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Abstract

Integrated Pest Management implementation continues to be an important topic among growers. Although the continuing concerns over the residual effects of pesticides have prompted government regulations to encourage environmentally friendly approaches to pest management, adoption levels remain stagnant. The study reported here investigates the perceptions and IPM adoption practices of corn growers in West Virginia. Respondents agreed that repeated use of herbicides and insecticides with the same mode of action leads to herbicide-resistant weeds and insecticide-resistant insect pests. Additionally, scouting was the most commonly used IPM practice for insect, disease, and weed control. Recommendations for practice are also discussed.

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Introduction

Integrated Pest Management (IPM) is an important topic among corporate and government policy makers across the United States (U.S.). To satisfy governmental regulations for sustainability, IPM implementation has become an important requirement for all market-based programs totaling more than 28 million production acres nationwide (IPM, 2008). As the demand for sustainability increases, growers and manufacturers are relied upon to ensure that IPM practices are adopted and any negative environmental side effects are at minimum levels (Environmental Protection Agency, 2011).

Because pesticides contribute to the increased production of food and fiber, the general acceptance of IPM has always been positive. This favorable view, coupled with the success of Extension agents in generating support to promote IPM, has often overshadowed the empirical evidence that growers are often confused on what specifically suffices as IPM adoption (Ehler & Bottrell, 2000; Ehler, 2006; Hollingsworth & Coli, 2001). This misinterpreted relationship between the perceptions of IPM and at what level growers are adopting IPM practices has called for a revision of government related initiatives for IPM implementation accountability (Dhawan & Peshin, 2009; Ehler, 2006; Ehler & Bottrell, 2000).

Because of its broadly defined definition, IPM has evolved into a collection of descriptions that has confused growers and played a large part in the lack of implementation (Ehler, 2006). Despite some differences, Dhawan and Peshin (2009) profess that most definitions of IPM have common elements such as the appropriate selection of pest control method; economic benefits to the grower, environment, and society; decision rules that guide the selection; control action; and the impact of multiple pest.

IPM Adoption Among U.S. Corn Growers

It is widely recognized that IPM adoption in the U.S. continues to be an underutilized practice to pest control in production agriculture (EPA, 2011). Despite much effort to increase IPM among growers, there have been few studies published within the past 10 years to conclusively determine why the lack of IPM implementation still exists (Ehler, 2006; Hammond Luschei, Boerboom, & Nowak, 2006; Pimentel, 2005).

In a study of 213 Wisconsin corn growers, Cullen, Stute, Raymond, and Boyd (2008) discovered that respondents perceived time (lack of), labor, and competing obligations as potential barriers to adopting IPM techniques. Contrarily, the researchers discovered that respondents' adoption of genetically modified corn hybrids producing a Bt toxin corn increased from 22% in 2004 to 41% by 2007 (Cullen, Stute, Raymond, & Boyd, 2008). In a similar study, Hammond, Luschei, Boerboom, and Nowak (2006) noted that the top IPM tactics used were field scouting, broadcast herbicide applications, crop rotation, planting Bt hybrids, and crop rotation.

In a study of Virginia corn farmers, Malone, Herbert, and Pheasant (2004) discovered that the most used IPM practices were scouting, herbicide rotation, use of reduced-till or no-till, and selecting disease-resistant corn. In contrast, the researchers discovered that the most rarely used IPM practices were scouting (by either hired scouting consultants or extension agents), use of cultivation to control for weeds, making maps hotspots (weeds), and using bait stations/wire traps to monitor insects.

Purpose and Objectives

The purpose of the study reported here was to analyze the perceptions and adoption levels of IPM practices of corn growers in the top five corn producing counties in West Virginia. Specific objectives were to:

1. Describe the perceptions of West Virginia corn growers toward the integration of IPM practices in corn production.
2. Describe West Virginia corn growers' IPM adoption levels for insect pest control in corn production.
3. Describe West Virginia corn growers' IPM adoption levels for disease and weed control in corn production.

Methods

The researchers employed a questionnaire using the traditional mailed notification followed by a series of mail reminders. The questionnaire was based on previous work by Malone, Herbert, and Pheasant (2004) concerning IPM adoption strategies among corn growers in Virginia. The items in the questionnaire were modified slightly to meet the objectives of the study and to coincide with the crop profile in West Virginia. The crop profile was used to identify the most commonly used IPM practices for insect, disease, and weeds along with the top insect pest in corn production (Baniecki & Dabaan, 2004). Part one consisted of 14 statements designed to gauge participants' perceptions of IPM practices in corn production. Part two consisted of six IPM practices used among corn growers in relation to West Virginia's top insect pests. Part three consisted of eight IPM practices used in corn production in relation to disease and weed control.

