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# Staff Paper Series

Farmers' Awareness and Use of IPM for Soybean Aphid Control:  
Survey Results for the 2004, 2005, and 2006 Crop Years

by

Kent D. Olson, Thaddee Badibanga, and Christina DiFonzo

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**APPLIED  
ECONOMICS**

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UNIVERSITY OF MINNESOTA

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# Farmers' Awareness and Use of IPM for Soybean Aphid Control: Survey Results for the 2004, 2005, and 2006 Crop Years<sup>1</sup>

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**Abstract:** In response to the introduction and rapid spread of soybean aphid as a major new invasive pest of soybean in North America, farmers who attended winter crop meetings in four states in North Central US were surveyed about their treatment of and knowledge about soybean aphids for crop years 2004, 2005, and 2006. Thirteen percent, 84%, and 35% of the farmers indicated they had treated for soybean aphid in 2004, 2005, and 2006, respectively. The average of the soybean acreage treated in each year was 50%, 87%, and 81%, respectively. Overall, the farmers showed a good understanding of soybean aphids and their impact on soybeans. Over 80% knew soybean aphids could repopulate and cause yield damage after an insecticide treatment. Seventy-five percent knew aphids damaged soybeans by sucking sap. Almost 80% said the frequency with which aphids should be treated for profitable control depends on aphid counts, weather conditions, and plant stage. On average, just under 70% considered an average of 250 aphids per plant to be the lowest density for profitable insecticide spraying. Scouting reports were selected by 84 to 94% of the farmers as very important information for the treatment decision; plant growth stage was the second most frequent selection.

## Introduction

The soybean aphid is a major new invasive pest of soybean in North America. In 2003, over 42 million acres of soybean in the north central U.S. were infested and over 7 million acres were treated with insecticides to control soybean aphid. Producers, industry and university research/extension personnel have identified the soybean aphid as one of the greatest threats to the U.S. soybean industry.

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<sup>1</sup> This study is part of a multi-state project, "Soybean Aphid in the North Central US: Implementing IPM on a Landscape Scale", funded in USDA's CSREES' Integrated Research, Education and Extension Competitive Grants Program – Integrated Pest Management, 112.B Risk Avoidance and Mitigation Program (RAMP).

<sup>2</sup> Kent Olson is a professor and Thaddee Badibanga is a Ph.D. candidate at the Department of Applied Economics, University of Minnesota, and Christina DiFonzo is an Associate Professor, Department of Entomology, Michigan State University. Survey assistance was provided Matthew O'Neal in Iowa and Eileen Cullen in Wisconsin.

The objective of this study is to measure soybean aphid IPM implementation and adoption and to track changes over time. To accomplish this objective, farmers were asked to complete brief surveys about their soybean production and soybean aphid treatments for crop years 2004, 2005, and 2006. Farmers completed these surveys while attending field days and winter meetings in the early months of the subsequent year, but before the next planting season began. Completing the survey was voluntary. The data in this report are not from a panel. The survey was developed by economists and entomologists on the project team. The surveys, recruitment statement, and consent statement are at the end of this report.

In the next section we report the combined numerical results from the surveys for Michigan, Minnesota, Iowa, and Wisconsin. Results for each state are presented in separate appendices. Following the numerical results, we make some concluding comments regarding the results and trends seen in the numerical results.

### **Results of Surveys for 2004, 2005, 2006 Crop Years**

For the 2004 crop year, 742 farmers completed the survey; 307 of these were in Iowa, 292 in Michigan, and 143 in Minnesota. For the 2005 crop year, 326 farmers completed the survey; 221 of these were in Michigan and 105 were in Minnesota. For the 2006 crop year, 600 farmers completed the survey, 201 of these were in Iowa, 220 in Michigan, 132 in Minnesota, and 47 in Wisconsin.

Not all the farmers said they had planted soybeans. For the crop year 2004, 91% said they planted soybeans; this percentage was 96% for 2005 and 88% for 2006 (Table 1). The average soybean acreage planted per farm was 521 in 2004, 548 in 2005, and 551 in 2006. For those who planted less than 10,000 acres, their average was 460 acres in 2004, 441 acres in 2005, and 439 acres in 2006. The median (or middle of the range) soybean acreage was 340 acres in 2004, 300 acres in 2005, and 300 acres in 2006. For those who planted less than 10,000 acres, the median was the same in each year.

For 2004, 13% said they treated an average 50% of their soybean acreage for soybean aphids. The highest level of treatment was in 2005, both in farmers treating (84%) and acres treated (87%). For 2005, 84% said they treated an average 87% of their soybean acreage. For 2006, 35% said they treated an average 81% of their soybean acreage. Of those who had treated

for aphids, the four most frequently used insecticides were Asana XL<sup>®</sup>, Lorsban 4E<sup>®</sup>, Mustang<sup>®</sup>, and Warrior<sup>®</sup> in all three years.

<b>Table 1: Reported soybean acres and aphid treatments in crop year 2004, 2005, and 2006</b>			
	<b>2004</b>	<b>2005</b>	<b>2006</b>
Number of surveys	742	326	600
Number of farmers who planted soybeans	672	313	528
Mean number of soybean acres per farm reporting soybeans	521	548	551
% of farmers treating for soybean aphids	13%	84%	34.7%
Most common insecticides used to treat for aphids*	Asana XL <sup>®</sup> , Warrior <sup>®</sup> Lorsban 4E <sup>®</sup> , Mustang <sup>®</sup>	Asana XL <sup>®</sup> , Warrior <sup>®</sup> Lorsban 4E <sup>®</sup> Mustang <sup>®</sup>	AsanaXL <sup>®</sup> , Warrior <sup>®</sup> Lorsban 4E <sup>®</sup> Mustang <sup>®</sup>
% of soybean acres treated for soybean aphids by those who did treat**	50	87	81
% of the farmers saying that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year**	81	91	87
*Some farmers in either year also reported using the following insecticides but to a lesser extent: Baythroid, Cruiser, Malathion, Nufos, Pilot, Proaxis, and Silencer. **Percentage of those farmers answering the specific question.			

