PROJECT REPORT TO NEW YORK STATE IPM PROGRAM, AGRICULTURAL IPM 2002-2003

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Project Type: Research and Development

Title: Monitoring Aphid Pressure, Movement and Distribution in Snap Beans

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Snap bean growers in Western New York

Type of Grant: Monitoring, forecasting and economic thresholds

Project Location: Western New York

Abstract: Viral diseases vectored by black bean aphid caused great devastation in snap beans in western New York in 2001. The main goal of this project is to obtain a better understanding of the aphid pest pressure, movement and distribution of the black bean aphid over the growing season through monitoring and networking techniques.

Background:

In 2001, black bean aphid (BBA, *Aphis fabae* Scopoli) pressure was severe in western NewYork. Within less than a week in late June, snap bean fields were infested with as many as 120 aphids per trifoliate leaf per plant, with younger plants being more severely infested. In addition to causing leaf rolling, leaf puckering and stunted growth in bean plants, the BBA was responsible for the transmission of several viruses including cucumber mosaic virus (CMV), alfalfa mosaic virus (AMV), and several potyviruses such as bean common mosaic virus (BCMV) and bean yellow mosaic virus (BYMV). CMV was the most prevalent of the viruses diagnosed, however, several samples were diagnosed with more than one viral infection per plant. One hundred percent infection per field was common and symptoms ranged from yellow and green leaf mottling, leaf deformation and puckering, shortened internodes, discolored nodes, discolored and misshapen pods, stunted growth, poor pod fill and drastically reduced yields. Ultimately, an estimated 3500 acres of snap beans were affected by this aphid-virus complex in western NY and yields were reduced by 30-80%. This is the second year that Wisconsin has experienced similar viral problems and it is expected that the occurrence of the aphid-virus complex in 2001 will not be an isolated incident. Consequently, the control of this pest complex was identified as a high priority for the IPM program.

BBA occurs naturally in North America and can be found from New Brunswick to Florida and westward to California. Infestations are generally localized and populations are usually kept in check by natural enemies including ladybird beetles, lacewings, Syrphid flies and

Cecidomyiids. Consequently, BBA is rarely considered a pest of importance in beans. BBA has a dark green to black body between 2 and 2.6 mm long with light colored legs. In the fall, females lay eggs on woody plants, *Euonymous* spp. and *Vibernum* spp. being the common winter hosts. In the spring, these eggs hatch into wingless, parthogenetic females that give birth to similar individuals. After a few generations winged forms appear and fly to summer hosts including several vegetable, agronomic, fruit and ornamental crops as well as several weeds. Repeated generations occur throughout the summer. Feeding and reproduction increase with warm weather. Wingless females give birth to about 80 nymphs over a 2.5 week period. At 53°F and 83°F, nymphs reach maturity in about 22 and 5 days, respectively. Temperatures greater than 85°F frequently inhibit buildup of large densities of BBA. Winged forms appear with cool fall weather and they fly to their winter hosts where sexual reproduction and egg-laying occurs.

CMV, AMV, BCMV and BYMV are all viruses which are vectored in a non-persistent manner by many species of aphids. This means that an aphid can acquire and disseminate a virus in a matter of seconds and that the virus can survive within the aphid for only a very short period of time (i.e. minutes). Consequently, an aphid carrying a virus merely needs to probe a plant to cause an infection, although efficiency of transmission may vary for a number of reasons. All of these viruses have very large host ranges including 1093, 599, 100 and 233 plant species for each of CMV, AMV, BCMV and BYMV, respectively. Consequently, there are several local hosts from where BBA may acquire these viruses. It is suspected that perennial crops and weeds such as alfalfa, red clover, Canada goldenrod, common milkweed, field chickweed and dandelion will be the most important sources of viruses in 2002. Primary spread occurs when the crop is initially infected by winged adults colonizing the field, while secondary spread occurs when the viral infection is spread within the crop.

Objectives:

1) To intensively monitor season-long pest pressure and movement of the BBA at five sites in western New York.
2) To create a network to monitor the distribution of BBA in western New York.

Procedures:

1) Monitoring Pest Pressure and Movement: Since many aphid species are capable of vectoring viruses, all aphid species captured were monitored. In addition, potato leafhopper (PLH) adults and nymphs were monitored in response to a request to amend the original proposal.

