Understanding and Managing the Soybean Aphid: New Invader of US and Illinois

Executive summary
In 2000, Illinois and much of the Midwest were invaded by the soybean aphid, a native of Asia. In 2003, soybean aphid densities reached significant, yield-threatening levels in northern and central Illinois. Based on estimates obtained from members of the Illinois Agricultural Aviation Association and our own observations, 750,000 to 1 million acres of soybean were treated with an insecticide to control soybean aphid in Illinois in 2003, about 7–10% of the total soybean crop (an estimated $900,000 to $12 million in treatment costs, assuming an average of $12 per acre). 75–80% of the treatments were applied by air, and most treatments occurred after mid-July. One estimate of yield loss caused by the soybean aphid in 2003 was $45 million due to fewer pods per plant and smaller beans in the pods. We developed sampling methods, forecasting tools, a fact sheet, and a website for use by those managing the soybean aphid in Illinois.

Primary objectives and goals
The goal of our program was to develop a comprehensive strategy that combines chemical, cultural, and biological tactics for effective control of *Aphis glycines* which invaded Illinois soybean fields in 2000. Because of limited funding we focused on surveying and sampling during the two years that we received Sentinel funds.

Principal investigator and co-investigators
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Beneficiaries
Soybean growers in Illinois

Outreach
In April, 2002, Onstad, Steffey, Voegtlin and Dr. Scott Isard produced a 2-page fact sheet that is available to farmers and extension staff through the National Soybean Research Lab. We interacted with radio, TV and print journalists to spread knowledge about aphid management to Illinois farmers. We delivered, at the invitation of regional University staff, presentations to Illinois farmers at field station tours and meetings. We developed a web site to disseminate suction trap data to the public. Onstad presented summaries of team research to Illinois Soybean Operating Board in March 2002 and in March 2003 Science of Soy Research Forum.

Web site
http://ipm.uiuc.edu/fieldcrops/insects/soybean_aphids/suction_trap_network/index.html

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Outcomes and Impacts

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Sampling and Forecasting

One study focused on the distribution and sampling of this aphid at two spatial scales: field and township. We sampled 14 soybean fields in each of two townships in Kendall and Champaign Counties in Illinois on four sampling dates during the summers of 2001-2003. Generally, there was little synchrony of population dynamics (increases or decreases) across the fields in either township during the middle of the summers. There was significant field-to-field variability in mean number of aphids per plant. Thus, multiple fields must be sampled to accurately understand the infestation levels in a township. For Kendall Township in all years, drilled soybean fields always had the highest mean density at the second and third sampling dates, but fields with wide rows (0.61-0.76 m widths) had the highest mean density at the fourth date. However, row spacing had no significant influence on the mean density in most of the other analyses of variance. The probability of finding an infested field by mid-July when mean density in the township is less than 2 aphids per plant is 50% for Kendall County and 11% for Champaign County. Thus, at least 2 and 14 fields in Kendall and Champaign Counties, respectively, must be sampled (50 plants/field) to have at least a 75% chance of finding a new invader in at least one infested field in a township during that period. Regression analysis showed no relationship between aphid density and distance from the field edge over the 50 m transects used in sampling. The relationship between the proportion of infested plants in a field, P, and mean aphid density, M, is represented by $P = 1 - \exp(-0.195764M)$. The proportion exceeds 0.99 for mean densities exceeding 24 aphids per plant in a field. Thus, our results suggest that aphids should be counted on 50 plants per field to obtain a reliable estimate of the population.

Additional data were used to develop models to forecast population growth of the soybean aphid during a season. From 2001-2004, 252 fifty-plant samples were collected from commercial soybean fields in three townships (93 km^2 area) in Illinois. Townships were sampled every 3 weeks from late June or early July when aphids first invaded the townships to early August. We used linear regression of 18 mean township field densities to calibrate several simple models to predict the change in aphid population density in a township from one sampling date to the next. Our intrinsic rate of increase for the population is much lower than rates calculated in other studies in the past. Results indicate the value of including monitoring data in the prediction.

The Illinois Suction Trap Network

In 2001 seven suction traps were set up in Illinois to monitor movement of the soybean aphid. Of these original seven traps, six are located on University of Illinois research farms (Northwestern Illinois Agricultural Research and Demonstration Center, Monmouth; Northern Illinois Agronomy Research Center, DeKalb; Orr Agricultural Research and Demonstration Center, Perry; Brownstown Agronomy Research Center, Brownstown; Dixon Springs Agricultural Center; and South Farms Research area on the U of I Campus, Urbana Champaign. One additional trap was added on the campus of Joliet Junior College in 2002 and in 2003 one more was added east of Peoria. Weekly trap catches are shipped to David Voegtlin's lab at the Illinois Natural History Survey where the aphids are sorted and identified.

The traps have provided an interesting look at the movement and relative abundance of the aphid. The summer counts reflect the surrounding field populations as might be expected. What was not expected was that the traps would catch the fall migrants that are moving from soybeans to the winter host, buckthorn. Years with high fall flight numbers have been followed by years of higher field populations and years with low fall flight numbers have been followed by years with low populations. Other entomologists in the mid-west found the data from the Illinois traps interesting and asked that the trap network be expanded. At present there are now 40 traps located in 10 mid-western states providing a look at regional movement and potential over-wintering areas.

Although the trap network was started primarily to monitor the soybean aphid, many other species of agriculturally important aphids are identified and counted as well. The suction trap data is widely circulated to those interested in aphid vectors of viruses to specialty crops, cereals and legumes as well as the species that may affect the same set of crops by direct feeding.