Pest Management in Indiana Soybean Production Systems

Article *in* Journal of Extension · August 2007

CITATIONS
14

READS
36

4 authors, including:

Shawn Paul Conley
University of Wisconsin–Madison
164 PUBLICATIONS **2,427** CITATIONS
SEE PROFILE

Christian H Krupke
Purdue University
115 PUBLICATIONS **4,474** CITATIONS
SEE PROFILE

Gregory E. Shaner
Purdue University
84 PUBLICATIONS **5,288** CITATIONS
SEE PROFILE

Journal of Extension
www.joe.org

August 2007 // Volume 45 // Number 4 // Research in Brief // 4RIB8

Pest Management in Indiana Soybean Production Systems

Abstract
As the disparity in farm size continues to increase and university Extension budgets tighten, it is imperative that Extension correctly identifies the specific needs of our clientele. Our objective was to identify clientele educational needs and to provide a framework for directing applied soybean research efforts. This assessment was conducted through a detailed direct-mail survey that was sent to 5,000 (1,330 respondents) Indiana soybean growers. The results of the survey demonstrate differences among grower operation sizes with respect to scouting and pest management practices. Farmers with large operations generally scout and manage pests more intensively than small or mid-size farmers.

Shawn P. Conley
Soybean Extension Specialist
conleysp@purdue.edu

Christian Krupke
Field Crops Extension Entomologist
ckrupke@purdue.edu

Judy Santini
Research Statistical Analyst
jsantini@purdue.edu

Gregory Shaner
Extension Plant Pathologist
shanerg@purdue.edu

Purdue University
West Lafayette, Indiana

Introduction

The introduction of Roundup Ready soybean in 1996 significantly changed soybean management in the United States. The insertion of a gene for tolerance to glyphosate into soybean (*Glycine max*) created a technology that provides growers a much broader time period during which weeds can be controlled. Growers believe that use of glyphosate as the primary weed control product reduces the time and effort required to manage their crop. Many growers feel they no longer need to scout their fields for weeds. While glyphosate-tolerant plants may have simplified weed control, pests and diseases such as soybean cyst nematode (*Heterodera glycines*) and Phytophthora root rot (*Phytophthora sojae*) continue to be problematic (Aref & Pike, 1998). These

long-standing problems coupled with recent events have further complicated soybean production.

After years with being faced with endemic pests that could be managed with varying degrees of success on a field-by-field basis, U.S. soybean producers are now faced with the introduction and establishment of two major, invasive pests that, if not monitored and treated, can afflict and seriously damage large acreages of the soybean crop. These pests--the soybean aphid (*Aphis glycines*) and the soybean rust fungus (*Phakopsora pachyrhizi*)--combine to form a potentially devastating new pest complex, both of which require management with pesticides. As profit margins for soybean production continue to tighten, it is imperative that growers fully understand their systems. This requires season-long vigilance over their soybean crop and a thorough understanding of the pest complex they face.

Objective

The objective of the project reported here was to survey Indiana soybean producers about production practices and concerns, to aid Purdue Extension and research faculty in developing Extension programs and educational materials that meet current and future clientele needs, and to provide a framework for directing applied soybean research efforts.

Methodology

A seven-page direct mail survey was sent to 5,000 Indiana soybean growers in August of 2005. Purdue University consulted with the Indiana Agricultural Statistics Service (IASS) to develop and distribute the survey to growers representing various size farming operations and geographic regions within Indiana. IASS generated the mailing list, distributed the surveys, conducted follow-up phone calls to non-respondents, and entered all of the data into a database. Once the information was entered into the database, all of the personal information of respondents was deleted. The database was then transferred to Purdue University for statistical analysis.

The survey covered a wide range of topics focused mainly on soybean production practices and issues, including farmed acres, agronomic practices, variety selection, nutritional practices, insect and disease issues, and grain marketing practices and issues. Information was gathered in several formats. Some questions required a direct response, such as total farmed acres, acres planted to soybeans, average soybean yield, seeding rate, row spacing, and number of times fields were scouted for problems. Some responses were ratings (1-5). For example, respondents were asked to rate the importance of factors influencing their pesticide choice and the importance of information resources for production and management decision making. Single choice answers were requested regarding use of a foliar fungicide (Yes, No) and who applies pesticides on the farm. Several questions allowed multiple responses, such as which insect pest(s) were targeted by insecticide treatments. Respondents were also asked to rank the five most important pest problems they encounter.