Field Locations. To monitor season-long aphid activity in western New York, early and late planted fields were selected in each of Chautauqua, Niagara, Erie, Orleans, Orleans (east) and Genesee counties. Of these, 6 fields (#2, 4, 6, 7, 8, and 11) overlapped with the study, Evaluating Seasonal Patterns of Aphid Movement and Virus Incidence in Snap Bean Fields by Nault et al. To monitor the movement of aphids into snap beans from alfalfa, half of these fields were located adjacent to an alfalfa field, while the rest, with exception of Orleans-east, were isolated from alfalfa. To monitor the movement of aphids into snap beans from soybeans, two additional late planted fields (#15, 16) adjacent to soybeans were selected in Niagara and Monroe counties and two isolated fields were selected from Genesee (#13,14) (also used in Nault et al. study). In total, 16 snap bean fields were selected from 6 counties of which 8 fields were

adjacent to alfalfa, 3 fields were adjacent to soybeans and 5 fields were "isolated" from both soybeans and alfalfa. Overall, this study is representative of the 11,000 acres of processing snap beans grown in these 6 counties in western NY. See Appendix I for a list of the field sites and characteristics.

Aphid Monitoring with Water Pan Traps. Water pan traps, designed by Nault et al. and Dave Ragsdale, University of Minnesota were used to monitor aphids in this study. The trap frame consisted of a tomato plant supporter with the bottom ring cut off leaving legs to penetrate the ground about 8 inches with the top ring holding a quart-sized Rubbermaid container. Within the container was a 4 1/4-inch piece of laminated paper painted a mottled green. Containers were filled about 1 inch deep with 20% glycol solution. Three traps were placed within the plant row in the border row of snap bean, adjacent alfalfa and adjacent soybean fields. In the field sites that were also used in the Nault et al study, a total of 12 traps were used with 3 located in the border row of the adjacent alfalfa, 3 in the snap bean border row, 3 in the center of the snap bean field and 3 on the far side of the snap bean field. Alfalfa fields for monitoring purposes only had 3 located in the border row of the adjacent alfalfa, and 3 in the center of the snap bean field. Where snap bean fields were "isolated" (> 3 miles of an alfalfa field), no traps were set up in an adjacent field. In snap bean fields adjacent to soybeans 3 traps were located in the border row of the adjacent soybean, 3 in the snap bean border row, 3 in the center of the snap bean.

Trap catches were collected once weekly. Winged aphids were removed and the glycol solution reused. Collected winged aphids were sent to Dr. R. V. Eckel for identification (as part of Nault et al. study).

In-Field Monitoring of Aphids. On the same day as the trap catches were collected, a field scout visually examined the 3 youngest trifoliates of 50 plants (10 plants x 5 sites) per field for the presence of immature and adult aphids including dead or alive and winged and wingless specimens and beneficial insects. Stage of growth was recorded. In the original proposal, viral symptoms were also to be noted, but this was abandoned when Nault et al found through ELISA testing that as much as 50 percent of symptomless plant samples tested positive for CMV and AMV.

Data Analysis. Data was analyzed by ANOVA and the mean cumulative number of alates captured per trap over the cropping season was compared between (1) snap bean fields adjacent to alfalfa (2) snap bean fields adjacent to soybeans, and those at least one mile away, (3) field edge and center. (4) field edge adjacent to a wood lot and a field edge far from a wood lot.

2) Network to Alert Industry of Aphid Pressure:

An informal network was set up by the members of the Lake Plains Vegetable Program (LPVP) with fieldmen, private consultants, field scouts and extension educators working with snap beans to report any incidents of aphids and viruses. All such reports were made available through the LPVP *Pestminder* and other similar weekly publications.

Results:

Aphid Pressure. Overall aphid pressure was very low in 2002. As an example, in 2001 there were as many as 40 black bean aphids reported on cotyledons, but in 2002, the highest number of aphids found on a trifoliate leaf was just over 3 (=150/50 trifoliates) during the week of 7/29/02

in a late planted field in Chautauqua County (Figure 2). Also, unlike in 2001, no aphid nymphs were found on snap bean plants in 2002, only winged aphids. Wingless aphids and nymphs would indicate that the population is reproducing in the field.

