Public-Private Partnership to Evaluate Aphid-Resistant Soybeans

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Jessica Hohenstein, post doc
Matthew O'Neal, professor
Department of Entomology
Molly Ryan, Corteva™ Agriscience

Introduction

The soybean aphid (*Aphis glycines* Hemiptera: Aphididae) is the most economically important insect pest of soybean in the North Central United States. An aphid outbreak can reduce yield by 40 percent. Foliar insecticides are the most widely used management strategy to protect against yield loss from soybean aphids, but recent resistance to insecticides has been reported. Using varieties with native aphid resistance genes (*Rag*) also is an effective strategy to suppress aphids and can replace insecticides. Additionally, a pyramid of two *Rag* genes offers more protection against aphids than a single *Rag* gene. Despite their effectiveness, *Rag* varieties are not widely used by soybean producers, partly because of their limited commercial availability. This project partnered with Corteva™ Agriscience to evaluate elite soybeans with and without aphid resistance as a means to combat soybean aphid outbreaks.

Materials and Methods

The effects of host plant resistance on aphid population and yield was evaluated. Four Corteva™ varieties (relative maturity 2.6, main plot) were tested in a split-plot randomized complete block design with four replicate blocks. Varieties included a *Rag1+Rag2* variety and its susceptible isoline (*rag1+rag2*) as well as a *Rag1+Rag3* variety and its susceptible isoline (*rag1+rag3*). All varieties were glyphosate-tolerant. A split-plot insecticide treatment was included to estimate yield loss from aphids and to determine if resistant varieties could offer a similar level of aphid suppression and yield protection. Seeds were planted in 30-in. rows at 140,000 seeds/acre June 4. Split plots were 6 rows x 40 ft long. Aphids were scouted at least twice monthly from July through September. When aphid populations reached the economic threshold (250 aphids/plant) August 16, split plots were sprayed with Warrior II. The number of aphids/plant was converted to cumulative aphid days (CAD) to estimate the seasonal exposure of plants to aphids. Soybean seeds were harvested October 26. Seed yield was estimated and compared among all treatments.

Results and Discussion

Seasonal aphid exposure. Aphid populations exceeded the economic threshold in 2019 (Figure 1). Soybean variety ($F_{3,21} = 44.06$; $P < 0.0001$) had a significant effect on aphid populations. Without using insecticides, the resistant varieties had significantly fewer CAD than the susceptible varieties (*Rag1+Rag2* isolines: $t = 3.81$; $df = 21$; $P = 0.0010$; *Rag1+Rag3* isolines: $t = 5.49$; $df = 21$; $P = 0.0004$) (Figure 2A) indicating effective aphid control. The two resistant lines controlled aphids similarly, as they did not significantly differ in CAD. Insecticide treatment had a significant effect on CAD ($F_{1,21} = 26.35$; $P < 0.0001$). Overall, plots without insecticides had more aphids than insecticide-treated plots. There was no significant interaction between varieties and insecticide treatments ($F_{3,21} = 1.23$; $P = 0.3230$), suggesting insecticidal treatment affected aphid populations similarly across varieties. Resistant varieties offered similar or better aphid suppression as an insecticide treatment.

Yield. Seed yield was not significantly affected by any treatment (variety: $F_{3,21}$ = 2.43, P =0.09; insecticide: $F_{1,21}$ = 0.56, P = 0.46) (Figure 2B). The aphid-resistant variety *Rag1+Rag2* had the highest seed yield with 70.69 bushels/acre followed by its susceptible isoline (*rag1+rag2*) at 67.63 bushels/acre. The *Rag1+Rag3* variety yielded 66.74 bushels/acre, followed by its susceptible isoline (*rag1+rag3*) with 63.23 bushels/acre. Although large aphid populations were present in 2019, these populations likely did not reach levels expected to cause yield loss until later in the season (i.e. after R5). In Iowa, there is little evidence that foliar insecticides provide yield protection from aphids past mid-seed set (R5.5).

