

Evaluation of Aphid-Resistant Soybean

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Introduction

The soybean aphid (*Aphis glycines* Hemiptera: Aphididae) is the most economically important insect pest of soybean in the north central region of the United States. Using varieties with native aphid resistance genes (*Rag*) can effectively suppress aphid populations and can replace insecticides. Furthermore, a pyramid of two or more *Rag* genes within the same variety offers better yield protection than a single *Rag* gene. Although this tool is highly effective, *Rag* varieties are not widely used by soybean producers, partly because of their limited availability. Soybeans with and without aphid resistance as a means to combat soybean aphid outbreaks were evaluated.

Materials and Methods

The effects of host-plant resistance on aphid population and soybean seed yield were evaluated. Four near-isogenic varieties (maturity group 1.9) developed at the University of Illinois Urbana-Champaign were evaluated in a randomized complete block design with four replicate blocks. Varieties included a susceptible variety without any *Rag* genes; a 2-gene *Rag1+Rag2* pyramid variety; a 2-gene *Rag1+Rag3* pyramid variety; and a 3-gene *Rag1+Rag2+Rag3* variety. Seeds were planted in 30-in. rows at 140,000 seeds/acre June 4. Plots were 12 rows x 30 ft long. Aphids were scouted at least twice monthly from July through September. 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 25. Seed yield was estimated and compared among all treatments.

Results and Discussion

Seasonal aphid exposure. Soybean aphid populations exceeded the economic threshold (i.e. 250 aphids/plant) in 2019. Overall, the susceptible variety had higher aphid populations than the resistant varieties (Figure 1). The soybean variety ($F_{3,9} = 72.34$; $P < 0.0001$) had a significant effect on aphid populations. Each of the resistant varieties had significantly fewer CAD than the susceptible variety (Figure 2A) indicating effective aphid control. The three resistant varieties controlled aphids similarly to each other, as these did not differ significantly in CAD.

Yield. Seed yield was significantly different among varieties ($F_{3,9} = 10.87$, $P = 0.0024$) (Figure 2B). The aphid-resistant *Rag1+Rag2* variety had the highest seed yield (45.6 bu/A) followed by the *Rag1+Rag3* variety (42.6 bu/A), then the *Rag1+Rag2+Rag3* pyramid variety (41.4 bu/A). The susceptible variety yielded the least (37.9 bu/A). Large aphid populations were present in 2019, and likely caused yield loss in the susceptible variety, but not the resistant varieties. Despite having very few aphids, seed yield of the 3-gene pyramid was not different from the susceptible variety or either of the 2-gene varieties. This could be due to interaction of genetic factors when combining all genes into one variety resulting in a minor yield drag not detected in the 2-gene pyramid varieties.

Overall, the results suggest soybean lines with native resistance to the soybean aphid provide season-long aphid suppression and yield protection.

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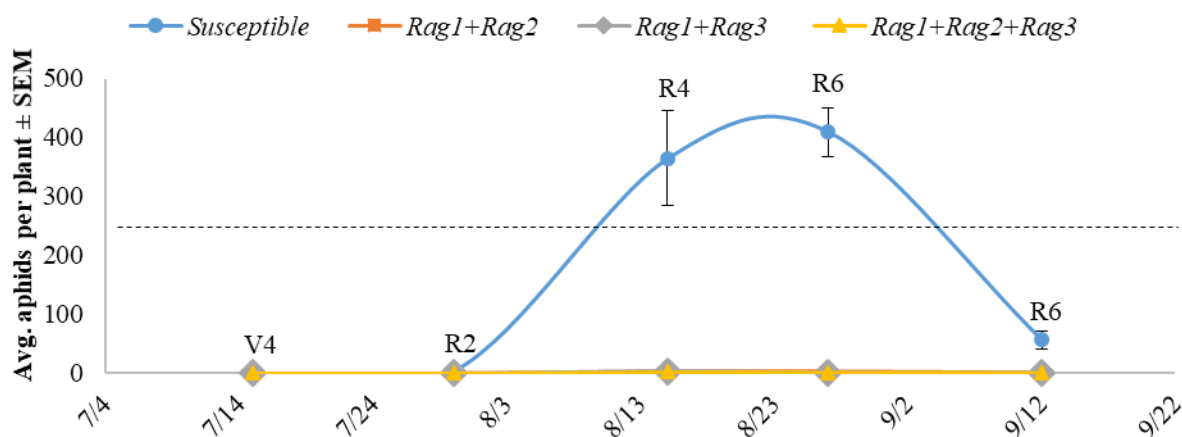


Figure 1. Aphid populations on the four MG 1.9 University of Illinois varieties. Aphid populations exceeded the economic threshold (250 aphids/plant, horizontal dashed line) on the susceptible variety in 2019. *Rag* pyramid varieties had few aphids. Growth stage of soybeans is indicated above data lines.

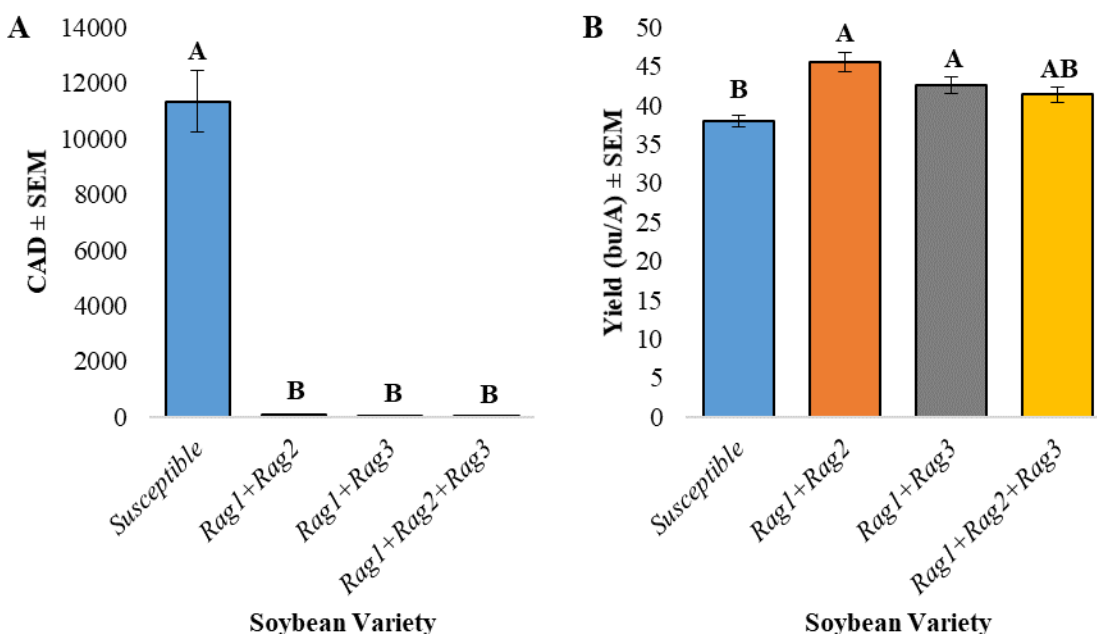


Figure 2. Season-long exposure of plants to soybean aphids CAD (A) and yield (B) for each of the four MG 1.9 University of Illinois varieties. Different letters indicate significant difference ($P < 0.05$). Variety had a significant effect on CAD and yield. *Rag*-varieties experienced significantly lower CAD and generally had higher seed yields compared with the aphid-susceptible variety.