Responses to each question were characterized by farm operation size. The farm size responses are broken down into the following acreage categories: 0-99 acres, 100-249 acres, 250-499 acres, 500-999 acres, and 1,000+ acres, with 206, 320, 263, 262, and 259 respondents, respectively (1,310 total; 20 did not respond to the farm acreage question). The statistical inferences given in this report were developed using chi-square tests for comparing categorical response frequencies and analysis of variance followed by Fishers protected LSD or t tests ($p \leq 0.05$). Ratings were considered to be linear for analysis of variance purposes. Frequency data are presented as counts or percent of respondents within each farm size. Additional chi-square tests were performed to identify specific farm size categories that responded differently. Farm size categories that were not statistically different may be grouped together in the discussion. Statistical analysis was conducted using SAS (SAS Institute Inc. Cary, NC.).

A total of 1,330 growers completed the survey. This response rate of 27% was similar to the response rates reported by others (Bourgeois, Morrison, & Kelner, 1997; Czapar, Currey, & Wax, 1997). For presentation purposes the survey was broken out into three sections: crop management, pest management, and crop marketing. Here we focus on analysis and discussion of the responses to the pest management questions with respect to differences in farm operation size.

Results

Scouting, Pesticide Application, and Decision Making

Crop Scouting

Independent of farm size, 57% of soybean respondents scout their own soybean fields, 32% hire a professional crop scout or agronomist, and 11% do not scout. The number of times that a field is scouted depends upon farm operation size ($p \leq 0.0001$) (Table 1). Small growers with fewer than 500 acres are more likely to scout soybean fields one to two times, whereas large growers with more than 500 acres are more likely to scout each soybean field three or more times ($p \leq 0.0001$). This suggests that managers of larger operations are more likely to observe, monitor, and treat a potential problem in a timely manner than managers of smaller operations.

Table 1.
Number of Times Soybean Fields Are Scouted Based on Farm Operation Size

	Number of Times Scouted			
Farm Size (acres)	**1-2**	**3-5**	**6+**	**Total Number of Respondents**
	Percent of Respondents			
0 - 99	50	33	17	128
100 - 249	42	37	21	263
250 - 499	42	33	25	197
500 - 999	27	46	27	234
1000+	27	50	23	232
Total	36	41	23	1,054

Pesticide Application

Once a problem that requires a pesticide application is identified, the decision as to who applies the pesticide (custom applicator, self or family member, it depends on the pesticide product) differed among farm operation size ($p \leq 0.0001$). As acreage increases, fewer growers hire a custom applicator. Sixty-one percent of growers who farm from 0 to 499 acres hire a custom applicator, whereas 49% and 33% of growers from 500-999 and 1,000+ acres, respectively, hire a custom applicator.

Grower Decision Making Process

Farmers were asked to rate the value of various sources of information to support pest management decisions from very important (1) to not important (5). The importance of the sources of information differed among farmers depending on the size of the farm operation (Table 2) ($p = 0.0026$). However, independent of farm size, the co-op agronomist received the highest rating as a source of information to assist growers in making pest management decisions, followed by crop scout, industry representative, and Purdue Extension ($p \leq 0.0001$). While the importance of an industry representative rated higher than Purdue Extension overall, they were not different, regardless of farm size. Neighbors, print/mass media, and the Internet were the least important sources of information. Very small growers (< 99 acres) relied less on industry reps and Purdue Extension than all larger growers.