The results suggest the soybean lines developed by Corteva™ Agriscience with native resistance to the soybean aphid provide season-long protection.

Acknowledgements

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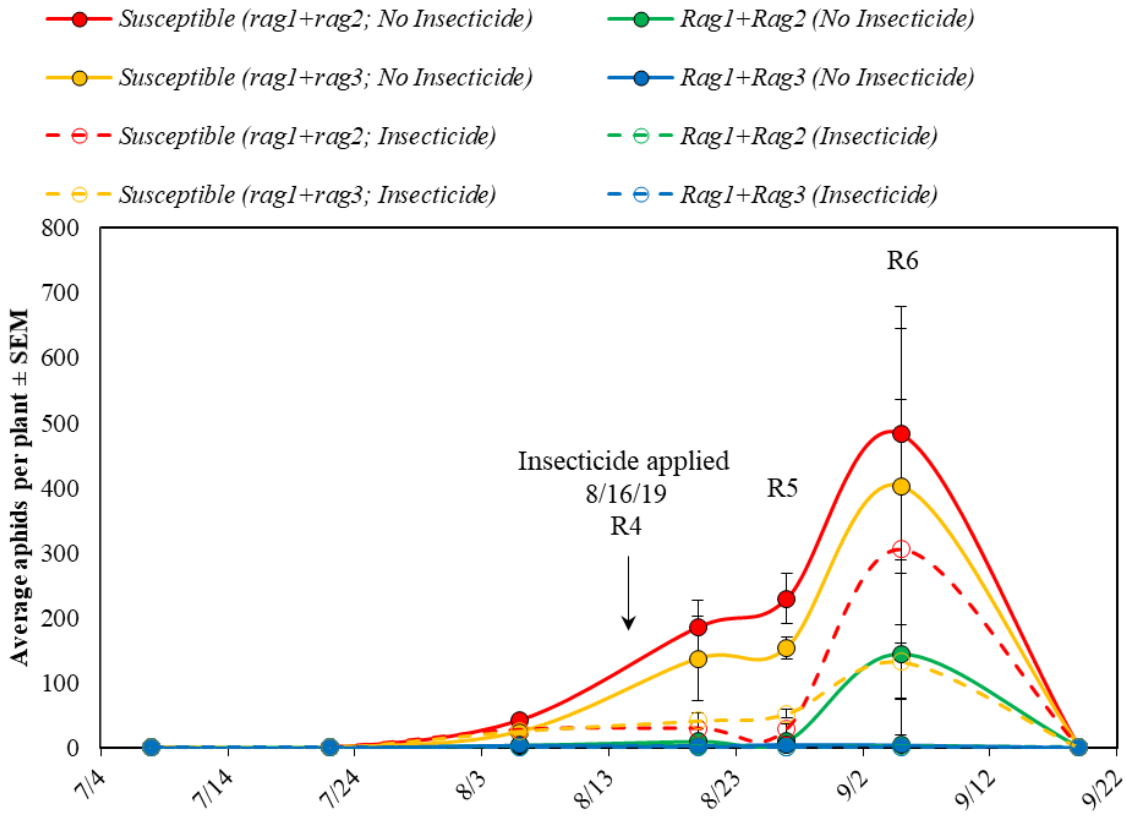
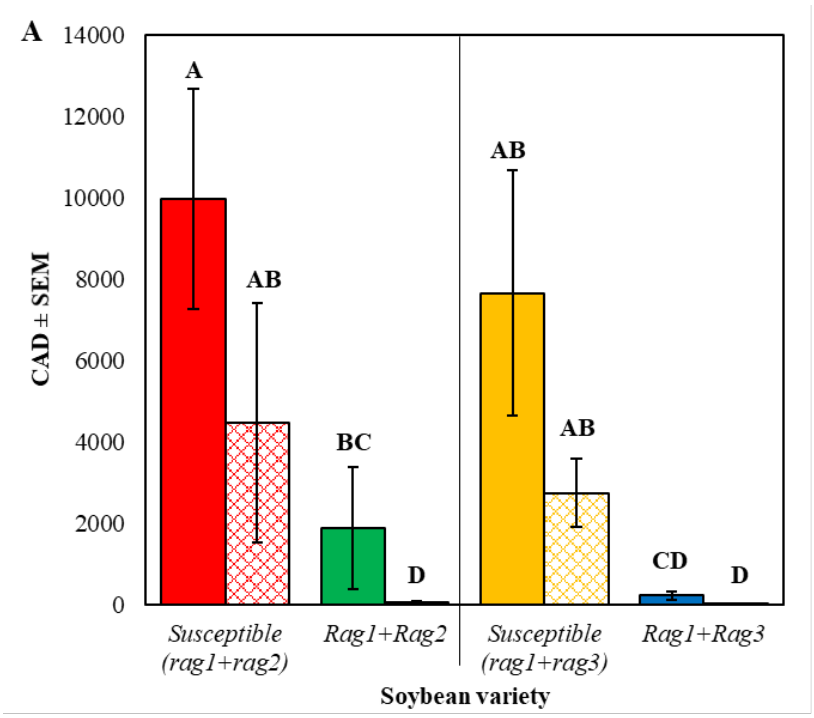


