

Courtesy of David Hansen, U of Minn.



Host plant response and a new predictive model

While some scientists are tracking whether *Binodoxys communis* survives and thrives in the Midwest, others are researching the soybean plant itself – and when it serves as the best host for soybean aphids.

“Picture a graph that resembles the mouth on a smiley face,” says David Ragsdale, University of Minnesota entomologist. “You’ve got high points at both ends, and a low point in the middle. That’s what we get when we look at the quality of the soybean plant as an aphid host over the course of the growing season. Early in the season (vegetative growth stages) and again late in the season when seeds are filling, soybeans are great aphid hosts.

“The poorest plant quality is when pods are forming (R3), elongating (R4) and seeds begin to develop (R5). The vegetative growth has stopped, and the plant is putting all its emphasis on reproduction, on the pods. That’s the low point.”

Ragsdale says that’s when farmers see white dwarves. “Aphids get smaller and don’t reproduce very well because the plant isn’t a very good host. Their lifetime reproduction is reduced by 70 percent.”

Then the plant starts to mobilize all the stored photosynthate and seeds begin to fill (R6). “At R6, the soybean plant is again as good a host as it was

when it was in the vegetative growth phase,” he explains.

New online aphid population predictor

Ragsdale’s team is developing a new mathematical model that will predict aphid population growth and include the smiley face phenomenon.

“The current model is solely driven by temperature,” he says. “It tells you what the maximum possible growth rate could be, given those temperatures. It gives you the worst-case scenarios, but doesn’t take into account plant quality, natural predators, plant variety or bad weather.

“The new model will incorporate the concept that the soybean plant is not a great host during part of its growth phase,” Ragsdale adds. “It also takes rainfall into account. For example, if a one-inch rainfall occurs in one hour in association with high winds accompanying a thunderstorm, aphid mortality can exceed 60 percent – especially in the vegetative growth stage, when aphids are at the top of the plant and exposed. They get knocked down and thrown into the mud, and they can’t get out.”

You can find the University of Minnesota’s newly revised aphid population predictor at www.soybeans.umn.edu.

Aphid feeding is a double-edged sword

When they feed, aphids’ piercing mouthparts (called stylets) are inserted between the soybean plant’s cells, where they tap into the nutritious phloem sap.

“Aphids suck the nutrition out,” says John Reese, Kansas State University entomologist. “They also pump salivary secretions into the plant, and we think what they’re injecting is very damaging. The combination of what they’re taking out and pumping in reduces the plant’s rate of photosynthesis, and causes all sorts of plant responses.”

Researchers are studying these responses, and how different varieties vary in their sensitivity to aphids. “The goal is to find varieties that are more tolerant to aphids,” Reese adds, “so the plant can continue to produce in spite of an aphid attack, and without placing selection pressure on the aphid population.”



Courtesy of Greg Zaherovich, KSU

This aphid is hooked up to an EPG (an electrical penetration graph, which is the aphid equivalent of an EKG). By passing an electrical current through the plant and the aphid, researchers can tell what cell the aphid is feeding in, how long it’s feeding, and how the cell responds.