Table 2.
Rating of Grower Information Resources Used to Assist Them in Making Pest Management Decisions

	Farm Size (acres)				
	0 - 99†	100 - 249	250 - 499	500 - 999	1000+
Resource	Rating (1-5 scale)				
Co-op agronomist	2.6	2.3	2.3	2.2	2.4
Crop scout	2.7	2.5	2.6	2.4	2.4
Industry rep	3.0	2.7	2.6	2.6	2.5
Purdue Extension	3.1	2.8	2.8	2.6	2.7
Neighbor	3.1	3.1	3.2	3.2	3.3
Print/mass media	3.5	3.6	3.5	3.5	3.7
Internet	4.1	4.1	4.2	3.9	3.9
†Rating based on a scale of 1-5, where 1 = very important and 5 = not important.					

Once a grower decided to treat a pest, choice of product was based primarily on efficacy, (Table 3) ($p \leq 0.0001$). Input supplier recommendation and pesticide cost were less important than product efficacy and were not different. Ease of application, whether or not the product was part of a complete pest control/crop input package, and neighbor recommendations were the least important.

Table 3.
Grower Rating of Key Factors They Consider When Choosing a Pesticide

	Farm Size (acres)				
Factor	**0 - 99†**	**100 - 249**	**250 - 499**	**500 - 999**	**1000+**
	Rating (1-5 scale)				
Best product for identified pest	2.1	1.6	1.9	1.7	1.5
Best broad spectrum pesticide	2.2	2.2	2.3	1.9	1.8
Recommended by input supplier	2.2	2.2	2.0	2.1	2.1
Pesticide cost	2.4	2.3	2.1	2.1	2.0
Ease of application	2.5	2.4	2.4	2.2	2.2
Part of complete pest control package	2.8	2.8	2.8	2.7	2.6
Part of a complete crop input package	3.0	3.1	3.0	2.9	3.0
Neighbor use/recommendation	3.2	3.3	3.4	3.6	3.7
†Rating based on a scale of 1-5, where 1 = very important and 5 = not important.					

Disease Management

Foliar Fungicide Usage

Prior to 2005, only 10% of respondents had applied a fungicide to soybean. Among those who farmed 1,000+ acres, 21% had applied a fungicide to soybean; among those who farmed less than 1,000 acres, only 7% had ($p \leq 0.0001$).

In 2005, 15% of respondents used a foliar fungicide (Table 4). The decision to apply a foliar fungicide in 2005 was dependent on farm operation size ($p \leq 0.0001$). Only 6% of growers with less than 250 acres and only 14% of growers with 250-999 acres used a fungicide in 2005. Growers with 1,000+ acres were most likely to use a foliar soybean fungicide (30%) compared to growers with less than 1,000 acres (9%) ($p \leq 0.0001$). Of the large growers (> 499 acres) who used a fungicide, 52% of them treated 25% or less of their acreage ($p \leq 0.0001$).

The increase in fungicide usage in 2005 may partly be due to the number of growers (11%) who pre-purchased fungicide because of the threat of soybean rust. Larger growers were more likely than smaller growers to pre-purchase fungicide in 2005 ($p \leq 0.0001$). Nineteen percent of large growers pre-purchased some fungicide in 2005. This compares to 9%, 5%, and <1% of growers with 250-499, 100-249, and 0-99 acres, respectively. Another reason for the increase in foliar fungicide usage may be increased marketing and sales pressure to apply fungicides to soybean for enhanced plant health.

Table 4.
Soybean Foliar Fungicide Usage in Indiana in 2005

	Number of Respondents					
		Percentage of Acreage Treated				
Farm Size (acres)	**No Fungicide Used**	**1 - 25**	**26 - 50**	**51 - 75**	**76 - 100**	**Total Number of Respondents**
0 - 99	171	0	2	0	6	179
100 - 249	275	2	1	4	16	298
250 - 499	205	10	6	0	19	240
500 - 999	219	19	5	1	10	254
1000+	173	40	14	4	19	250
Total	1043	71	28	9	70	1221

Phytophthora Root Rot and Seed Treatments

Independent of farm size, 73% of respondents reported that they have no fields with a history of Phytophthora root rot, and 16% reported they do not know if they have this disease. Knowledge about the existence of phytophthora root rot depended on farm size ($p \leq 0.0001$). The percent of growers who did not know whether they had the disease increased from 7% of those who had 1,000+ acres to 21% of growers with 0 — 99 acres. Of the 11% of respondents who indicated that they have Phytophthora root rot in their fields, 45% manage this disease by selecting soybean varieties with a combination of genetic resistance and tolerance, 33% select varieties with race-specific resistance only, and 22% select varieties with tolerance only.