Ground application was used by the vast majority of farmers in all three years. For the 2004 crop year, 80% of farmers used ground application, 17% used air application, and 3% used a mix of methods. For 2005, 87% used ground application, 8% used air application, and 5% used a mix of methods. For 2006, 78% used ground application, 10% used air application, and 12% used a mix of methods.

Most farmers made only one treatment application and most did not apply it in a mixture. For 2004, 5% of the farmers who specified the number of applications said they made more than one application; this percentage was 12% in 2005 and 7% in 2006. For 2004, 19% of those answering the question said the insecticide was mixed with a glyphosphate/Roundup application. This percentage was 19% in 2005 and 22% in 2006. For 2004, 8% of the farmers answering the question said they had mixed the insecticide with a foliar fertilizer application. This percentage was 21% in 2005 and 10% in 2006.

Over half of the farmers surveyed had treated for soybean aphids before. Fifty-five percent of farmers in 2004, 55% in 2005, and 79% in 2006 said they had treated for soybean aphids before 2004, 2005, and 2006, respectively.

More than 80% of the farmers knew soybeans aphids could repopulate after a treatment. Eighty-one percent in 2004, 91% in 2005, and 87% of farmers in 2006 said that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year.

At least 75% of the farmers knew aphids damaged soybeans by sucking sap. A declining percent chose other damage methods, but an increasing percent chose a combination of methods. Seventy-five percent in 2004, 77% in 2005, and 77% of farmers in 2006 said aphids damaged their soybeans by sucking sap (Table 2). Eleven percent in 2004, 9% in 2005, and 6% of the farmers in 2006 said aphids damaged their soybeans by chewing holes in the leaves. Three percent in 2004 and less than 1% of the farmers in 2006 and/or in 2007 said aphids damaged their soybeans by eating seed pods. Less than 1% of the farmers in each surveyed year said aphids damaged their soybeans by feeding on roots.

<b>Table 2: Percentage of farmers saying aphids damaged their soybeans in the following ways*</b>			
	<b>2004</b>	<b>2005</b>	<b>2006</b>
By Sucking sap	75%	77%	77%
By chewing holes in leaves	11	9	6
By eating seed pods	3	<1	<1
By feeding on roots	<1	0	<1
More than one choice	<1	6	9
Did not answer	11	6	8
*Percentage of those completing survey.			

Just over 75% of the farmers said profitable treatment frequency depended on aphid counts, weather conditions, and plant stage (Table 3). Seventy-seven percent in 2004, 79% in 2005, and 77% of the farmers in 2006 said the frequency with which aphids should be treated for profitable control depends on aphid counts, weather conditions, and plant stage. Fifteen percent in 2004, 16% in 2005, and 17% of farmers in 2006 said aphids should be treated *once in late July or early August*. At most, 3% of farmers in each of the surveyed years said aphids should be treated *once* in July and *once* in August. Less than 1% of farmers in each of the surveyed years said aphids should be treated *twice* in July and *twice* in August. Less than 1% of farmers in each

of the surveyed years said aphids should be treated *every week* beginning in late July through August.

<b>Table 3: Percentage of farmers indicating how often they thought aphids should be treated for profitable control*</b>			
	<b>2004</b>	<b>2005</b>	<b>2006</b>
Depends on aphid counts, weather conditions, and plant stage	77%	79%	73%
Once in late July or early August	15	16	17
Once in July and once in August	2	2	3
Twice in July and twice in August	<1	<1	<1
Every week beginning in late July through August	0	0	<1
More than one choice	<1	<1	2
Did not answer	6	2	5
*Percentage of those completing survey.			

The farmers held a range of beliefs on when aphids inflict the most damage. Thirty-seven percent in 2004, 29% in 2005, and 26% of farmers in 2006 believed that aphids can inflict significant damage at any growth stage (Table 4). Twenty-nine percent of farmers in 2004, 33% in 2005, and 33% in 2006 believed that aphids inflict the most yield damage during early flowering through pods set (R1-R3) in their soybean fields. Fifteen percent of farmers in 2004, 23% in 2005, and 17% in 2006 believed that aphids inflict the most yield damage from early vegetative (V5) through early flowering and pod set (R3, maybe R4). Twelve percent of farmers in 2004, 5% in 2005, and 11% of farmers in 2006 believed that aphids inflict the most yield damage after pods are set and seeds are filling (R4-R6). Only two percent or less in each of the surveyed years believed that aphids inflict the most yield damage during early vegetative stages (VE-V4).



<b>Table 4: Percentage of farmers who believe that aphids inflict the <u>most</u> yield damage in their soybean fields at the following growth stage</b>			
	<b>2004</b>	<b>2005</b>	<b>2006</b>
Significant damage can occur at any stage	37%	29%	26%
During early flowering through pod set (R1-R3)	29	33	33
From early vegetative (V5) through early flowering and pod set (R3, maybe R4)	15	23	17
After pods are set and seeds are filling (R4-R6).	12	5	11
During early vegetative stages (VE-V4)	2	2	1
More than one choice	<1	<1	4
Did not answer	6	8	8
*Percentage of those completing survey.			

At least two-thirds of the farmers considered 250 to be the lowest aphid density for profitable treatment (Table 5). Sixty-six percent of farmers in 2004, 73% in 2005, and 66% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 250 aphids per plant. Seventeen percent in 2004, 10% in 2005, and 10% in 2006 considered the lowest average aphid density for profitable insecticide spraying to depend on several factors. Nine percent of farmers in 2004, 7% in 2005, and 11% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 100 aphids per plant. Three percent of the farmers in each of the surveyed years considered the lowest average aphid density for profitable insecticide spraying to be greater than 1000 aphids per plant. Less than 1% in 2004 and/or in 2005, and 1% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 3 aphids per plant.

<b>Table 5: Percentage of farmers considering each of the following to be the <u>lowest</u> average aphid density for profitable insecticide spraying *</b>			
	<b>2004</b>	<b>2005</b>	<b>2006</b>
250 aphids per plant	66%	73%	66%
Depends on several factors	17	10	10
100 aphids per plant	9	7	11
>1000 aphids per plant	3	3	3
3 aphids per plant	<1	<1	1
More than one choice	<1	<1	4
Did not answer	5	2	5
*Percentage of those completing survey.			