Weather. Differences in spring weather between 2001 and 2002 may help to explain why aphid populations did not explode in snap beans in 2002 as was observed in 2001. Aphids are expected to thrive under dry conditions and rain events can help maintain a population. In 2001, more heat units accumulated than in 2002 in May and June (Fig. 1a). Considerably more rainfall was received in 2002 in April (3.7"), May (4.7") and June (3.7") in comparison to 2001 (April: 1.1"; May: 3.2"; June: 3.7") (Fig. 1b). The North East Weather Association weather stations recorded rainfall throughout the LPVP on June 5th & 14th. July, August and September were similar in accumulated heat units while August 2002 was the driest in the last four years. Despite the hot and dry end to the 2002 season, the cooler weather early in the season slowed the rate of growth of aphid populations. This combined with more frequent rainfall to knock populations down may explain why we did not see an aphid population explosion in 2002.

Shower and heavy rains were very isolated and scattered. Consequently, associating population fluxes with rain events on an individual field basis is almost impossible.

Figure 1a: Average Monthly Base 50 GDD Accumulations for the Lake Plains Vegetable Region in 1999-2002.

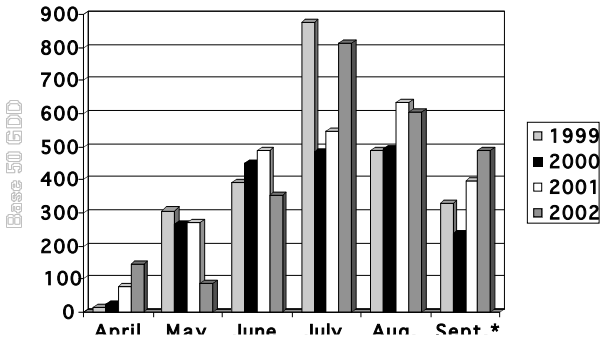
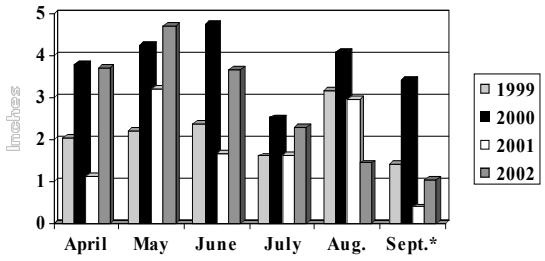


Figure 1b: Average Monthly Rainfall for the Lake Plains Vegetable Region in 1999-2002.



Season-Long Monitoring. In 2001, high aphid populations were reported in Niagara, Orleans and Genesee counties. In 2002, the first trap counts were recorded on an early planted fields 6/10. By 6/17 aphids were captured in Erie and Niagara counties and were observed later in Orleans and Genesee counties. Aphid trap catches peaked around 8/5 in Chautauqua, Niagara and Erie counties, and about a week later in Orleans and two weeks later in Orleans-east. The highest trap catches occurred in Niagara and Orleans counties. Generally, more aphids were captured in late plantings than in the early plantings.

Aphid Species Identified. In 2001 the predominant aphid species identified was the black bean aphid and soybean aphid. In 2002, Nault et al identified in water pan traps mostly the pea aphid, *Acyrthosiphon pisum*, in early plantings, whereas the yellow clover aphid, *Therioaphis trifolii*,

may be one of the most abundant in late plantings; data have not been processed past July 29 Both of these species are commonly found in alfalfa fields. No soybean aphids, *Aphis glycines*, were trapped in fields through the end of July. Soybean aphids could be found on soybean plants adjacent to snap bean fields in August.

Beneficial Insects: Where aphids peeked in Chautauqua County 7/29 there was also an increase in ladybird beetles was observed in the field.