Seed-applied fungicides can provide protection against seedling infection by Phytophthora sojae, Pythium species, and other seedling blight fungi. Independent of farm size, 64% of respondents do not use seed treated with a fungicide. Use of treated seed depended on farm size ($p \leq 0.0001$). Use of treated seed decreased from 42% of farmers with 1,000+ acres to 26% of those with 0-99 acres. Of those who do use treated seed, 83% buy treated seed, 11% buy untreated seed and have the seed treated locally, 4% use a hopper-box seed treater, and 2% treat their seed on-farm using an auger mist system.

Insect and Nematode Management

Soybean Cyst Nematode

Sixty-two percent of respondents reported that they have no problem with soybean cyst nematode (SCN). This response was greatly affected by farm size ($p \leq 0.0001$). Larger growers knew more about the existence of SCN in their fields than smaller growers. Forty-eight percent of growers with 1,000+ acres indicated that SCN was a problem. This compares to 32%, 20%, and 10% of growers with 500-999, 250-499, and 0-249 acres, respectively. Conversely, the percent of growers who didn't know whether they had an SCN problem in their fields increased as farm size decreased. Only 9% of growers with 1,000+ acres did not know whether they had SCN, compared to 12%, 15%, and 18% of growers with 500-999, 250-499, and 0-249 acres, respectively.

When asked if they have ever had their soybean fields tested for SCN, only 35% of respondents indicated that they had. This response was also dependent upon grower size ($p \leq 0.0001$). Sixty-two percent of growers with 1,000+ acres indicated that they have had fields tested for SCN. This compares to 48%, 24%, and 13% of growers with 500-999, 100-499, and 0-99 acres, respectively.

Crop rotation and planting SCN-resistant varieties are the primary management tools for SCN, despite recent evidence that many widely used resistant varieties have declined in effectiveness (Colgrove Smith, Wrather, Heinz, & Niblack, 2002). Planting SCN-resistant varieties was dependent upon grower size ($p \leq 0.0001$). Seventy-seven percent of respondents with 1,000+ acres plant SCN resistant varieties (Table 5). This compares to 69%, 50%, and 34% of growers with 500-999, 100-499, and 0-99 acres, respectively. Conversely, the percent of growers who don't know whether they are planting SCN-resistant varieties increases with a decrease in grower size, with 2%, 5%, 14%, and 32% of growers with 1,000+ acres, 500-999, 100-499, and 0-99 acres, respectively. The number of growers planting SCN-resistant varieties is significantly higher in each of the five grower categories than the number of growers who either know they have a problem ($p \leq 0.0001$) or have had fields tested for SCN ($p \leq 0.05$). This suggests that growers are treating for this pest whether or not they know that it is present.

Table 5.
Do You Plant Soybean Cyst Nematode-Resistant Varieties?

	Percent of Respondents			
Farm Size (acres)	**Yes**	**No**	**Do Not Know**	**Total Number of Respondents**
0 - 99	34	34	32	188
100 - 249	45	39	15	305
250 - 499	55	33	12	252
500 - 999	69	26	5	258
1000+	77	21	2	257
Total	57	31	12	1260

Insect Management

Eighty-four percent of respondents planted seed that was not treated with insecticides in 2005. Our results indicate no differences among farm size or specific target insect pest for the use of seed treated with insecticide in 2005.

Overall, 36% of Indiana soybean growers have ever applied a foliar insecticide to their soybean crop. Foliar insecticide usage increased as farm size increased ($p \leq 0.0001$). Fifty-eight percent of growers with 1,000+ acres have applied a foliar insecticide. This compares to 39%, 25%, and 16% of growers with 250-999, 100-249, and 0-99 acres, respectively. The primary target pests for foliar insecticide applications were soybean aphid (49%) and spider mites (29%). Japanese beetle (10%), bean leaf beetle (9%), and rootworm beetles (3%) were also reported as targeted pests.