Scouting reports were very important to most farmers for making a decision to treat, followed in importance by plant growth stage. Eighty-four percent chose scouting reports as very

important information for making a decision to treat soybean aphids in 2004. This percentage was 85% in 2005 and 94% in 2006 (Table 6). Fifty-four of farmers in 2004, 52% in 2005, and 61% in 2006 said plant growth stage was very important in their decision. Thirty-one percent in 2004, 27% in 2005, and 28% of farmers in 2006 said regional reports of aphid activity were very important. Eighteen percent of farmers in 2004, 25% in 2005, and 26% in 2006 said the availability of custom application was very important. Thirteen percent of farmers in 2004, 12% in 2005, and 13% in 2006 said a neighbor treating for aphids was very important.

<b>Table 6: Percentage of farmers indicating the importance of the following information for making a decision to treat aphids*</b>				
	VERY important	somewhat important	NOT important	No answer
<b>2004 Crop Year</b>				
Scouting reports	84%	8%	<1%	9%
Plant growth stage	54	28	4	14
Regional reports on aphid activity	31	47	12	13
A neighbor treating for aphids	13	50	25	13
The availability of custom application (aerial or ground)	18	27	42	14
Other	3	2	3	92
<b>2006 Crop Year</b>				
Scouting reports	85%	5%	<1%	10%
Plant growth stage	52	26	6	15
Regional reports on aphid activity	27	46	10	17
A neighbor treating for aphids	12	49	22	17
The availability of custom application (aerial or ground)	25	27	32	16
Other	0	0	0	100
<b>2007 Crop Year</b>				
Scouting reports	94%	5%	<1%	0%
Plant growth stage	61	30	8	0
Regional reports on aphid activity	28	60	12	0
A neighbor treating for aphids	13	53	34	0
The availability of custom application (aerial or ground)	26	31	43	0
Other	0	0	0	100
*Percentage of those completing survey.				

Fifty percent of farmers in 2005 and 51% in 2006 said they had adopted most university IPM recommendations for soybean aphids (Table 7). Thirteen percent of farmers in each year (2005 and 2006) said they had adopted all of them.

<b>Table 7: Percentage of farmers indicating their adoption level for university IPM recommendations for soybean aphids.*</b>		
	<b>2005</b>	<b>2006</b>
Do not understand them	2%	1%
Not at all	2	2
Somewhat	23	23
Most of them	50	51
All of them	13	13
Did not answer	11	11
*Percentage of those completing survey. This question was not in the survey for 2004.		

## Concluding Comments

The survey results show a good level of knowledge about soybean aphids on most topics. Over 80%, increasing to almost 90%, of the farmers completing the survey knew that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year. At least 75% knew aphids damaged soybeans by sucking sap. In 2004 and 2005, almost 80% said the frequency with which aphids should be treated for profitable control depends on aphid counts, weather conditions, and plant stage—although this understanding slipped to 73% for the 2006 crop year. Sixty-six percent of the farmers chose 250 aphids per plant as the lowest average aphid density for profitable insecticide spraying in 2004. This percentage rose to 73% for 2005 but fell back to 66% for 2006. The percent saying the lowest average aphid density was 100 rose from 9% in 2004 to 11% in 2006 while the percent saying it depended on several factors fell from 17% to 10%. A consistent 3% said the treatment level was greater than 1000. The farmers held an even greater range of knowledge of when aphids could inflict the most damage: 29-33% said during early flowering through pod set (R1-R3); 26-37% said any stage; 15-23% said from early vegetative (V5) through R3 or maybe R4; and 5-12% said R4-R6. This dispersion did not narrow over the three years. The reliance on scouting reports and plant growth stage for making treatment decisions did increase over time, but so did the availability of custom application. The farmers were consistent in their adoption of

university IPM recommendations for soybean aphids: 50-51% said they adopted most of the recommendations and 13% said they adopted all of them.

## Appendix A: Michigan Results for Survey for 2004, 2005, and 2006 Crop Years

For the 2004 crop year, 292 Michigan farmers completed the brief surveys. This number was 221 for the 2005 crop year and 220 for the 2006 crop year. The average soybean acreage planted per farm was 360 in 2004, 422 in 2005, and 373 in 2006. The median (or middle of the range) soybean acreage was 240 in 2004, 280 in 2005, and 200 in 2006 (Table A-1). No farm planted more than 3,500 acres of soybeans in each of the surveyed years.

For the crop year 2004, 5% of the Michigan farmers said they treated on average 48% of their soybean acreage for soybean aphids. For the crop year 2005, 91% of the Michigan farmers said they treated on average 87% of their soybean acreage for soybean aphids. For the crop year 2006, 4% of the Michigan farmers said they treated on average 81% of their soybean acreage for soybean aphids.

Table A-1. Michigan's Reported soybean acres and aphid treatments in crop years 2004, 2005, and 2006			
	2004	2005	2006
Number of surveys	292	221	220
Number of farmers who planted soybeans	261	210	194
Mean number of soybean acres per farm reporting soybeans	360	422	373
% of farmers treating for soybean aphids	5%	91%	4%
Most common insecticides used to treat for aphids*	Asana L <sup>®</sup> Warrior <sup>®</sup>	Asana L <sup>®</sup> Lorsban 4E <sup>®</sup> Mustang <sup>®</sup> Warrior <sup>®</sup>	Asana L <sup>®</sup> Lorsban 4E <sup>®</sup> Mustang <sup>®</sup> Warrior <sup>®</sup>
% of soybean acres treated for soybean aphids by those who did treat**	48%	87%	81%
% of farmers who had treated for soybean aphids before 2004, 2005, and 2006**	44%	50%	83%
% of the farmers saying that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year**	79%	93%	93%
*Some farmers in either year also reported using the following insecticides but to a lesser extent: Baythroid, Cruiser, Dimethoate, and Imidan. ** Percentage of those completing the survey.			

Of those who specified the *application method* used, 26% in 2004, 19% in 2005, and 95% in 2006 said they used ground application. Of those who specified the *number of applications*, 8% in 2004, 15% in 2005, and 8% in 2006 said they made more than one application.