Aphid Movement:

Overall, water pan trap counts and plant counts seemed to follow the same trends. Snap bean fields adjacent to alfalfa fields had very similar average number of aphids per trap. In most cases average number of aphids per trap were slightly higher in alfalfa fields than in adjacent snap bean fields (table 1). Aphid populations in alfalfa fields decreased when alfalfa was cut and increased in adjacent snap bean fields (figure 2). However, when alfalfa started to re-grow trap catches in alfalfa resumed to higher than traps in adjacent snap bean fields. This trend was not captured when monitoring plants (figure 3). When plants were very young in the case of Chautauqua County route 72 and 85, water pan traps did not capture the high population of aphids found on plants. At 7/29 plants were at the two leaf stage. The water pan trap is

Table 1: Average Cumulative Number of Alate Aphids per Water Pan Trap per Week in Early and Late Planted Snap Beans and Alfalfa Fields in Western New York 2002.

Field Proximity	N	Average Cumulative Number of Aphids
Early Planting		
Adjacent Alfalfa	5	9
Snap Bean Adj.	5	6
P value		NS[1]
Late Planting		
Adjacent Alfalfa	3	28
Snap Bean Adj.	3	20
Snap Bean (Isolated)	3	26
P value		NS[1]

[1]NS: not significant according to Fisher's Protected LSD test ($p>0.05$).

approximately 18 inches high. Possibly the mottled green card was faded not attracting the aphids. Possibly, the height of the trap is too great of a distance between the bean plants and the mottled green card in the bottom of the plastic container. The aphid population peek of approximately one per leaf, at the 2 leaf stage of growth did not seem to effect yield since it was one of the highest yielding fields (6 tons) in the area. Unfortunately, this field was not in common with Nault et al and virus incidence through ELISA tests were not taken. There were no visual virus symptoms in the field.

Average cumulative number of alates per trap at the end of the season for late planted fields was greater in snap bean fields far from soybean fields than in those fields bordering soybean fields and soybean fields themselves. There were no significant interactions between these fields (table 2), nor were there any significant interactions within the fields.

Table 2: Average Cumulative Number of Alate Aphids per Water Pan Trap per Week in Late Planted Snap Bean and Soybean Fields in Western New York 2002.

Field Proximity	N	Average Cumulative Number of Aphids
Adjacent Soybean	3	11
Snap Bean Near	3	14
Snap Bean Far	3	26
P value		NS[1]

[1]NS: not significant according to Fisher's Protected LSD test ($p>0.05$).

Fields that had a wood lot that bordered one side of a snap bean field and were far from either soybeans or alfalfa were evaluated for aphid interactions within the field. Trap catches were slightly higher in those traps on the far side of the field than those traps bordering the field (table 3) but were not statistically significant.

Table 3: Average Cumulative Number of Alate Aphids per Water pan Trap per Week in Late Planted Snap Beans Bordering Wooded Areas.

Snap Bean fields Bordering Woods on one side.	N	Average Cumulative Number of Aphids
Isolated Fields		
Woods Border	5	23
Far Woods Border	5	26
P value		NS[1]

[1]NS: not significant according to Fisher's Protected LSD test ($p>0.05$).