Most Important Soybean Pests in Indiana

Soybean growers were asked to rank their top five soybean pest problems (Table 6). Pests were ranked by the total number of respondents. For all pests, farm size did not influence the pest ranking, so farm size data were pooled. Growers identified weeds as their number one pest problem. Soybean aphid, sudden death syndrome (SDS), soybean cyst nematode (SCN), and Phytophthora root rot completed the top five.

Table 6.
Ranking of the Top Soybean Pests in Indiana Based on Grower Perception

		Overall Pest Rank Given by Respondent (1-5)					Number of Respondents
Rank	**Pest**	**1**	**2**	**3**	**4**	**5**	
1	Weeds	720	77	46	34	55	932
2	Soybean aphid	176	210	145	102	92	725
3	Sudden death syndrome	107	135	123	84	123	572
4	Soybean cyst nematode	92	147	129	89	98	555
5	Phytophthora root rot	60	128	137	100	94	519
6	Bean leaf beetle	36	79	146	92	97	450
7	Asian soybean rust	103	64	53	51	143	414
8	Seedling blights	37	56	90	86	101	370
9	White mold	33	44	96	88	106	367
10	Seed corn maggot	26	35	66	77	110	314
11	Frogeye leaf spot	17	21	70	70	114	292
12	Purple seed stain (pod blights)	20	10	51	65	143	289
13	Charcoal rot	18	22	55	67	118	280

It was somewhat surprising that weeds were identified as the number one pest problem in soybean. The rationale for the rapid adoption of Roundup Ready technology was to more effectively manage weeds in soybean . The survey reported here indicates that most growers still consider weeds a major problem ($p \leq 0.0001$). Weeds may remain a top production concern because the Roundup Ready technology is not without some problems (e.g., weeds resistant to glyphosate or weeds not readily controlled by glyphosate).

Another interesting finding was that Asian soybean rust, a disease that has not been found in Indiana, was

ranked 7th in the list. In fact, 103 of 414 respondents indicated that Asian soybean rust was their number one pest concern ($p \leq 0.0001$). This suggests that growers are well informed as to the destructive potential of this pest and are concerned that this pest may be a significant problem in the future.

Conclusions

The results of the survey reported here demonstrate that farm operation size has a dramatic impact on pest management practices. The intensity of management increases as farm size increases. Large growers were more likely to scout their soybean field more regularly, apply a foliar fungicide to soybean, apply their own pesticides, and possess a more thorough understanding of the pest complex that they must manage.

Purdue Extension programming is primarily targeted towards crop advisors (crop scouts and co-op agronomists) who service the large growers. Small and mid-scale farm operations tend to not use these consultants as much as large-scale operations. This suggests that additional education and effort must be targeted at the small and/or part-time grower to improve overall soybean management practices in Indiana.

Acknowledgements

The authors would like to thank the Indiana Soybean Board for funding this research and the Indiana Agricultural Statistics Service for their cooperation in developing, distributing, and tabulating the results of this survey.

References

Aref, S., & Pike, D. R. (1998). Midwest farmers' perceptions of crop pest infestation. *Agron. J.* 90:819-825.

Bourgeois, L., Morrison, I. N., & Kelner, D. (1997). Field and producer survey of ACCase resistant wild oat in Manitoba. *Can. J. Plant Sci*. 77:709-715.

Colgrove, A. L., Smith, G. S., Wrather, J. A., Heinz, R. D., and Niblack, T. L. 2002. Lack of predictable race shift in *Heterodera glycines* — infested field plots. Plant Dis. 86: 1101-1108.

Czapar, G. G., Currey, M. P., & Wax, L. M. (1997). Grower acceptance of economic thresholds for weed management in Illinois. *Weed Technol*. 11:828-831.

Marra, M.C., Piggot, N. E., & Carlson, G. A. (2004). The Net benefits, including convenience, of Roundup Ready® soybeans: Results from a National Survey. NSF Center for IPM Technical Bulletin. Retrieved May 16, 2006 from: http://cipm.ncsu.edu/cipmpubs/marra_soybeans.pdf