Final Report to the Northeast Soybean Promotion Board - December 2005

Evaluation of economic injury level, biological control, and host plant resistance for soybean aphid in NY

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Objectives:
1. Evaluate soybean yield loss at different aphid densities in a field cage experiment and in field surveys in order to define an economic injury level (EIL) for New York.
2. Conduct a survey of soybean variety trials to determine relative abundance and yield impacts of soybean aphid, *Aphis glycines* Matsumura on commonly grown soybean varieties in New York. Soybean rust, *Phakopsora pachyrhizi*, will also be surveyed for detection.
3. Survey natural enemies (predators, parasitoids and fungal pathogens) affecting soybean aphid in New York State. Evaluate the importance of these natural enemies (especially fungal epizootics) for controlling soybean aphids while soybean plants grow and soybeans develop.
4. Enhance cooperative extension outreach efforts, communication, networking, regarding soybean aphid, optimize rapid and early detection of this exotic pest: Continue to increase awareness of soybean aphid and its importance to NY field personnel (producers, crop consultants, agricultural industry, field crop extension educators). Utilize electronic technology and traditional approaches to strengthen timely communication and convey survey activities and findings to Northeast region clientele, and other stakeholders.
5. Share survey findings with appropriate soybean IPM workers in the Northeast and north central US (Northeast IPM and NC 502), state and federal agencies (USDA National Agricultural Pest Information System (NAPIS), USDA Cooperative Agricultural Pest Survey (CAPS), and USDA Animal Plant Health Inspection Service (APHIS)).

Progress on Objectives:
Objective 1.

The Northeast Region Soybean Promotion Board funded a second year of cage studies to help define an economic injury level (EIL) for New York. Soybean yield loss and aphid density were measured in a field cage experiment using 9 cages (three levels of aphids each replicated three times) containing equal densities of soybean plants, and seeded with soybean aphids for low, medium, and high density. We had a range of aphid levels to regress against yields, aphid populations did reach high levels, some above the Midwestern threshold of 250 per plant. Interestingly, at the end of July aphid populations in the cages and across the research farm plummeted to low levels. The sudden decline of all aphid populations in late July, probably due to high temperatures and drought on the Aurora Farm, shortened the window of time for the experimental aphid levels inside the cages in 2005. Yields from the experimental cages are being processed on a per plant basis. We will compare these results to those from 2004, where although

the relationship between yield and aphid numbers was not statistically significant, means showed a trend towards reduction of yield at 280 aphids per plant.

Objective 2.

Soybean variety trials were surveyed as in 2002-04. In 2005, the Northeast Region Soybean Promotion Board funded biweekly surveys for soybean aphid in New York. Surveys were conducted in Cornell Crop and Soil Science soybean variety trials conducted at the Musgrave Research Farm by William Cox. These trials included evaluations of 32 soybean varieties. In each soybean variety plot, we measured the relative abundance and yield impacts of the soybean aphid. Total mean soybean aphids per plant for each variety were calculated using whole plant counts of five plants from each of six replications. Peak aphid population data were collected on July 19, 2005. In general, soybean aphid populations were higher in 2005 than 2004, populations peaked when plants were R3-R4. Soybean aphid populations in the variety trial did not, however, exceed the 250 aphids per plant economic threshold guideline. The Group I trial was harvested in late September and Group II varieties were harvested in early October. All yields were adjusted to 13% moisture. Our analysis of 2005 soybean aphid populations and yield data show significant differences in yield and aphid ratings between varieties. Varieties tested, soybean aphid numbers and yield data are presented in Table 1.

In group 1 varieties, the variety with the highest yield also had the highest aphid population (Figure 1). In group 2 varieties, the highest average number of aphids was 245 aphids per plant and some individual plants had 600+ aphids (Figure 2). In contrast, the lowest variety averaged 29 aphids per plant. Although many factors impact ultimate yield, as aphid populations are increasing differences between varieties are more evident and may be an important factor in choosing soybean varieties in New York.

Objective 3.