Of those who answered the question, 27% in 2004, 15% in 2005, and 25% in 2006 said the insecticide tank was mixed with a glyphosphate/Roundup. Twenty-seven percent of farmers in 2004, 26% in 2005, and 27% in 2006 said they mixed the insecticide with a foliar fertilizer application.

Forty-six percent of farmers in 2004, 50% in 2005, and 83% in 2006 said they had treated for soybean aphids before 2004, 2005, and 2006, respectively.

Seventy-nine percent in 2004, 93% in 2005, and 93% of farmers in 2006 said that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year. One percent of the farmers in 2004, 2% in 2005, and 4% in 2006 said no. Eight percent in 2004, 5% in 2005, and 3% in 2006 were not sure.

Seventy-two percent in 2004, 78% in 2005, and 76% of farmers in 2006 said aphids damaged their soybeans by sucking sap. Eleven percent in 2004, 9% in 2005, and 5% of the farmers in 2006 said aphids damaged their soybeans by chewing holes in the leaves. Three percent in 2004 and less than 1% of the farmers in 2005 and/or in 2006 said aphids damaged their soybeans by eating seed pods. None of the farmers in each of the surveyed year said aphids damaged their soybeans by feeding on roots.

Seventy percent in 2004, 79% in 2005, and 74% of the farmers in 2006 said the frequency with which aphids should be treated for profitable control depends on aphid counts, weather conditions, and plant stage. Eighteen percent in 2004, 16% in 2005, and 17% of farmers in 2006 said aphids should be treated *once in late July or early August*. Only three percent in each of the surveyed years said aphids should be treated *once* in July and *once* in August. One percent or less in each of the surveyed years said aphids should be treated *twice* in July and *twice* in August. None of the farmers for 2004 and 2005 and less than 1% of the farmers for 2006 said aphids should be treated *every week* beginning in late July through August. Less than 1% in each of the surveyed years either chose more than one answer or did not answer the question.

Thirty-six percent in 2004, 31% in 2005, and 28% of farmers in 2006 believed that aphids can inflict significant damage at any growth stage. Twenty-five percent of farmers in 2004, 29% in 2005, and 34% in 2006 believed that aphids inflict the most yield damage during early flowering through pods set (R1-R3) in their soybean fields. Twenty-one percent of farmers in 2004, 21% in 2005, and 18% in 2006 believed that aphids inflict the most yield damage from early vegetative (V5) through early flowering and pod set (R3, maybe R4). Eight percent of

farmers in 2004, 4% in 2005, and 5% of farmers in 2006 believed that aphids inflict the most yield damage after pods are set and seeds are filling (R4-R6). Four percent in 2004, 2% in 2005, and no farmer in 2006 believed that aphids inflict the most yield damage during early vegetative stages (VE-V4).

Seventy-one percent of farmers in 2004, 75% in 2005, and 72% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 250 aphids per plant. Eleven percent in 2004, 7% in 2005, and 8% in 2006 considered the lowest average aphid density for profitable insecticide spraying to depend on several factors. Nine percent of farmers in 2004, 5% in 2005, and 6% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 100 aphids per plant. One percent of farmers in 2004, 8% in 2005, and 2% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be greater than 1000 aphids per plant. Less than 1% in 2004, none of farmers in 2005, and less than 1% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 3 aphids per plant.

The most important information for making a decision to treat soybean aphids was scouting reports with 78% of farmers in 2004, 82% in 2005, and 90% in 2006 rating this as very important. Fifty-one percent of farmers in 2004, 50% in 2005, and 57% in 2006 said plant growth stage was very important in their decision. Thirty-seven percent in 2004, 29% of in 2005, and 38% of farmers in 2006 said regional reports of aphid activity were very important. Eighteen percent of farmers in 2004, 11% in 2005, and 21% in 2006 said the availability of custom application was very important. Eighteen percent of farmers in 2004, 24% in 2005, and 16% in 2006 said a neighbor treating for aphids was very important. Other information specified as important by farmers in either of the surveyed years included: weather conditions, free time to apply, insecticide choice and cost, price of soybean, and application cost.

Forty-eight percent of farmers in 2005 and 48% in 2006 said they had adopted most university IPM recommendations for soybean aphids. Thirteen percent of farmers in 2005 and 15% in 2006 said they had adopted all of them.

## Appendix B: Minnesota Results for Survey for 2004, 2005, and 2006 Crop Years

For the 2004 crop year, 143 Minnesota farmers completed the brief surveys. This number was 105 for the 2005 crop year and 132 for the 2006 crop year. The average soybean acreage planted per farm was 541 in 2004, 756 in 2005, and 671 in 2006. The median (or middle of the range) soybean acreage was 400 in 2004, 400 in 2005, and 340 in 2006 (Table B-1). No farm planted more than 3,500 acres of soybeans in each of the surveyed years.

For the crop year 2004, 10% of the Minnesota farmers said they treated on average 40% of their soybean acreage for soybean aphids. For the crop year 2005, 67% of the Minnesota farmers said they treated on average 87% of their soybean acreage for soybean aphids. For the crop year 2006, 69% of the Minnesota farmers said they treated on average 89% of their soybean acreage for soybean aphids.

Table B-1. Minnesota's Reported soybean acres and aphid treatments in crop year 2004, 2005, and 2006			
	<b>2004</b>	<b>2005</b>	<b>2006</b>
Number of surveys	143	105	132
Number of farmers who planted soybeans	132	103	119
Mean number of soybean acres per farm reporting soybeans	541	756	671
% of farmers treating for soybean aphids	10%	67%	69%
Most common insecticides used to treat for aphids*	Asana XL® Lorsban 4E® Warrior®	Asana XL® Lorsban 4E® Warrior®	Asana XL® Lorsban 4E® Mustang® Warrior®
% of soybean acres treated for soybean aphids by those who did treat**	40%	87%	89%
% of farmers who had treated for soybean aphids before 2004, 2005, and 2006**	76%	66%	92%
% of the farmers saying that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year**	93%	87%	95%
*Some farmers in either year also reported using the following insecticides but to a lesser extent: Baythroid, Chlorpyrifos, Malathion, Pilot, and Proaxis. **Percentage of those completing the survey.			

