CURRENT AND DEVELOPING SOYBEAN APHID SCOUTING PROTOCOLS

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Presentation Overview

Soybean aphid, *Aphis glycines*, is capable of reducing soybean yield by 20-40% during severe outbreaks in the North Central growing region of the U.S. (McCornack et al., 2007). Since soybean aphid was first documented in Wisconsin in 2000, a common University research protocol was adopted by entomologists in six North Central states (MN, IA, WI, MI, ND, and NE) who provided data from 19 yield-loss experiments conducted over a 3-year period. Results of this research validated the soybean aphid economic threshold (ET) recommendation to treat within 7 days when aphid density exceeds 250 aphids/plant.

The ET is the pest density at which management action should be taken to prevent an increasing pest population from reaching the economic injury level (EIL). The EIL is the lowest population of insects that will cause economic damage, i.e., yield loss that equals the cost of control. In 2003, a preliminary EIL of 1,000 aphids per plant was reported based on research from the University of Minnesota. Since then, data from additional states (2003-2005), including Wisconsin, have refined the EIL at 674 (± 95) aphids/plant during the R1 – R5 soybean growth stages (Ragsdale et al., 2007).

Based on these data from multiple states, doubling times for field populations of soybean aphid averaged 6.8 (±0.8) days. By contrast, in controlled laboratory environments soybean aphid populations can double in 1.5 days (McCornack et al., 2004), but these high rates of increase are only observed under ideal conditions where aphid population growth is not constrained by soybean host plant quality, effects of weather, or natural enemies. Setting an ET too low by using population doubling times based on laboratory-derived aphid reproductive rates or those that occur in caged field populations which exclude natural enemies will result in an artificially low ET and insecticide treatment without realizing an economic benefit (Ragsdale et al., 2007). Due to dynamic changes in soybean aphid populations on a field by field basis within one season (e.g., time of aphid colonization, soybean host plant quality, effects of temperature and rainfall, and natural enemies), repeated field sampling is required to determine if aphid populations are reaching the ET of 250 aphids/plant.

Populations that average less than 250 aphids/plant should not be sprayed. It is important to remember that the ET of 250 aphids/plant is set several hundred aphids below the EIL and this ET incorporates a 5- to 7-day lead time before the aphid population would be expected to pass the economic injury level and cause economic damage. There is little to no University research evidence that populations below 250 aphids/plant result in significant yield loss. Current research on soybean yield gain equal to the lowest treatment cost is approximately 1 bushel/acre, and significant yield differences this small were not measurable from any of the 19 location-years in treated versus untreated plots (Ragsdale et al., 2007). Similarly, Myers et al. (2005) showed that application of insecticides to vegetative growth stages for soybean aphid control had no measurable impact on yield, so any plant injury caused by aphid populations below ET feeding on vegetative growth stage soybeans in their study was likely immeasurable.

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Two established and one developing soybean aphid scouting protocol(s) are discussed in this presentation. In all cases, weekly scouting for SBA should begin no later than when soybean plants are in the late vegetative (pre-reproductive) to early reproductive R1 (i.e., flowering) growth stages and continue through the R5 (full size pod) stage. As a result, agricultural professionals are spending significant amounts of time making treatment decisions for soybean aphid. Current and developing research on soybean aphid scouting protocols addresses time constraints faced by farmers and agricultural professionals given the large acreages they are responsible for managing.

Whole Plant Count Soybean Aphid Sampling Protocol

The ET of 250 aphids/plant is strongly supported by research data through the R5 (full size pod) soybean growth stage (Ragsdale et al., 2007). The ET is based on whole plant counts from at least 20 plants randomly sampled throughout a soybean field on a repeated basis, i.e., weekly or as close to weekly as possible, from late vegetative/R1 to R5. Whole plant counts, the most reliable soybean aphid sampling method, serve as the basis for the ET and the metric against which other soybean aphid sampling protocols are measured. Full details on whole plant count soybean aphid sampling are available on pages 123-124 in UWEX Publ. A3626 *Pest Management in Wisconsin Field Crops 2008* (http://learningstore.uwex.edu/pdf/A3646.PDF) and the *University of Wisconsin Madison Soybean Plant Health Soybean Aphid* web site (http://www.plantpath.wisc.edu/soyhealth/aglycine.htm).