The Northeast Region Soybean Promotion Board also helped fund a survey to determine the identity of natural enemies (predators, parasitoids and fungal pathogens) affecting soybean aphid in New York State. The presence of potential natural enemies was established in summer 2000, when a combination of natural enemies, both lacewings (Chrysopidae) and the multicolored Asian lady beetle (*Harmonia axyridis*), and fungal pathogens (*Pandora neoaphidis* and *Conidiobolus thromboides*) were observed to be active in soybean fields colonized by the soybean aphid (DiFonzo and Hines, 2001; NC Pest Management Center, 2001). In New York we also detected predators in fields where soybean aphids occurred during 2001 but these are generalists and their impact on soybean aphid populations is uncertain. In 2003, parasitoid wasps were found emerging from soybean aphids at all locations surveyed. We first discovered these soybean aphid parasitoids in the Northeastern U.S in 2002. The parasitoids are all from the family Aphidiidae and comparisons are being made between these wasps with *Lysiphlebus testaceipes*, the species found in MN on soybean aphid, to see if ours are different. Five different fungal pathogens of soybean aphid were recovered in 2003. Rates of infected aphids were high (30-89%) in the same Wayne and Cayuga County NY fields where aphids were at damaging levels. During 2004, abundant fungal infections were found in all fields and we were excited to find another species of fungal pathogen, possibly a species not previously reported from North America (*Pandora kondoiensis* but exact identity is presently being resolved by molecular means). Also, in 2004 *P. neoaphidis* was the dominant pathogen.

In 2005, predators found were Aphidoletes, coccinellids, syrphids and lacewings, the first two were more common than the latter two. Two weeks after the aphid crash, predators were still found although aphids were at low density by then. The following parasitoids were reared:

From soybean aphids on *Rhamnus*: Aphidiidae: *Ephedrus incompletes*

From soybean aphids on soybean: Aphelinidae: *Aphelinus albipodus, Aphelinus varipes*

Aphidiidae: *Praon unicum.* Out of 41 mummified specimens sent for identification, 10 were hyperparasitoids. It is interesting to note that most of these species were not found in 2004.

Maximum infection levels were found in mid-June. In both 2004 and 2005, it seems that parasitoids are more active in June. After which the aphid population increased, followed by an increase in fungal infection levels, which, based on results from both years, varied in timing from early August through Sept. The most common species of fungal pathogen was an unidentified species of *Pandora*. A close runner-up was the most common species from 2004, *P. neoaphidis*. One pathogen found a few times was a species of *Zoophthora* and we are still waiting for identification to species. If this *Zoophthora* is *occidentalis*, then all fungal species found in 2005 were also found in 2004. The peak fungal infection was found in early August. In the August 1 collection most infection was seen among alatae. The continued discovery of epizootics of fungal natural enemies of soybean aphid in NY is promising and warrants further investigation.

Objectives 4 and 5. Cooperative extension, consultants, agricultural business field personnel, producers and other appropriate clientele are being kept informed of soybean aphid survey activities and were engaged to contribute information to help identify soybean fields at risk. A summary of outreach activities and publications is shown below.

Soybean aphid / Soybean IPM Extension Outreach and Other Presentations (Waldron):

10/26/04, Field Crop Dealer Meetings, Clifton Park, NY, Soybean Aphid: New pest, new concern?, 57 people

10/27/04, Field Crop Dealer Meetings, New Hartford, NY, Soybean Aphid: New pest, new concern? , 62 people

10/28/04, Field Crop Dealer Meetings, Batavia, NY, Soybean Aphid: New pest, new concern?, 42 people

10/29/04, Field Crop Dealer Meetings, Auburn, NY, Soybean Aphid: New pest, new concern? , 59 people

11/30/04, CCA Training, Waterloo, NY, Soybean IPM Update, 33 people

12/2/04, CCA Training, Waterloo, NY, Soybean IPM Update, 37 people

12/15/04, Otsego Cty CCE, Richfield Springs, NY, Soybean Pests: Soybean Rust and Soybean aphid , 28 people

2/9/05, WNY CCE Soybean Congress, Batavia, NY, Soybean Aphid 2004 - Keith developed ppt, Julie Stavisky. Presented, 98 people

2/10/05, WNY CCE Soybean Congress, Waterloo, NY, Soybean Aphid 2004 - Keith developed ppt, Julie Stavisky. presented, 112 people.