Of those who specified the application method used, 83% in 2004, 67% in 2005, and 83% in 2006 said they used ground application. Of those who specified the number of applications, 5% in 2004, 0% in 2005, and 11% in 2006 said they made more than one application.



Of those who answered the question, 19% in 2004, 17% in 2005, and 31% in 2006 said the insecticide tank was mixed with a glyphosphate/Roundup. None of farmers in 2004, 6% in 2005, and 4% in 2006 said they mixed the insecticide with a foliar fertilizer application.

Seventy-six percent of farmers in 2004, 66% in 2005, and 92% in 2006 said they had treated for soybean aphids before 2004, 2005, and 2006, respectively.

Ninety-three percent in 2004, 87% in 2005, and 95% of farmers in 2006 said that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year. Less than 1% of the farmers in 2004, 3% in 2005, and 2% in 2006 said no.

Eighty-two percent in 2004, 75% in 2005, and 82% of farmers in 2006 said aphids damaged their soybeans by sucking sap. Nine percent in 2004, 10% in 2005, and 5% of the farmers in 2006 said aphids damaged their soybeans by chewing holes in the leaves. Four percent in 2004, 2% in 2005, and 2% of the farmers in 2006 said aphids damaged their soybeans by eating seed pods. None of the farmers in each of the surveyed year said aphids damaged their soybeans by feeding on roots.

Eighty-seven percent in 2004, 77% in 2005, and 74% of the farmers in 2006 said the frequency with which aphids should be treated for profitable control depends on aphid counts, weather conditions, and plant stage. Ten percent in 2004, 19% in 2005, and 19% of farmers in 2006 said aphids should be treated *once in late July or early August*. None of the farmers in 2004, less than 1% in 2005, and 2% in 2006 said aphids should be treated *once* in July and *once* in August. One percent or less in each of the surveyed years said aphids should be treated *twice* in July and *twice* in August. None of the farmers in 2004 and/or 2005 and less than 1% of the farmers in 2006 said aphids should be treated *every week* beginning in late July through August.

Thirty-two percent in 2004, 24% in 2005, and 24% of farmers in 2006 believed that aphids can inflict significant damage at any growth stage. Thirty-eight percent of farmers in 2004, 39% in 2005, and 36% in 2006 believed that aphids inflict the most yield damage during early flowering through pods set (R1-R3) in their soybean fields. Thirteen percent of farmers in 2004, 26% in 2005, and 21% in 2006 believed that aphids inflict the most yield damage from early vegetative (V5) through early flowering and pod set (R3, maybe R4). Twelve percent of farmers in 2004, 6% in 2005, and 11% of farmers in 2006 believed that aphids inflict the most yield damage after pods are set and seeds are filling (R4-R6). Only one percent of farmers in

2004, 1% in 2005, and 2% in 2006 believed that aphids inflict the most yield damage during early vegetative stages (VE-V4).

Seventy-four percent of farmers in 2004, 68% in 2005, and 58% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 250 aphids per plant. Seventeen percent in 2004, 15% in 2005, and 17% in 2006 considered the lowest average aphid density for profitable insecticide spraying to depend on several factors. Four percent of farmers in 2004, 12% in 2005, and 17% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 100 aphids per plant. Three percent of farmers in 2004, 3% in 2005, and less than 1% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be greater than 1000 aphids per plant. None of farmers in 2004 and/or 2005, and less than 1% in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 3 aphids per plant.

The most important information for making a decision to treat soybean aphids was scouting reports with 87% of farmers in 2004, 91% in 2005, and 96% in 2006 rating this as very important. Sixty percent of farmers in 2004, 57% in 2005, and 60% in 2006 said plant growth stage was very important in their decision. Twenty-three percent in 2004, 23% of in 2005, and 16% of farmers in 2006 said regional reports of aphid activity were very important. Twenty percent of farmers in 2004, 26% in 2005, and 30% in 2006 said the availability of custom application was very important. Seven percent of farmers in 2004, 13% in 2005, and 8% in 2006 said a neighbor treating for aphids was very important. Other information specified as important by farmers in either of the surveyed years included: weather conditions, free time to apply, insecticide choice and cost, price of soybean, and application cost.

Forty-four percent of farmers in 2005 and 58% in 2006 said they had adopted most university IPM recommendations for soybean aphids. Twelve percent of farmers in 2005 and 11% in 2006 said they had adopted all of them.

## Appendix C: Iowa Results of Survey for Crop Years 2004 and 2006

For the 2004 crop year, 307 Iowa farmers completed the brief surveys (Table C-1). This number was 201 for the 2006 crop year. (The survey was not completed in Iowa for 2005.) The average soybean acreage planted per farm was 662 in 2004 and 726 in 2006. The median (or middle of the range) soybean acreage was 400 in 2004 and 450 in 2006. Three farms surveyed in 2004 and two in 2006 planted more than 3,500 acres of soybeans. Of those who planted less than 3,500 acres of soybeans, the average soybean acreage was 547 in 2004 and 552 in 2006. However, the median soybean acreage for those who planted less than 3,500 acres of soybeans was the same in each surveyed year, that is, 400 in 2004 and 450 in 2006.

For the crop year 2004, 21% of the Iowa farmers said they treated on average 54% of their soybean acreage for soybean aphids. For the crop year 2006, 48% of the Iowa farmers said they treated on average 75% of their soybean acreage for soybean aphids.

Table C-1. Iowa's Reported soybean acres and aphid treatments in crop years 2004 and 2006		
	2004	2006
Number of surveys	307	201
Number of farmers who planted soybeans	279	175
Mean number of soybean acres per farm reporting soybeans	662	726
% of farmers treating for soybean aphids	21%	48%
% of soybean acres treated for soybean aphids by those who did treat*	54%	75%
Most common insecticides used to treat for aphids	Asana XL <sup>®</sup> , Lorsban 4E <sup>®</sup> , Warrior <sup>®</sup>	Asana XL <sup>®</sup> , Lorsban 4E <sup>®</sup> , Mustang <sup>®</sup> , Warrior <sup>®</sup>
% of farmers who had treated for soybean aphids before 2004, 2005, and 2006*	55%	69%
% of the farmers saying that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year*	76%	92%
*Percentage of completing the survey.		