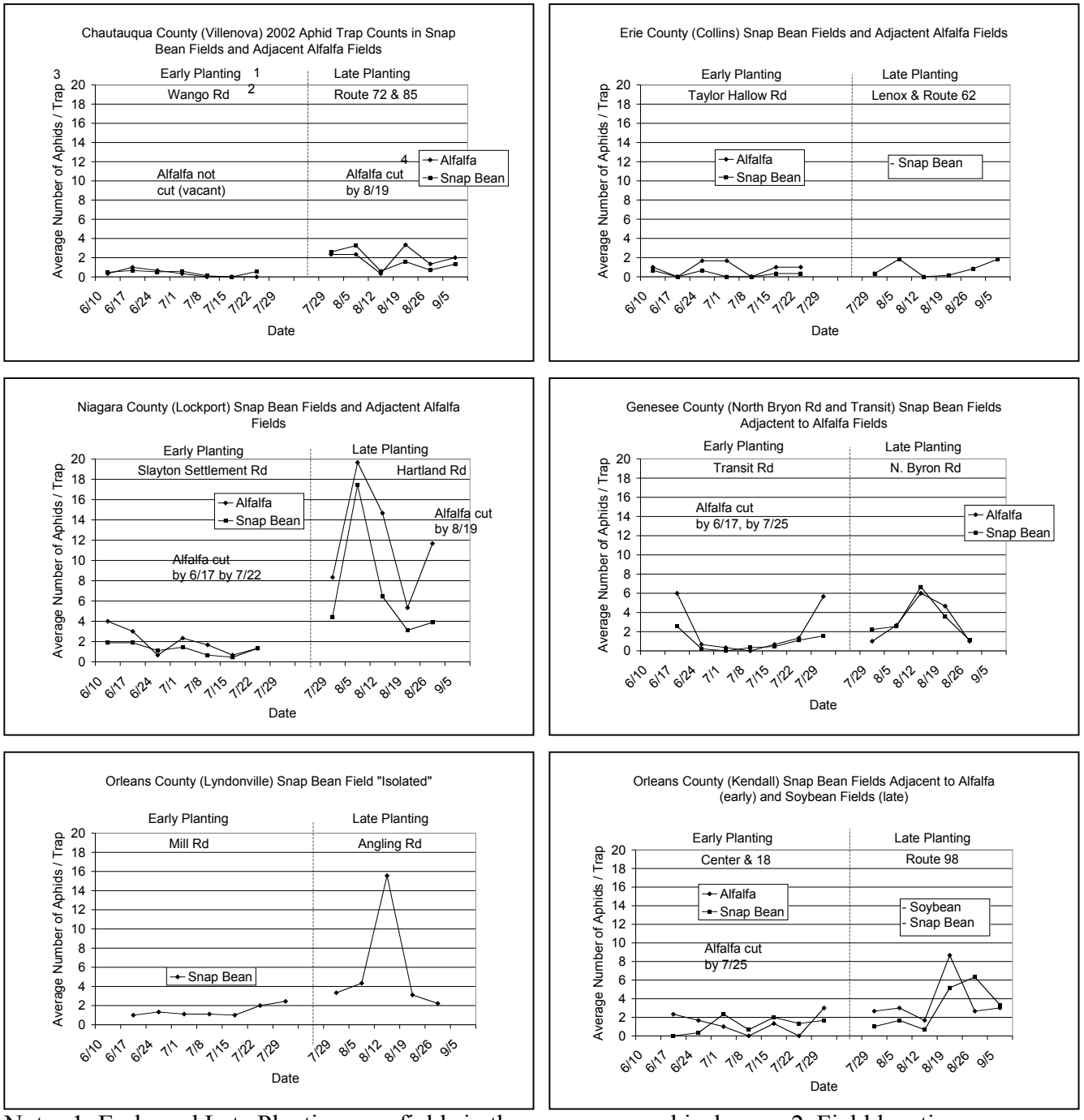
Conclusions:

Aphid populations were very low in 2002. The cool wet spring appeared to be unfavorable for aphid populations to build. The black bean aphid was one of many aphid species captured in water pan traps in snap bean fields. Weekly monitoring showed that trap catches peaked in early August for Chautauqua, Niagara, Genesee, and two weeks later in East Orleans. Highest water pan catches occurred in Niagara and Orleans. Field infestation reflects the trap catches with the exception of Chautauqua. Aphid populations increased again in September in Niagara and Orleans counties. There did not appear to be any major movements of aphids between snap bean fields and alfalfa fields, soybean fields and wooded areas.