3/10/05, NYS IPM Program Statewide Advisory Committee Meeting, Syracuse, Soybean IPM Activity Update and Progress Report

3/22/05, Eastern Branch ESA, Harrisburg PA, Eastern Branch ESA: SBA Update and Discussion about soybean aphid surveys. Collaboration with Dennis Calvin, PSU; Dennis presented the talk.)

4/4/05, Soybean Tactical Agriculture Teams Educational Materials Development Strategy Meeting, Oriskanny Falls, (Collaborative discussion on related Soybean Promotion Board Funded Project: An On-Farm Soybean IPM Education Program)
7/15/05, Musgrave Farm Field Day, Aurora NY, LFC IPM Demonstration (soybean aphid, horse weed) - w/ Ken Wise and Julie Stavisky, 98 people
8/9/05, Field Crop IPM Diagnostic Day, Ithaca NY, Field Crop IPM Training for Cornell Entomology/Plant Pathology students, 18 students.
10/29/05, Organic Field Crops Field Day, Musgrave Farm, Aurora NY, Soybean Aphid Overview, 47 people, Leslie Allee
2/8/06, Soybean/Small Grain Congress, Batavia NY, Soybean Aphid Update, 102 people
2/9/06, Soybean/Small Grain Congress, Waterloo NY, Soybean Aphid Update, 112 people
3/22/06, Cornell Pesticide Applicators Update, Ithaca NY, "NY Soybean Pest Challenges: *Plan local, watch global...*"
4/4-6/06, National IPM Symposium , St Louis, MO , Invited speaker, mini-symposium: "Pathogen, Insect and Weed Pests of Soybean: Integrated Pest Management of Multiple Pests in a Single Crop", Soybean IPM: A New York Agronomist's Perspective*: Issues, Information, Integration into Implementation* (http://www.ipmcenters.org/ipmsymposiumv/)

Publications:

Neilsen, C. and Hajek, A.E. 2005. Control of Invasive Soybean Aphid, *Aphis glycines* (Hemiptera: Aphidae), Populations by Existing Natural Enemies in New York State, with Emphasis on Entomopathogenic Fungi. Environmental Entomology 34(5): 1036-1047.

Cox, W.J., P. Atkins and M. Davis. 2006. 2005 New York State Soybean Variety Yield Tests. Cornell Dept. Crop and Soil Sciences, Extension Series No. 06-1, http://www.css.cornell.edu/extension/Extension%20Publications.html

Losey, J. , K. Waldron, A. Hajek, and L. Allee 2005. Evaluation of economic injury level, biological control, and host plant resistance for soybean aphid in NY. Progress report to the Northeast Soybean Promotion Board – 4/15/04-4/14/05. IN: Annual Report 2004-05, The New York State Integrated Pest Management Program: Agriculture and Community IPM, NYS IPM Publication #502

2006 Cornell Guide to Integrated Field Crop Management publication and website released October 2005. Updated section on soybean IPM.

Soybean aphid information/articles (eight) in NYS IPM Weekly Pest report, http://nysipm.cornell.edu/fieldcrops/tag/pestrpt/default.asp

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Table 1. 2005 Soybean variety trial, Cornell University Musgrave Research Farm, Aurora NY: Soybean aphid loads and crop yields.