Of those who specified the application method used, 70% in 2004 and 84% in 2006 said they used ground application. Of those who specified the number of applications, 3% in 2004 and 1.1% in 2006 said they made more than one application.

Of those who answered the question, 15% in 2004 and 12% in 2006 said the insecticide tank was mixed with a glyphosphate/Roundup. Of those who answered the question, no farmers

in 2004 and 5% of farmers in 2006 said they mixed the insecticide with a foliar fertilizer application.

Fifty-five percent of farmers in 2004 and 69% of farmers in 2006 said they have treated for soybean before 2004 and 2006, respectively.

Seventy-six percent of farmers in 2004 and 90% of farmers in 2006 said that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year. Three percent in 2004 and 1.5% of the farmers in 2006 said no. Thirteen percent of farmers in 2004 and 6% of farmers in 2006 were not sure. Eight percent of farmers in 2004 and 3% of farmers in 2006 did not answer the question.

Seventy-five percent of farmers in 2004 and 77% of farmers in 2006 said aphids damaged their soybeans by sucking sap. Eleven percent of farmers in 2004 and 5.5% of farmers in 2006 said aphids damaged their soybeans by chewing holes in the leaves. Two percent of farmers in 2004 and no farmers in 2006 said aphids damaged their soybeans by eating seed pods or feeding on roots. Twelve percent of farmers in 2004 and 4% of farmers in 2006 did not answer the question.

Seventy-eight percent of farmers in 2004 and 74% of the farmers in 2006 said the frequency with which aphids should be treated for profitable control depends on aphid counts, weather conditions, and plant stage. Fourteen percent of farmers in 2004 and 18% of farmers in 2006 said aphids should be treated *once in late July or early August*. Only 3% of farmers in 2004 and 4% of farmers in 2006 said aphids should be treated *once* in July and *once* in August. Less than one percent of farmers in 2004 and 1% of farmers in 2006 said aphids should be treated *twice* in July and *twice* in August. None of the farmers in each of the surveyed year said aphids should be treated *every week* beginning in late July through August. Fifteen percent of farmers in 2004 and 2% of farmers in 2006 did not answer the question.

Thirty-nine percent of farmers in 2004 and 26% of farmers in 2006 believed that aphids can inflict significant damage at any growth stage. Twenty-eight percent of farmers in 2004 and 26% of farmers in 2006 believed that aphids inflict the most yield damage during early flowering through pods set (R1-R3) in their soybean fields. Eleven percent of farmers in 2004 and 14% of farmers in 2006 believed that aphids inflict the most yield damage from early vegetative (V5) through early flowering and pod set (R3, maybe R4). Sixteen percent of farmers in 2004 and 21% of farmers in 2006 believed that aphids inflict the most yield damage after pods are set and

seeds are filling (R4-R6). Less than one percent of farmers in 2004 and 1% of farmers in 2006 believed that aphids inflict the most yield damage during early vegetative stages (VE-V4). Three percent of farmers in 2004 and 8% of farmers in 2006 did not answer the question.

Fifty-six percent of farmers in 2004 and 65% of farmers in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 250 aphids per plant. Twenty-two percent of farmers in 2004 and 7% of farmers in 2006 considered the lowest average aphid density for profitable insecticide spraying to depend on several factors. Eleven percent of farmers in 2004 and 14% of farmers in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 100 aphids per plant. Six percent of farmers in 2004 and 5% of farmers in 2006 considered the lowest average aphid density for profitable insecticide spraying to be greater than 1000 aphids per plant. Less than one percent of farmers in 2004 and 1% of farmers in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 3 aphids per plant. Four percent of farmers in 2004 and 3% of farmers in 2006 did not answer the question.

The most important information for making a decision to treat soybean aphids was scouting reports with 87% of farmers in 2004 and 95% of farmers in 2006 rating this as very important. Fifty-five percent of farmers in 2004 and 65% in 2006 said plant growth stage was very important in their decision. Thirty percent of farmers in 2004 and 25% of farmers in 2006 said regional reports of aphid activity were very important. Fourteen percent of farmers in 2004 and 22% of farmers in 2006 said the availability of custom application was very important. Ten percent of farmers in 2004 and 13% of farmers in 2006 said a neighbor treating for aphids was very important. Other information specified as important by farmers included: temperature, weather conditions, weather forecast, moisture forecast, moisture availability, insecticide pressure, price of soybean, ISU extension, personal scouting, time of maturity, agronomist recommendation, what's in own field, IPM newsletter, population in own field, drought, and rain.

Fifty-seven percent of farmers in 2006 said they had adopted most university IPM recommendations for soybean aphids. Sixteen percent said they had adopted all of them.

## Appendix D: Wisconsin Results of Survey for the Crop Year 2006

For the 2006 crop year, 47 Wisconsin farmers completed the brief surveys. The average soybean acreage planted per farm was 296 (Table D-1). The median (or middle of the range) soybean acreage was 200. No farm planted more than 3,500 acres of soybeans in 2006.

For the crop year 2006, 25% of the Iowa farmers said they treated on average 68% of their soybean acreage for soybean aphids.

Table D-1. Wisconsin's Reported soybean acres and aphid treatments in crop year 2006	
	2006
Number of surveys	47
Number of farmers who planted soybeans	40
Mean number of soybean acres per farm reporting soybeans	296
% of farmers treating for soybean aphids	25%
% of soybean acres treated for soybean aphids by those who did treat*	68%
Most common insecticides used to treat for aphids**	Lorsban 4E®, Warrior®
% of farmers who had treated for soybean aphids before 2006*	71%
% of the farmers saying that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year*	81%
*Percentage of farmers completing the survey.	
**Silencer was also used but less frequently.	

Of those who specified the application method used in 2006, 32% said they used ground application. Of those who specified the number of applications, 7% said they made more than one application.

Of those who answered the question, 7% said the insecticide tank was mixed with a glyphosphate/Roundup, and 21% said they mixed the insecticide with a foliar fertilizer application.

Seventy-one percent of farmers said they have treated for soybean before 2006.

Seventy-five percent of farmers in 2006 said that once a field is treated with an insecticide, soybean aphids could repopulate and cause yield damage in the same year. Six percent of the farmers said no, 11% were not sure, and 9% did not answer the question.