Respondents were instructed to select all IPM practices used in their pest management technique. Spearman-Brown Split half statistic was used to establish the instrument's reliability, which was found to be exemplary with a coefficient of .86 (Robinson, Shaver, & Wrightsman, 1991). Faculty in agricultural and Extension education at West Virginia University formed the panel of experts and reviewed the instrument for face and content validity. Construct validity was measured from a pilot test of corn growers not included in the final survey population.

The target population consisted of all commercial corn growers in West Virginia. Due to the unavailability of a statewide sampling frame, access to all growers was not feasible. A convenience sample of the state's corn growers whose contact information was listed through the West Virginia Cooperative Extension Service was used in the study (n = 100). Data collection was attempted from all the names present (100%). Given the non-random sampling method and the inability to determine the representativeness of the sample, the researchers make no attempt to generalize the findings beyond the sample. As such, the study contributes to the knowledge base by providing empirical data for comparison purposes and providing the basis for future research from samples that would allow generalizability to larger populations (Gall, Gall, & Borg, 2007).

Participants received an introductory letter outlining the purpose of the study and informing them that they would receive a printed questionnaire in the mail. A week later, the initial mailing packet containing a cover letter, instrument, and self-addressed return envelope was sent. For the reminder of the 6-week data collection phase, the researchers sent follow-up post cards every 2 weeks until the study ended. Early and late respondents were compared ,and no significant differences existed (Lindner, Murphy, & Briers, 2001). Final response rate was 64%.

Findings

The first objective of the study was to describe the perception of growers toward the integration of IPM practices. More than nine out of 10 respondents (94%) reported that the repeated use of herbicides with the same mode of action leads to herbicide-resistance weeds. Respondents agreed (92%) that crop rotation is a method that controls the weed population in corn production (Table 1). Additionally, 54% agreed that their exposure to pesticides (during application) will cause life-long health problems. Growers agreed (78%) that crop rotation is one method that can be used to control for pest populations in corn production. Half (50%) of the respondents agreed that, with the exception of crop rotation, non-chemical methods to control pest in corn production were readily available to them. Only 9% of the respondents agreed that they could properly identify all insect pests seen on their crop (Table 1).

Table 1.
Perceptions of West Virginia Corn Growers on Integrated Pest Management Practices

Statement	**% A**	**% U**	**% D**
Repeated use of herbicides with the same mode of action leads to herbicide-resistance weeds.	94	6	- -
Crop rotation is one method that controls the weed population in corn production.	92	5	3
Pesticides should not be placed within 30 meters of a water source.	91	6	3
Fungicide-treated seeds help in the reduction of soil borne diseases.	86	14	- -
The use of Bt-Corn can reduce the number of insecticide applications within a season.	84	14	2
Repeated use of insecticides with the same mode of action leads to insecticide-resistance insects.	83	17	- -
Crop rotation in corn production is one method that can be used to reduce crop damage due to diseases.	83	14	3
Crop rotation is one method that can be used to control for pest populations in corn production.	78	19	3
My exposure to pesticides (during application) will cause life-long health problems.	54	30	16
With the exception of crop rotation, non-chemical methods to control pest in corn production are readily available to me.	50	39	11
I can properly identify all weed types seen in my corn field(s).	45	42	13
The chemical levels specified for IPM use are not sufficient for my crop sustainability.	35	47	18
I can properly identify all disease types that can affect my corn crop.	16	36	48
I can properly identify all insect pests seen on my corn crop.	9	14	77

Note. n = 64. Original scale: 1 = Disagree Strongly, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree. Responses are collapsed into: A = Agree, U = Undecided and D = Disagree.

The second objective of the study was to describe growers' IPM adoption levels for insect pest control. Respondents were asked to select the IPM practice(s) used for the insect pest identified. Scouting was the most use IPM practice among respondents towards insect pest. Additionally, the European corn borer was the most common insect pest that required multiple IPM practices (Table 2). Planting Bt corn was the most common (81.2%) IPM practice among respondents.

Table 2.

Respondents' IPM Adoption Levels for Insect Pests Control Practices used in Corn Production*

	Insect									
	Cutworm		**Corn Borer**		**Armyworm**		**Wireworm**		**White Grub**	
IPM Practice	***f***	**%**	***f***	**%**	***f***	**%**	***f***	**%**	***f***	**%**
Scouting	26	40.6	10	15.6	22	34.3	--		--	
Know the Economic Threshold	25	39.0	--		18	28.1	--		--	
Early Planting	#		37	57.8	#		#		#	
Planting Bt Corn	#		52	81.2	#		#		#	
Baited Wire Traps	#		#		#		2	3.1	8	12.5
Dig and Count	#		#		#		--		1	1.5

Note: *n* = 64. # = Not an applied IPM practice for respondents in the study. *Frequencies and percentages are nominal indications of responses.