Group I Soybean varieties				Group II Soybean varieties			
COMPANY	VAR NAME	AVG SBA	AVG YIELD	COMPANY	VAR NAME	AVG SBA	AVG YIELD
NK	S17-R3	80.00	36.32	NK	S24-K4	53.54	45.34

NK	S19-R5	34.83	44.07	Asgrow	AG2107	65.04	41.47
Asgrow	AG0803	33.67	30.32	DeKalb	DB26-53	29.25	49.91
Asgrow	AG1502	20.75	30.95	Chemgro	2237RR	215.71	41.86
Asgrow	AG1903	31.50	43.18	Chemgro	C2439RR	188.04	45.21
T.A. Seeds	TS1990R	80.33	41.39	Chemgro	X42622	204.75	42.92
T.A. Seeds	TS1440R	84.00	33.33	Chemgro	X12101	96.58	45.64
Hyland	Richochet	140.92	36.59	T.A. Seeds	TS2560R	159.42	51.30
Hyland	Razor	97.83	39.17	Hyland	Rodney	145.71	44.68
Hyland	Rochester	155.92	42.37	Hyland	Renwick	138.67	50.07
Hyland	Respond	174.58	48.51	Seedway	SG2205	200.46	44.21
Seedway	SG1405	150.75	35.10	FS Seeds	217RR	151.00	46.77
Seedway	SG1919	157.17	38.69	FS Seeds	XP2521RR	119.29	41.60
FS Seeds	122aR	114.75	32.86	Asgrow	AG2705	245.71	44.39
FS Seeds	199R	92.25	40.32	Pio. HiBred	92M91	155.21	49.35
NK	S19-V2	109.83	40.74	Pio. HiBred	92B38	231.42	48.57
Avg.		98	45	Avg.		150	46
LSD 0.05			5	LSD 0.05			4

Soybean aphid data collected July 19, 2005, plants at R3-R4 growth stage, yields (Bu/A) adjusted to 13% moisture.

Figure 1: Effect of soybean aphid on yields of different Group 1 soybean varieties

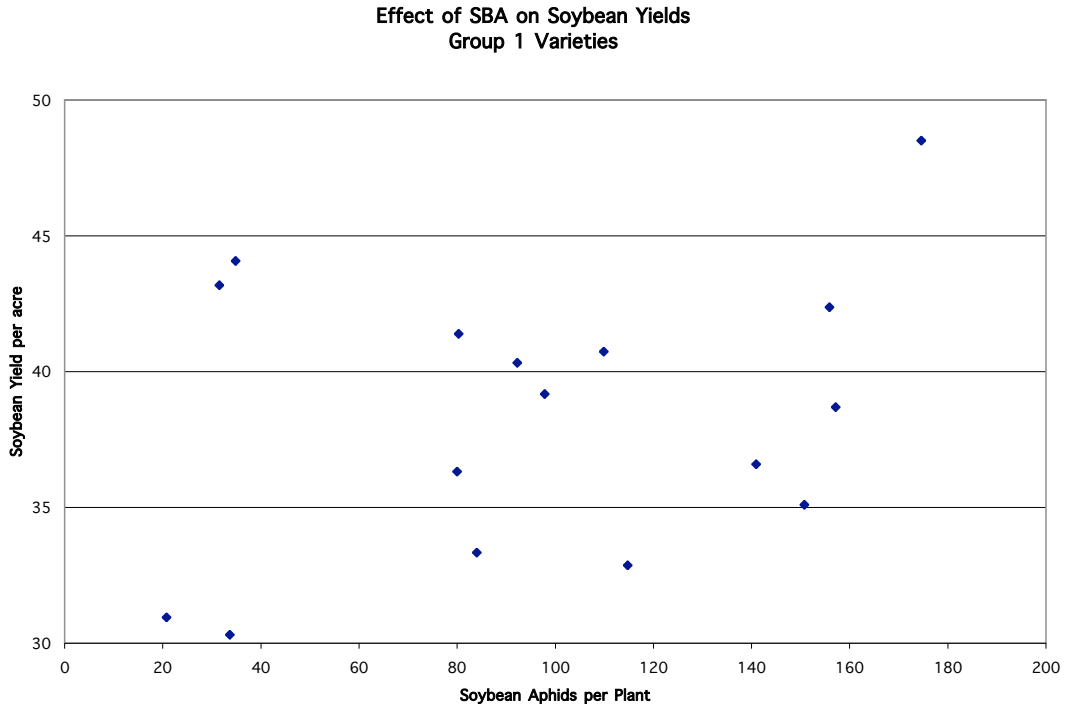

Figure 2: Effect of soybean aphid on yields of different Group 2 soybean varieties