Sixty-six percent of farmers in 2006 said aphids damaged their soybeans by sucking sap. Fifteen percent said aphids damaged their soybeans by chewing holes in the leaves. None of the

farmers in each of the surveyed year said aphids damaged their soybeans by eating seed pods or feeding on roots. Eleven chose combinations and 9% did not answer the question.

Sixty-two percent of the farmers in 2006 said the frequency with which aphids should be treated for profitable control depends on aphid counts, weather conditions, and plant stage. Twenty-one percent said aphids should be treated *once in late July or early August*. None of the farmers said aphids should be treated *once* in July and *once* in August or *twice* in July and *twice* in August or *every week* beginning in late July through August. Eight percent chose more than one answer, and 9% did not answer the question.

Nineteen percent of farmers in 2006 believed that aphids can inflict significant damage at any growth stage. Forty-three percent of farmers believed that aphids inflict the most yield damage during early flowering through pods set (R1-R3) in their soybean fields. Nineteen percent believed that aphids inflict the most yield damage from early vegetative (V5) through early flowering and pod set (R3, maybe R4). None of farmers believed that aphids inflict the most yield damage after pods are set and seeds are filling (R4-R6). Only four percent believed that aphids inflict the most yield damage during early vegetative stages (VE-V4). Fifteen percent did not answer the question.

Fifty-eight percent of farmers in 2006 considered the lowest average aphid density for profitable insecticide spraying to be 250 aphids per plant. Fifteen percent considered the lowest average aphid density for profitable insecticide spraying to depend on several factors. Eleven percent considered the lowest average aphid density for profitable insecticide spraying to be 100 aphids per plant. None of farmers considered the lowest average aphid density for profitable insecticide spraying to be greater than 1000 aphids per plant. Only 2% of farmers considered the lowest average aphid density for profitable insecticide spraying to be 3 aphids per plant. Six percent chose multiple answers, and 9% did not answer the question.

The most important information for making a decision to treat soybean aphids was scouting reports with 95% of farmers in 2006 rating this as very important. Seventy-three percent said plant growth stage was very important in their decision. Twenty-five percent said regional reports of aphid activity were very important. Twenty-three percent said the availability of custom application was very important. Sixteen percent said a neighbor treating for aphids was very important. Other information specified as important by farmers included: price of soybean versus cost of treatment, presence of spider mites at threshold, and own scouting.

Fifty-five percent of farmers in 2006 said they had adopted most university IPM recommendations for soybean aphids. Seven percent said they had adopted all of them.



**Controlling Soybean Aphids in Soybeans**  
**RECRUITMENT STATEMENT**  
**Brief Farmer Survey**

Since you are attending today's meeting on soybean production, we invite you to participate in a regional research study of the cost, benefit, perception, and adoption of production methods for reducing the negative impacts of soybean aphids in soybean production. Results will be made available by state.

The purpose of this study is to better understand growers' motives and levels of adoption of soybean aphid IPM. If you agree to be in this study, you will be asked a series of questions about your practices, expenses, and yields related to soybean production; your perceptions of the efficacy of the alternative aphid control methods; your farm; and yourselves. There are no questions that will allow us to identify you, your farm, or your answers. The survey will take approximately 10 minutes to complete

The only risks involved with this study involve the possibility that questions regarding you, your farm and your practices, expenses, and yields may be considered sensitive. However since the surveys have no name or identification on them, they are anonymous and no one can identify you, your farm, or your answers.

The benefits to participation are the chance to help improve our understanding of the costs, benefits, and efficacy of alternative production techniques. This knowledge can potentially improve your economic viability and reduce your exposure to risk.

Your decision whether or not to participate is entirely voluntary and will not affect your current or future relations with our University or the University of Minnesota. Further details are available in the consent statement being handed out with the brief survey.

Are there any questions about this survey or why you are being asked to participate?

[If there are questions, we'll answer them at this point.]

If there are none, we'll hand out the survey. Please return your completed surveys to the end of the row [or boxes by the door, ... These details may differ with meeting location.]

**Controlling Soybean Aphids in Soybeans**  
**CONSENT STATEMENT**  
**Brief Farmer Survey**

You are invited to be in a research study of the cost, benefit, perception, and adoption of production methods for reducing the negative impacts of soybean aphids in soybean production. You were selected as a possible participant because you are attending a soybean production meeting. We ask that you read this form and ask any questions you may have before agreeing to be in this portion of the regional study.

Dr. Kent Olson, Professor in the Department of Applied Economics at the University of Minnesota, is conducting this portion of the study. Results will be available and reported in all states involved.

**Background Information:** The purpose of this study is to better understand growers' motives and levels of adoption of soybean aphid IPM. If you agree to be in this study, you will be asked a series of questions about your practices, expenses, yields, related to soybean production your perceptions of the efficacy of the alternative aphid control methods, your farm, and yourselves. There are no questions that will allow us to identify you, your farm, or your answers. The survey will take approximately 10 minutes to complete

**Procedures:** If you agree to be in this study, you will be asked a series of questions about your practices, expenses, and yields related to soybean production; your perceptions of the efficacy of the alternative aphid control methods; your farm; and yourselves. There are no questions that will allow us to identify you, your farm, or your answers. The survey will take approximately 10 minutes to complete. This will be the only activity you will need to do as part of this portion of the study.

**Risks and Benefits of Being in the Study:** The only risks involved with this study involve the possibility that questions regarding you, your farm and your practices, expenses, and yields may be considered sensitive. However since the surveys have no name or identification on them, they are anonymous and no one can identify you, your farm, or your answers.

The benefits to participation are the chance to help improve our understanding of the costs, benefits, and efficacy of alternative production techniques. This knowledge can potentially improve your economic viability and reduce your exposure to risk.

**Confidentiality:** The records of this study will be kept private. There is no name or identification attached to the survey so the information will be anonymous. There is no way to identify the person being interviewed. Only the staff involved with the survey and its analysis will have access to the completed surveys. In any sort of report we might publish, we will include only summary information and statistical results. We will not include any information that will make it possible to identify a subject. Research records will be kept in a secure area; only researchers will have access to the records.