References

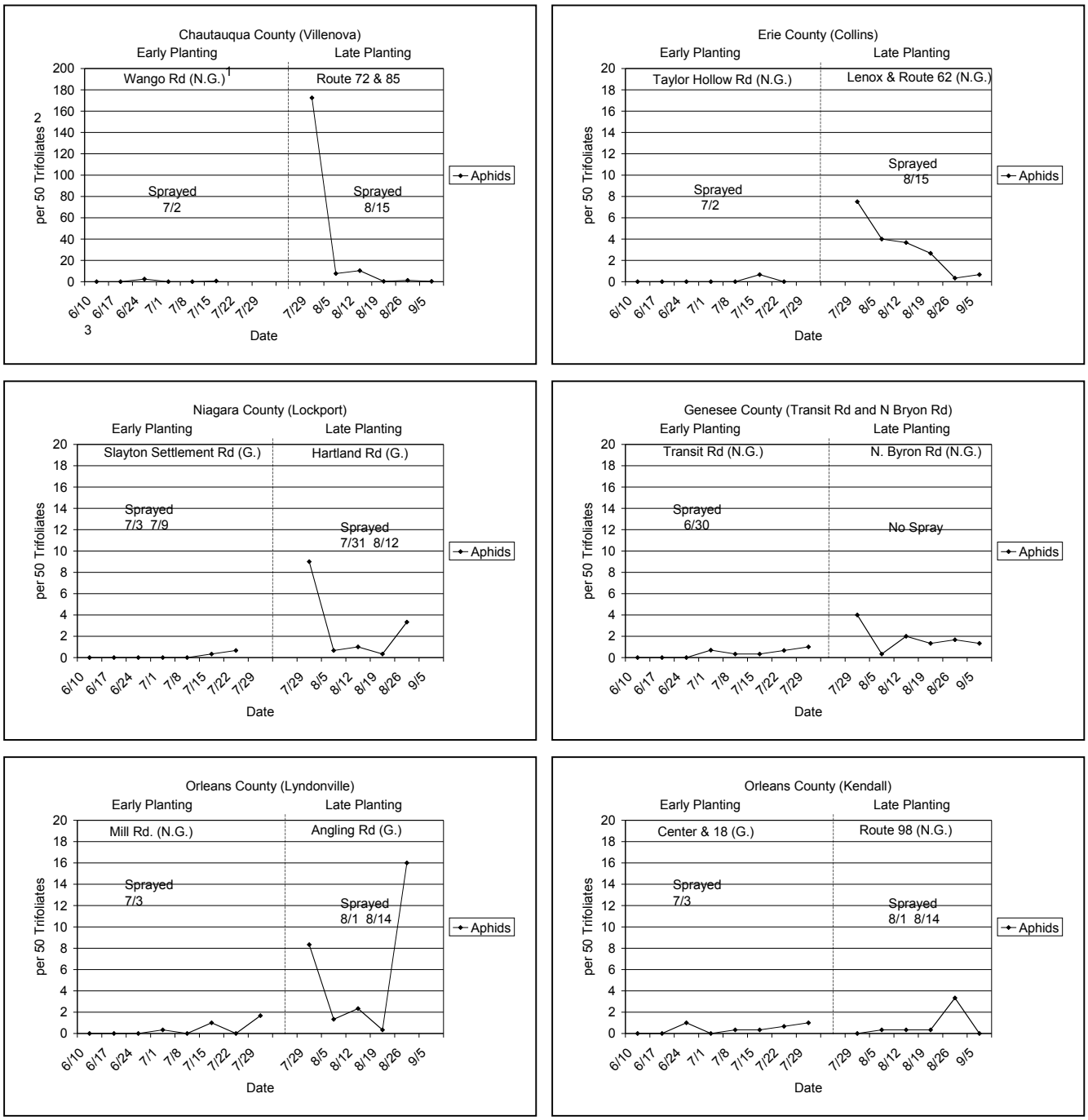
Nault, B.A. D. Shaw, H. Dillard, S.M Mazumdar-Leighton, D. Gonsalves and A. McFaul. Seasonal Patterns of Aphid Movement and Virus Incidence in Snap Bean Fields. 2002 Report for New York Crop Research Association.

Figure 2: Season Long Monitoring of Winged Aphids using Water Pan Traps in Early and Late Planted Snap Bean Fields Adjacent to Alfalfa Fields or Soybean Fields and Isolated Fields in Chautauqua, Erie, Niagara, Genesee, and Orleans Counties in Western New York.



