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Assessing Integrated Pest Management Implementation and Knowledge Gaps in South Dakota

Abstract

A survey of commercial pesticide applicator training participants was carried out during 2015 winter pesticide certification meetings to assess integrated pest management (IPM) knowledge gaps. Overall, the majority of the respondents reported that they have adequate access to IPM information and that they apply IPM principles in their pest management programs. Preventive fungicide use was identified as a regular practice by half the respondents and was dependent on the region of the state. Participants identified basic pest identification as an area in which more resources are needed. Online information and field days were the preferred options for accessing outreach and Extension.

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Introduction

Integrated pest management (IPM) is an effective and sustainable tool, and when implemented properly, it can also be highly profitable (Flint, 2012). The potential economic benefits of IPM stem from implementation of diverse tactics that include engaging in proper crop rotation, managing

weeds, maximizing the role of biological control agents, and gauging pest thresholds before using chemical pest control. These practices delay resistance of pests to pesticides and provide long-term benefits to producers and the environment (Kogan, 1998; Environmental Protection Agency, 2008; Flint, 2012). Although IPM approaches were introduced several decades ago, widespread implementation of IPM has been declining recently, owing to the increasing size of farms and the low costs of some pesticides (Sappington, 2014). These factors contribute to a prevalence of preventive applications of pesticides, ranging from seed treatments to scheduled foliar sprays of fungicides and insecticides that often are not warranted by existing pest pressure (Thelin & Stone, 2013).

Because crop managers make their decisions based on perceived threats of economic losses from crops, assessing the managers' access to IPM information, IPM knowledge gaps, and preferred means of IPM information delivery can help improve sustained adoption of IPM. Identifying knowledge gaps is a fundamental prerequisite to any educational effort implemented to address the needs of clientele. Moreover, it is equally important to determine how to customize information delivery to meet the needs and preferences of clientele.

Recently, the use of preventive fungicides, especially strobirulins, has increased. This trend is due, in part, to aggressive marketing of these products to achieve plant health benefits even in the absence of fungal diseases (Wise & Mueller, 2011; Kyveryga, Blackmer, & Mueller, 2013). Strobilutrin fungicides are being applied in corn as early as the V6 growth stage, in soybeans as early as the R1 growth stage, and in wheat as early as the tillering growth stage. Such early applications of fungicides often occur while there is negligible to low disease pressure and are unlikely to affect yield of crops. Moreover, these applications lead to negative impacts of calendar pesticide sprays, such as resistance development and elimination of nontarget organisms. Consequently, the overall long-term economic and environmental costs of preventive fungicide applications can be high.

Thus, one goal of the survey discussed here was to assess the prevalence of fungicide use in South Dakota. Moreover, we also solicited participants' feedback on the availability of IPM information, the most relevant IPM knowledge gaps, and the preferred means of delivery of IPM information. Because this survey was administered during the state's commercial pesticide applicator training, which brings together over 2,000 crop managers each year, we were able to survey a representative sample of professionals making pest management decisions in the state. The outcomes we report indicate that soliciting basic information on pest management practices and availability of IPM resources is one of the tools for assessing clientele needs.

Methodology

The surveys were administered at the commercial pesticide applicator trainings held at seven South Dakota State University (SDSU) regional Extension centers (Figure 1) in January and February 2015. The participants were crop managers who oversee 3.4 million acres of cropland (30%) in South Dakota and make the majority of pest management decisions.

Participants in the commercial pesticide applicator training were requested to respond anonymously to a set of six questions by selecting their answers using clickers (Turning Technologies, LLC, Youngstown, OH). A Likert scale with the points Strongly agree, Agree, Neutral, Disagree, and

Strongly disagree (Allen & Seaman, 2007) was used to gather responses to the first three questions, which related to whether participants have access to information on integrated pest and disease management, use principles of integrated pest and disease management practices in their operations, and use preventive fungicide applications on the crops corn, soybeans, or wheat. The fourth question asked which of these crops received the most fungicide applications. We also assessed needs for IPM-related information related to pest thresholds, pesticide efficacies, pest and disease identification, and IPM practices (fifth question). Because of the rapid changes in information delivery systems and the popularity of mobile devices and social media, we assessed what proportion of the participants preferred traditional means (printed handouts and field days/crop tours) as opposed to novel means (website, social media, or broadcast) of receiving IPM information (sixth question).

