WISCONSIN RESEARCH ON SOYBEAN APHID THRESHOLDS

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Introduction

Widespread infestation of soybeans with soybean aphid across Wisconsin continues to be a major problem for soybean producers in the state. In 2001 we began a research project to examine the economic impact this insect poses to the soybean crop in terms of direct yield losses. The 2003 growing season marked the third year of this study. The overall goal of this study is to examine the impact of the soybean aphid on soybean yield and to determine the level of infestation at which a foliar insecticide application is economically justified. Development of an economic threshold along with sampling criteria will allow soybean producers to make informed decisions regarding the importance of aphid damage and optimal use of control methods.

Methods

Small plot field experiments were established at the University of Wisconsin Agricultural Ag Research Station near Arlington, WI. Experiments were conducted in both early (early May) and late (early June) planted soybeans. The soybean variety DSR215RR and NKS19-T9 were used in the early and late planted experiments respectively, and both experiments were planted in 30-inch rows at a seeding rate of 133,000 plants per acre. Treatments were established by applying increasing rates of insecticide to provide a gradient of aphid populations that would allow the relationship between aphid populations and yield losses to be established. The five treatments used were: (1) a multiple spray treatment which was sprayed on 7-10 day intervals after the first aphid populations were detected in the experiment. Alternating foliar applications of Warrior (?-cyhalothrin [0.030 lbs aia]) and Lorsban (chlorpyrifos [0.50 lbs aia]) were used in this treatment to avoid any potential localized insecticide resistance problems with the aphid population. Additional treatments consisted of (2) a high (0.030 lbs aia), (3) medium (0.020 lbs aia) and low (4) rate (0.015 lbs aia) of Warrior, and (5) an unsprayed check treatment. Insecticides were applied to treatments 2-4 treatments as aphid populations began to reach peak numbers (late July – early August).

Individual plots were sampled for aphids on a weekly basis beginning in late June after aphids were first observed in the field. Ten plants from the middle rows of each plot were sampled and the number of individual aphids per plant was recorded from each plant.

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The center two rows of each plot were harvested using a two-row combine and yields were adjusted to 13% moisture. Comparisons among the six treatments were made using Fisher's least significant difference (LSD) procedure (SAS 1999). Differences among treatment means were considered significant at the $P<0.05$ level.

Results and Discussion

Soybean aphids were first detected at the Arlington Research Station in the early planted experiments in mid to late June. Initial populations generally occurred at very low numbers on plants scattered throughout the field. Weekly sampling data showed that early aphid populations increased at a slow rate from the end of June to the middle part of July. In 2001 and 2003, aphid populations increased rapidly during the late part of July and early part of August. Exponential increases in aphid density were most prominent in the late planted experiments. During the 2002 growing season, rapid increases in aphid populations did not occur in either the early or late planted experiments. In 2002, only a slight increase in aphid population growth occurred at the end of July and continued into the first part of August. Overall numbers per plant did not approach those observed in 2001 and 2003. The late planted experiments in all three years showed overall higher numbers of aphids per plant. This likely results from late-planted soybeans providing more nutritious foliage to the developing aphids.

Overall differences in the spray applications were minimal among the three rates applied. Low rates did, however, appear to be less effective in controlling aphids over the length of the growing season. During the 2001 growing season aphid numbers were able to quickly rebound from spray applications in as little as one week. This may be partly due to the small plot size used in this experiment as nearby untreated plots could provide a source for aphids to recolonize the sprayed areas. During the 2002 and 2003 growing season rebounds in aphid populations after insecticide application were not observed.

The sampling protocol in 2001 made it difficult to accurately assess the upper limit in aphid numbers. Populations peaked above 1000 aphids per plant in both the early and late planted experiments, thought the late planted experiment exhibited higher numbers of aphids at an earlier growth stage. Insecticide applications were made during late July (7/26). Yield losses between the unsprayed check treatment and the single (high rate) Warrior application were 3.8 and 5.4 bushels per acre in the early and late planted experiments respectively.

In 2002, spray applications were made at aphid levels below 100 per plant in the early planted experiment on 8/6. The untreated check treatment peaked at ~200 aphids per plant. No significant difference in soybean yield was observed among any of the sprayed treatments and the untreated check. Spray applications were made in the late planted experiment in 2002 when aphid populations were ~150 aphids/plant. The untreated check treatment peaked at 350 aphids per plant. Similarly to the early planted experiment no significant differences in were observed when yields were compared among the treatments.

Insecticide applications were made in the early planted experiment in 2003 at aphid levels ~500 per plant on 7/29. The untreated check treatment exhibited a peak of 700+ aphids plant. Yield results showed no significant difference in yields among any of the treatments. The late planted experiment was also sprayed at 500-700 aphids per plant. In this experiment aphid numbers in the untreated check peaked at ~1000 / plant. Yield losses between the single high rate spray and the untreated check measured 6.4 bushels per acre.

Aphid populations varied substantially during the three years that this study was conducted. Aphid populations were high enough to result in significant yield losses in 2001 and 2003, however low levels during 2002 did not impact soybean yields.

The results from this study indicate that the soybean aphid is capable of causing significant yield losses, however it appears that the degree of damage will vary both among locations, planting dates, and year. Fields planted later in the growing season have consistently shown higher populations of aphids at an earlier growth stage than the early planted fields. Early establishment of the aphids on young soybean plants appears to be crucial in their ability to build up large populations that result in yield losses. While large numbers can still occur later in the growing season these populations may not accurately reflect plant damage equivalent to the early season populations. For this reason careful consideration must be taken before early planted soybeans are treated with insecticides to avoid the cost of an unnecessary application.

Based on the data from this study it appears that insecticide applications should be made when only when aphid populations exceed 500 aphids per plant during the late flowering to early pod stages. Insecticide applications made on soybeans with fewer than 500 aphids per plant may not be economically beneficial, as yield losses may not result. Additionally, proper timing of insecticide applications should also be considered