The third objective was to describe growers' IPM adoption levels for disease and weed control. A large majority (92.1%) of respondents planted disease-resistant corn as their primary IPM practice. In addition, 78% of respondents used crop rotation as an acceptable IPM practice for disease control (Table 3). Slightly more than three-fourths (78%) of respondents reported that scouting and herbicide rotation were the most common IPM practices used in corn production. In contrast, only 14% of respondents reported using cultivating and hotspot identification as IPM practices (Table 3).

Table 3.

Respondents' IPM Adoption Levels for Disease and Weed Control in Corn Production*

	Disease		**Weed**	

IPM Practice	f	%	f	%
Scouting	39	56.2	50	78.1
Cultivating	--		9	14.0
Identify Hotspots	--		9	14.0
Crop Rotation	50	78.1	--	
Weed Rating	--		10	15.6
Plow Down	14	21.8	--	
Planting Disease-resistant Corn	59	92.1	#	
Herbicide Rotation	--		50	78.1

Note: *n* = 64. # = Not an applicable IPM technique for weed. *Frequencies and percentages are nominal indications of responses.

Conclusions, Discussions, and Recommendations

The intent of the study reported here was to extend the body of literature concerning the perceptions and adoption levels of IPM in corn production. Given the complexity of the issue and the absence of an all-inclusive solution to implementation, exploratory studies such as this one are warranted. In addition, the study contributes to the profession by providing empirical evidence needed to develop and quantify the impact that IPM has on present and future growers.

Based upon the results of the study, it can be concluded that participants hold positive perceptions about IPM practices in corn production, which confirms previous research investigating the perceptions of IPM in corn production (Hammond, Luschei, Boerboom, & Nowak, 2006; Malone, Herbert, & Pheasant, 2004).

Over 75% of respondents believed that crop rotation was a useful IPM practice in all categories. Cullen, Stute, Raymond, and Boyd (2008) also reported corn growers using crop rotation as a sufficient IPM practice. Hammond, Luschei, Boerboom, and Nowak (2006) reported that crop rotation was the most common management practice used by corn growers against weed, insect, and plant disease pests. Buhler, Liebman, and Obrycki (2000) reported that since many insects are host specific, crop rotation between a host/non-host species will cause insects to die or relocate. Additionally, the researchers reported that crop rotation—under certain circumstances—can be effective on weed species.

According to the results, scouting was the most common IPM practice implemented in all three categories. Previous research indicates that field scouting is a proactive IPM practice used in corn production (Cullen, Stute, Raymond, & Boyd, 2008; Malone, Herbert, and Pheasant, 2004). Participants use a diverse set of scouting strategies based upon their knowledge of the practice. Furthermore, scouting can also be employed by Extension agents, crop advisers, and agronomists (Cullen, Stute, Raymond, & Boyd, 2008). Future research should focus on determining what methods are used in field scouting practices and what factors determine grower implementation.

The results indicate that respondents are implementing a variety of IPM practices to control disease and weed infestations. In the U.S. alone, corn ranks first in pesticide usage as growers consumed over 30% more than all other crops with roughly 115 different types used (Alexandre, Nehring, Cornejo, & Grube, 2008). In order to advance IPM practices among growers, the study provides a better understanding of trends in growers' implementation of IPM. Although determining growers' trends is warranted, most IPM studies have focused on insect management (Dhawan & Peshin, 2009). Considering this finding along with regulations to increase sustainable agricultural practices, additional research that provides a more holistic approach on the tendencies of grower implementation is necessary.

Recommendations for Practice

While today's growers are flooded with IPM information through a variety of sources, most of the information lacks accuracy in dissemination of IPM technology (Dhawan & Peshin, 2009). Based upon the findings, the researchers posit three recommendations:

1. West Virginia Extension agents can promote user incentives that reflect the value of IPM to the public. If the public desires that IPM be adopted, then one option might be to use cost sharing as an incentive to the consumer and grower. In addition, programs such as the NRCS Environmental Quality Incentive Program (EQIP) can be used to incorporate IPM tactics as rewarded practices (Hollingsworth & Coli, 2001).

2. Since the acceptances of certain IPM practices are influenced by the cost of their implementation, funding sources should be sought to assist growers in developing a coordination/support program to encourage IPM implementation (Hollingsworth & Coli, 2001). Governmental grant initiatives such as the Extension Integrated Pest Management Coordination and Support Program could be used to assist growers in adopting alternative pest management practices through training, demonstration, and evaluation of methods and strategies.

3. Although participants in our study are familiar with IPM, an increase in educational training and awareness of IPM techniques and adoption is still warranted. One recommendation for practice is the development of transition programs that will assist growers in the transition to increase IPM practices (Goldberger, Lehrer, & Brunner, 2011).Using field and classroom-based settings with IPM consultants, growers would have firsthand opportunities to enhance the technical and social impacts of IPM at the local level.

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