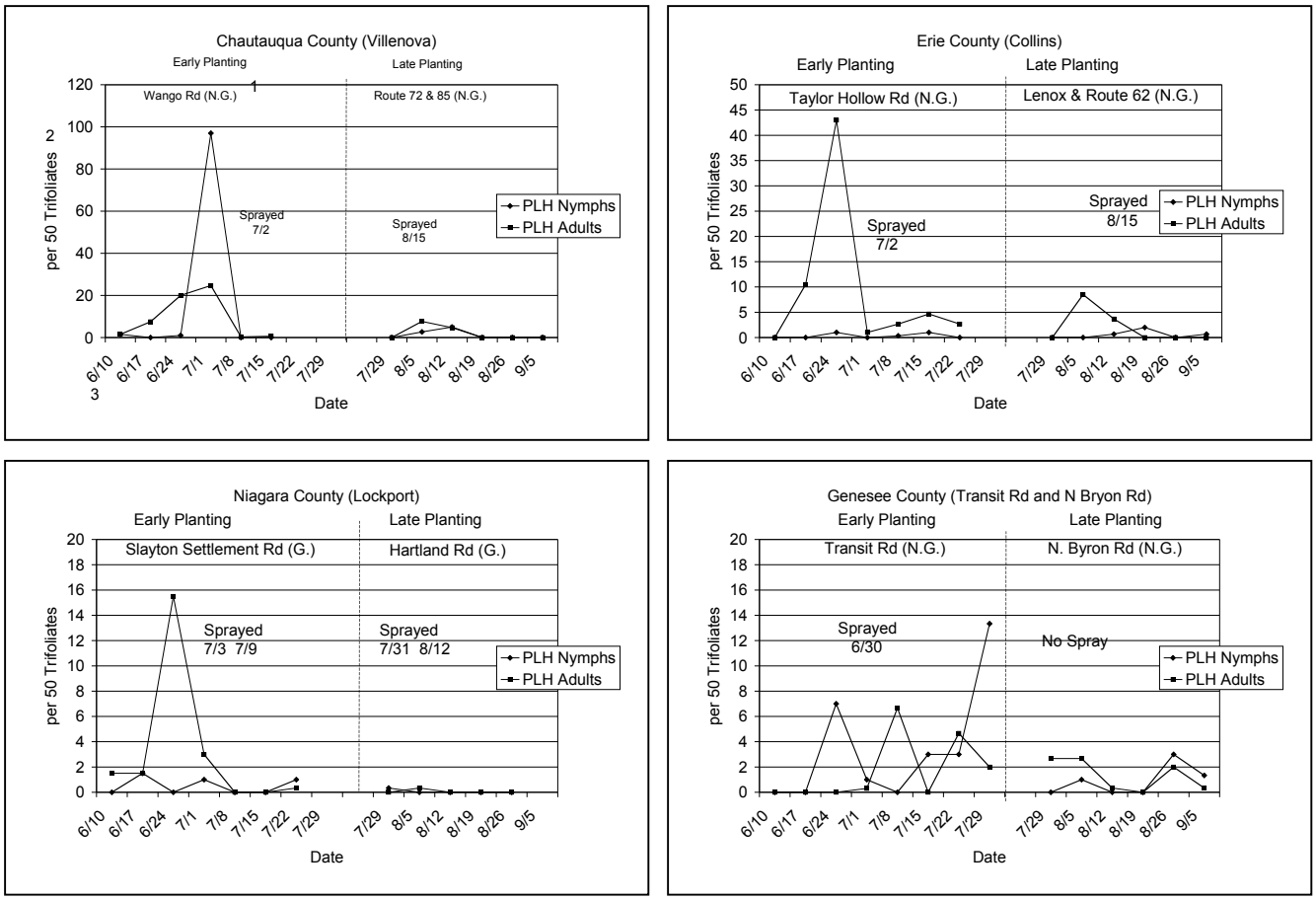
Notes:1 Early and Late Plantings are fields in the same geographical area. 2 Field locations within geographical area are described by road name. 3 Adjacent Alfalfa fields and soybean fields had 3 traps 60 yards from the edge of the field and snap bean fields had a minimum of 6 traps. 4 Alfalfa cut "by" denotes adjacent fields were cut within the week prior to the scouted date. Actual dates reported are actual dates cut.

Figure 3: Season Long Monitoring of Aphids on Plants on Early and Late Planted Snap Bean Fields in Chautauqua, Erie, Niagara, Genesee, and Orleans Counties in Western New York.



Notes: 1- N.G. & G. after the field location represents No Guacho and Gaucho seed treatment
2- Potato Leafhopper (PLH) Adults and Nymph counts are based on n=50 50 trifoliate samples.
3- Date is adjusted for 2 leaf growth stages and converted to a trifoliate.