**Voluntary Nature of the Study:** Your decision whether or not to participate is entirely voluntary and will not affect your current or future relations with the University of Minnesota.

**Contacts and Questions:** The researchers conducting this study are Dr. Kent Olson, Department of Applied Economics, University of Minnesota. You may ask any questions you have now. If you have any questions later, you may contact Kent Olson at 612-625-7723. If you have any questions or concerns regarding the study and would like to talk to someone other than the researchers, contact Research Subjects' Advocate line, D528 Mayo, 420 Delaware Street S.E., Minneapolis, Minnesota 55455; telephone (612) 625-1650.

This is your copy to keep for your records.

LOCATION: \_\_\_\_\_ DATE: \_\_\_\_\_

PLEASE ANSWER THE FOLLOWING QUESTIONS  
BY FILLING IN THE BLANK OR CIRCLING YOUR ANSWER.

1. How many acres of soybeans did you plant in 2004? \_\_\_\_\_
2. What percent of your soybean acres did you treat for soybean aphids in 2004? \_\_\_\_\_%
3. If you treated for aphids, what insecticide did you use? And at what rate and how was it applied?
  - a. Insecticide: \_\_\_\_\_
  - b. Rate: \_\_\_\_\_
  - c. How was it applied? (circle one):                      ground      air      seed treatment
  - d. Did you make more than one application?    No    Yes    (If yes, describe the details on back.)
  - e. Was the insecticide tank mixed with:
 

(1) a glyphosate/Roundup application?	Yes	No	Not sure
(2) a foliar fertilizer application?	Yes	No	Not sure
4. Have you treated for soybean aphids before 2004?    Yes    No    Not sure
5. Once a field is treated with an insecticide, can soybean aphids repopulate and cause yield damage in the same year?                      Yes  
No    Not sure
6. How did aphids damage your soybeans?
  - a. By chewing holes in the leaves
  - b. By eating seed pods
  - c. By sucking sap
  - d. By feeding on roots
7. How often do you think aphids should be treated for profitable control?
  - a. Once in late July or early August
  - b. Twice in July and twice in August
  - c. Once in July and once in August
  - d. Every week beginning in late July through August
  - e. Depends on aphid counts, weather conditions, and plant stage
8. At what growth stages do you believe that aphids inflict the most yield damage in your soybean fields?
  - a. During early vegetative stages (VE-V4)
  - b. From early vegetative (V5) through early flowering and pod set (R3, maybe R4)
  - c. During early flowering through pods set (R1-R3)
  - d. After pods are set and seeds are filling (R4-R6)
  - e. Significant damage can occur at any stage
9. What do you consider to be the lowest average aphid density for profitable insecticide spraying?
  - a. 3 aphids per plant
  - b. 100 aphids per plant
  - c. 250 aphids per plant
  - d. >1000 aphids per plant
  - e. Depends on several factors
10. Rate the importance of the following information for you to make a decision to treat soybean aphids.
 

a.	2	1	0	The availability of custom application (aerial or ground)	
b.	2	1	0	Plant growth stage	2 = VERY important to you
c.	2	1	0	Scouting reports (mine or a consultant's)	1 = somewhat important to you
d.	2	1	0	A neighbor treating for aphids	0 = NOT important to you
e.	2	1	0	Regional reports on aphid activity	
f.	2	1	0	Other, please specify: _____	

LOCATION: \_\_\_\_\_ DATE: \_\_\_\_\_

PLEASE ANSWER THE FOLLOWING QUESTIONS  
BY FILLING IN THE BLANK OR CIRCLING YOUR ANSWER.

1. How many acres of soybeans did you plant in 200\_? \_\_\_\_\_
2. What percent of your soybean acres did you treat for soybean aphids in 200\_? \_\_\_\_\_%
3. If you treated for aphids, what insecticide did you use? And at what rate and how was it applied?
  - f. Insecticide: \_\_\_\_\_
  - g. Rate: \_\_\_\_\_
  - h. How was it applied? (circle one):                      ground      air      seed treatment
  - i. Did you make more than one application?      No      Yes      (If yes, describe the details on back.)
  - j. Was the insecticide tank mixed with:
    - (1) a glyphosphate/Roundup application?      Yes      No      Not sure
    - (2) a foliar fertilizer application?      Yes      No      Not sure
4. Have you treated for soybean aphids before 200\_?      Yes      No      Not sure
5. Once a field is treated with an insecticide, can soybean aphids repopulate and cause yield damage in the same year?  
Yes      No      Not sure
6. How did aphids damage your soybeans?
  - e. By chewing holes in the leaves
  - f. By eating seed pods
  - g. By sucking sap
  - h. By feeding on roots
7. How often do you think aphids should be treated for profitable control?
  - f. Once in late July or early August
  - g. Twice in July and twice in August
  - h. Once in July and once in August
  - i. Every week beginning in late July through August
  - j. Depends on aphid counts, weather conditions, and plant stage
8. At what growth stages do you believe that aphids inflict the most yield damage in your soybean fields?
  - e. During early vegetative stages (VE-V4)
  - f. From early vegetative (V5) through early flowering and pod set (R3, maybe R4)
  - g. During early flowering through pods set (R1-R3)
  - h. After pods are set and seeds are filling (R4-R6)
  - e. Significant damage can occur at any stage
9. What do you consider to be the lowest average aphid density for profitable insecticide spraying?
  - f. 3 aphids per plant
  - g. 100 aphids per plant
  - h. 250 aphids per plant
  - i. >1000 aphids per plant
  - j. Depends on several factors
10. Rate the importance of the following information for you to make a decision to treat soybean aphids.
  - g. 2    1    0    The availability of custom application (aerial or ground)
  - h. 2    1    0    Plant growth stage                                              2 = VERY important to you
  - i. 2    1    0    Scouting reports (mine or a consultant's)                      1 = somewhat important to you
  - j. 2    1    0    A neighbor treating for aphids                                              0 = NOT important to you
  - k. 2    1    0    Regional reports on aphid activity
  - l. 2    1    0    Other, please specify: \_\_\_\_\_
11. How well have you adopted university IPM recommendations for soybean aphids?  
Don't understand them      Not at all      Somewhat      Most of them      All of them