	57.1 B	45.5 B	75.9 A
Unsprayed Check	57.0 B	37.0 C	76.3 A
LSD a=0.05	6.60	7.56	6.64

Summary

- Soybean aphid yield losses vary with location and date of planting.

- Early spray applications or sprays on low levels of aphid populations do not effect yield loss.

Summary Cont.

- Determining when and if to treat will require monitoring the aphid population. Aphid infestations will not always result in yield losses.

- Considering a spray application cost of $15 per acre and a soybean value of $5 / bushel then any yield loss resulting from aphid infestation that exceeds 3 bushels per acre would warrant an insecticide application.

- Our preliminary results indicate that if the majority of the plants are infested with 200+ aphids at the beginning of the population peak (late July) a spray treatment is worthwhile.

Conclusions

- Early season aphid numbers do not accurately reflect yield loss potential.
- Late planted fields seem to have the highest aphid populations and greatest damage.
- Control measures are often warranted.
- Insecticide applications need to be carefully timed to effectively prevent yield loss.
- Better sampling methods and continued study will help more us more accurately assess aphid damage.

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