Speed Scouting Soybean Aphid Protocol

In an effort to reduce the time required to make treatment decisions, a binomial sequential sampling protocol called "Speed Scouting" was developed for soybean aphid. The sampling plan that underlies Speed Scouting was derived from commercial field-collected data in Minnesota from 2001 to 2003 and computer-simulation of the sampling effort using a software program (Hodgson et al., 2004).

Speed Scouting is based on the mathematical relationship between the proportion of infested plants, the density of aphids per plant, and an ET of 250 aphids/plant. Instead of counting every aphid on a plant, a more convenient tally (set at 40 or more aphids/plant) is used to score plants as "infested" or "not infested." Only 11 plants are needed to make a treatment decision with Speed Scouting. Plants are sampled for soybean aphid presence (presence = "infested" at 40 or more aphids/plant) or absence (absence = "not infested" at 0-39 aphids/plant) with three possible outcomes: treat, do not treat, or resample. If the decision after 11 plants is to resample, sets of 5 plants are sampled and scored as infested or not until a decision is made. If a decision cannot be made after sampling 31 total plants, the field should be re-sampled in 3 to 4 days because the aphid population is likely close to the ET of 250 aphids/plant. Full details on Speed Scouting are available at the University of Minnesota Extension Service *Soybean Aphid: Speed Scouting* web site (http://www.soybeans.umn.edu/crop/insects/aphid/aphid_sampling.htm).

In 2005, University research validated Speed Scouting using commercial fields in Minnesota and replicated small plot trials in Iowa, Michigan, Minnesota and Wisconsin (Hodgson et al., 2007). Speed scouting resulted in the same treatment decision as using the 250 aphids/plant ET whole plant count protocol in 79% of commercial fields sampled in 2005. Yield (bushels/acre ± S.E.) was not significantly different between areas of the field treated based on 250 aphids/plant ET whole plant counts and areas of the field where treatment was applied based on Speed Scouting. On average, yields following treatment with either scouting method were significantly higher (50.7 ± 1.7) compared to untreated controls (46.9 ± 1.6). By contrast, when incorrect (21% of the time), Speed Scouting was conservative and recommended a treatment before aphid densities reached the ET of 250 aphids/plant.

Speed Scouting is a cost-effective sampling method and saves time, especially at low aphid densities and at very high aphid densities. However, Speed Scouting is a conservative method which may result in unnecessary insecticide applications in years when aphid populations are increasing slowly. To avoid over-application, Hodgson et al. (2007) report that some crop consultants base treatment decisions on two consecutive "treat" decisions from Speed Scouting because they believe this method recommends treatment too early in some field situations (C.D. DiFonzo, E.W. Hodgson, D.W. Ragsdale; *personal communications*).

Node-Based Sample Units for Estimating Whole-Plant Aphid Densities in Soybean

It has been observed that soybean aphids are found predominantly in the top portion of the plant through mid-July, after which point aphids redistribute to lower parts of the canopy. This aphid behavior has thus far prevented sampling from a single leaf or node to accurately estimate whole plant aphid density. Entomologists at the University of Minnesota have conducted intensive field sampling research to describe and quantify within-plant distribution of soybean aphid over time during the growing season, define optimal sample units of varying sizes, and test the ability of selected sample units to estimate whole-plant aphid densities (McCornack et al., 2007). For example, node-based sample units are defined as the trifoliate leaf, petiole, internode (stem between nodes) and pods (if present). Aphids on all of these component parts are counted as one node-based unit. Ideally, as few as 3 node-based sample units could be counted on each plant to accurately estimate whole-plant aphid population densities relative to the 250 aphids/plant ET and reduce sampling time by 50-60%.

In 2007, entomologists conducted validation experiments comparing node-based sampling and whole-plant counts to determine if this relationship holds for other parts of the North Central region. Data analysis from this multi-state experiment is underway. If this validation confirms that a node-based sample unit is appropriate across soybean varieties and maturity groups tested in 6 states in 2007, University of Minnesota and cooperating states on this protocol will move forward with developing a sampling plan. This sampling method is under research development and not yet recommended for commercial use.

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