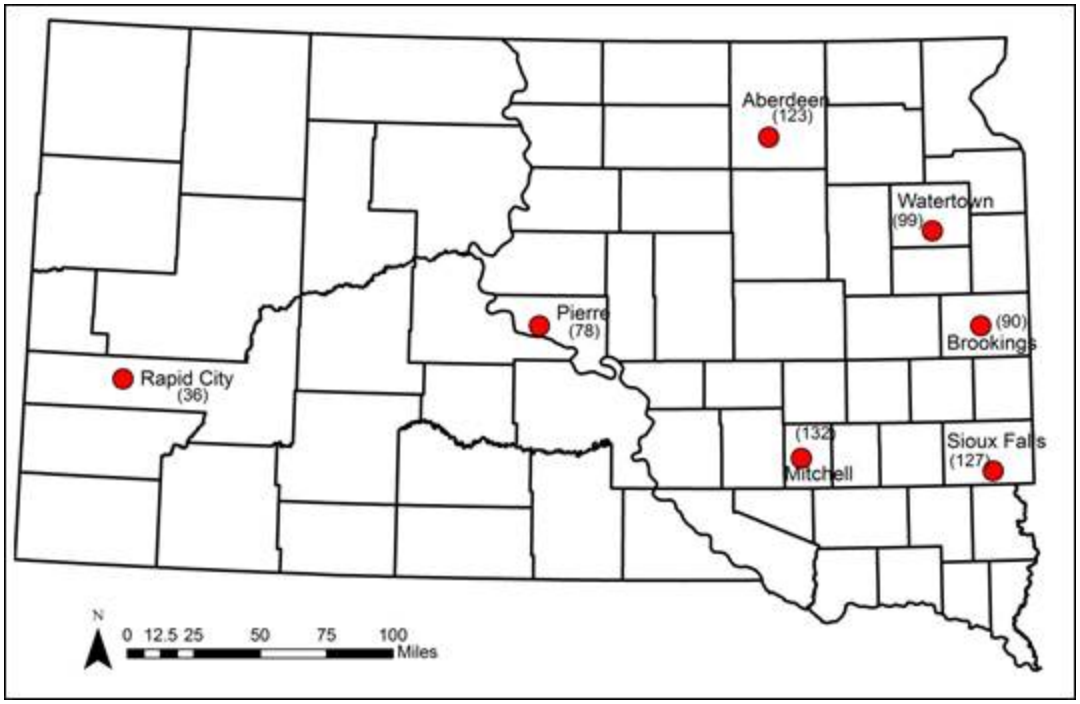
Responses from the survey participants were subjected to Proc Frequency analysis performed using SAS (SAS Institute, Cary, NC) to identify the choices with the highest number of responses for each category in each region and across regions. Pearson's chi-square option was used to test whether there was an association between the regions and the response selected for each question posed to the participants.

Results

A total of 685 participants in the commercial pesticide applicator training responded to questions in the survey. Mitchell Regional Extension Center had the highest number of respondents (132), and Rapid City Regional Extension Center had the least number of respondents (36) (Figure 1).

Figure 1.

Locations of SDSU Regional Extension Centers and Number of Survey Participants at Each Center



More than 88% of respondents said they had access to IPM information. These respondents either

strongly agreed or agreed with the statement that they had adequate access to IPM information (Table 1). Chi-square analysis revealed no significant association between regions and the response given when respondents were asked whether they had access to integrated pest and disease management information (χ^2 = 27.35, degrees of freedom [*df*] = 24, *P*-value = 0.288).

When participants were asked whether they use integrated pest and disease management information in their operations, 83% of respondents across the regions either agreed or strongly agreed (Table 1). A greater percentage of respondents agreed with the statement (53%) as compared to those who strongly agreed with the statement (30%). We found that location had a significant association with the response on whether the survey participants used IPM information in their operations (χ^2 =38.29, *df* = 24, *P*-value = 0.032). East-central locations (Brookings and Watertown) had a higher percentage of participants strongly agreeing with the statement of using IPM, as compared to other locations.

Table 1.

Responses Related to Access to and Use of IPM Information for Different Regions and for th Combined Regions

I have access to integrated pest and disease management information in my operation.															
Response	**Watertown**		**Mitchell**		**Aberdeen**		**Brookings**		**Sioux Falls**		**Pierre**		**Rapid City**		**Ove**
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Strongly agree	48	44	56	42	48	39	36	40	43	36	30	41	13	36	274
Agree	48	44	62	46	56	46	48	53	62	53	36	49	13	36	325
Neutral	6	6	12	9	14	11	7	8	12	10	6	8	9	25	66
Disagree	1	1	1	1	1	1	0	0	1	1	0	0	1	3	5
Strongly disagree	4	4	2	2	4	3	0	0	0	0	2	3	0	0	12
I use integrated pest management information in my operation.															
Strongly agree	41	39	36	27	28	22	31	34	38	32	26	33	10	30	210
Agree	51	48	72	54	68	55	47	52	76	64	35	45	13	40	362
Neutral	8	8	16	12	22	18	10	11	12	10	14	18	10	30	92

Disagree	2	2	6	5	2	2	2	2	1	1	1	1	0	0	14
Strongly disagree	3	3	2	2	4	3	0	0	0	0	2	3	0	0	1 1

When asked about preventive fungicide applications, the majority of all the respondents were neutral (32%), whereas 25% disagreed with the statement that they apply fungicides as a preventive measure. Interestingly, the same proportion (25%) agreed with the statement (Table 2). The location significantly influenced the responses about fungicide use, with east-central (Brookings) and central (Pierre) locations having 52% and 40% of the respondents strongly disagree or disagree with the statement (χ^2 = 40.71, *df* = 24, *P*-value = 0.018).