Figure 4: Season Long Monitoring of Potato Leaf Hoppers and Nymphs on Plants in Early and Late Planted Snap Bean Fields in Chautauqua, Erie, Niagara and Genesee Counties in Western New York.



Notes: 1- N.G. & G. after the field location represents No Guacho and Gaucho seed treatment
2- Potato Leafhopper (PLH) Adults and Nymph counts are based on n=50 50 trifoliate samples.
3- Date is adjusted for 2 leaf growth stages and converted to a trifoliate.

Appendix 1: Monitoring Aphid Pressure, Movement and Distribution in Snap Beans Field Information

#	Field Location	County	Adjacent	Dates Cut[1]	Variety	Planting Date	Gaucho	Foliar Insecticide	Foliar Application	Harvest Date	Average Yield	Common[2]
	Season Monitoring Early Planting											
1	Wango Rd	Chaut.	Tim./Alfalfa	no cutting.	Zeuc	5/23	No	Orthene	7/2/02	7/21/02	3.65	
2	Slayton Settlement Rd	Niagara	Alfalfa	by 6/17 by7/22	Zuec	5/26	Yes	1-Dimethoate, 2-Orthene	1-7/3/02, 2-7/9/02	7/23/02	5.28	Nault et al
3	Taylor Hollow Rd	Erie	Alfalfa	by 6/24	Rom.942	6/1	No	1-Sevin, 2-Sevin	1-6/25/02, 2-7/16/02	8/1/02	3.93	
4	Mill Rd	Orleans	Isolated		Hystyle	6/6	No	Orthene	7/3/02	8/2/02	1.86	Nault et al
5	Center & Route 18	Orl. East	Alfalfa	by 7/25	Hystyle	6/7	Yes	Orthene	6/19/02	8/4/02	1.5	
6	Transit Rd	Genesee	Alfalfa	6/18, 7/25, 8/27	Storm	6/7	No	Dimethoate	6/30/02	8/5/02	3	Nault et al
	Season Long Late Planting											
7	Hartland Rd	Niagara	Alfalfa	by 8/19	Hercules	7/1	Yes	1-Dimethoate, 2-Orthene	1-7/31/02, 2-8/12/02	8/27/02	3.2	Nault et al
8	Angling Rd	Orleans	Isolated		Hystyle	7/4	Yes	1-Dimethoate, 2-Orthene	1-8/1/02, 2-8/14/02	8/29/02	4.68	Nault et al
9	Lennox and Rte 62	Erie	Isolated		Labrador	7/19	No	1-Sevin 2-Sevin	1-5/18/02, 2-9/7/02	9/20/02	4.4	
10	Route 72 & 85	Chaut.	Alfalfa	by 8/19	Hystyle	7/8	No	1-Orthene, 2-Sevin	1-8/15/02, 2-8/21/02	9/7/02	6	
11	North Byron Rd	Genesee	Alfalfa		Labrador	7/12	No	none	none	9/11/02	2.06	Nault et al
12	Route 98	Orl. East	Soybean		Hystyle	7/16	No	none	none	9/7/02	2.8	
	Soybeans Adjacent to Snap Bean versus Isolated Comparison											
8	Angling Rd	Orleans	Isolated		Hystyle	7/4	Yes	1-Dimethoate, 2-Orthene	1-8/1/02, 2-8/14/02	8/29/02	4.68	Nault et al
13	Harris Rd	Genesee	Isolated		Igloo	7/7	Yes	1-Capture, 2-Orthene	1-7/25/02, 2-8/9/02	9/5/02	3.95	Nault et al
14	Kelsey Rd	Genesee	Isolated		Igloo	7/15	Yes	Capture	9/6/02	9/17/02	4	Nault et al
15	Scottsville Rd	Monroe	Soybean		Summit	6/25	No	Orthene	7/15/02	8/25/02	3.81	
16	Haight Rd	Niagara	Soybean		na	na	Na	na	na	an	na	
12	Route 98	Orl. East	Soybean		Hystyle	7/16	No	none	none	9/7/02	2.8	

Notes 1 Alfalfa cutting date-Alfalfa was cut "by" this date.

2 Common refers to those fields that were in common with Nault et al's study and this survey.