Figure 1. Aphid populations for each of the four Corteva™ Agriscience varieties. Aphid populations exceeded the economic threshold (250 aphids/plant) on the susceptible varieties in 2019. *Rag*-varieties had fewer aphids. Growth stage of soybeans is indicated above data lines.



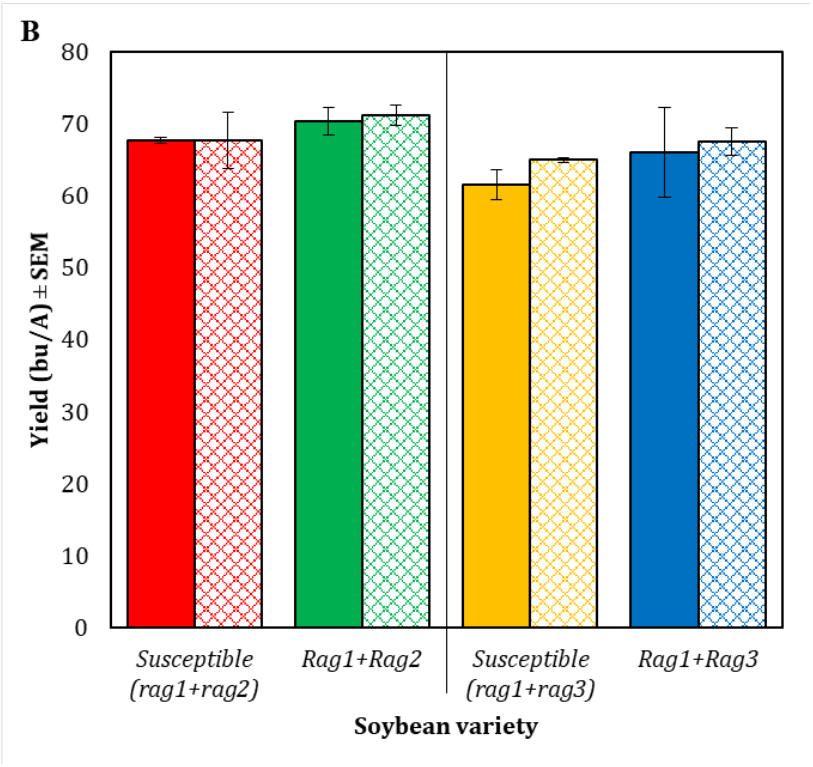


Figure 2. Season-long exposure of plants to soybean aphids (CAD; A) and yield (B) for each of the four Corteva™ Agriscience varieties. Variety and insecticide treatments had a significant effect on CAD. *Rag*-varieties experienced significantly lower CAD compared with aphid-susceptible varieties. No yield differences were detected among any treatment.