The majority of all participants (72%) responded that they apply more fungicides to wheat as compared to soybeans and corn. Participants in the southeast location, Sioux Falls, indicated higher rates of fungicide applications to corn and soybeans than respondents in any other location (23% and 24%, respectively), but as with other regions, wheat was singled out as the crop receiving the greatest amount of fungicide treatments (Table 2).

Table 2.

Responses Related to Fungicide Use for Different Regions and for the Combined Regions

I usually apply a fungicide on crops just in case the diseases develop.															
Response	**Watertown**		**Mitchell**		**Aberdeen**		**Brookings**		**Sioux Falls**		**Pierre**		**Rapid City**		**Ove**
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Strongly agree	15	14	5	4	10	8	6	7	12	9	4	5	5	14	57
Agree	23	22	39	30	36	28	20	23	35	28	14	18	6	17	173
Neutral	31	30	42	32	44	35	26	30	45	36	19	24	14	39	221
Disagree	22	21	37	29	26	21	26	30	26	20	25	32	7	19	169
Strongly disagree	13	13	7	5	10	8	9	10	9	7	17	21	4	11	69
Which crop receives more fungicide application?															
Corn	5	5	11	8	18	14	6	6	16	24	5	6	8	22	69
Soybean	14	13	15	1	28	22	17	19	15	2	3	3	-	-	92

				2						3					
Wheat	83	80	100	78	8	61	67	74	35	53	72	89	26	70	463
None of these	2	2	3	2	4	3	1	1	0	0	2	2	3	8	15

When asked about major shortcomings in IPM-related resources, half of the survey participants identified the need to improve the availability of pest and disease identification, and this response was consistent across the regions (Table 3). Pest/disease thresholds was selected as the second most relevant area about which more information was needed. The location was not significantly associated with the responses given (χ^2 = 26.26, *df* = 18, *P*-value = 0.094), indicating that all regions tended to identify similar knowledge gaps.

The main method participants identified as the best way in which IPM information can be availed to them was online media (37%), followed by field days (27%) and printed materials (23%). Social media and broadcasts were selected as the least favorite means of communication (Table 3). Preferred modes of delivery of IPM guidelines and updates were similar across all regions (χ^2 = 27.21, *df* = 24, *P*-value = 0.2946).

Table 3.

Responses Related to Need for IPM-Related Resources for Different Regions and for the Comb Regions

One area more information is needed in pest and disease management is. . .															
Response	**Watertown**		**Mitchell**		**Aberdeen**		**Brookings**		**Sioux Falls**		**Pierre**		**Rapid City**		**Ove**
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Pest thresholds	30	30	32	25	29	24	27	31	38	31	10	12	3	9	169
Pesticide efficacies	15	15	17	13	20	17	13	15	18	15	14	18	8	24	105
Pest and disease ID	46	45	73	56	60	51	41	46	57	46	45	56	15	46	337
IPM practices	10	10	8	6	9	8	7	8	10	8	11	14	7	21	62
One best way of delivering IPM information is. . .															
Online	32	31	42	3	39	38	36	41	53	4	24	3	19	5	24

				2						3		3		4	5
Print media	23	22	39	30	18	17	18	21	25	20	20	27	9	26	152
Field days	34	33	36	27	30	29	22	25	31	25	21	28	4	11	178
Social media	6	6	8	6	9	9	10	11	6	5	3	4	1	3	43
Broadcast	9	8	6	5	6	6	2	2	7	6	6	8	2	6	38

Discussion

Surveys are instrumental in assessing clientele needs and establishing the type of IPM-related resources and events that are best suited to the state and region. These surveys are routinely performed and have been important in organizing events that are customized to unique needs of the clientele (Alston & Reding, 1998; Malone, Herbert, & Pheasant, 2004). With changes in Extension that resulted in regional specialists' replacing county agents in South Dakota, reaching the audience and gauging their needs is more difficult, and surveys such as the one we report here are the best means of ensuring that we address important IPM-related knowledge and resource gaps.

We identified several very important trends among the respondents to our survey. Most of them reported using IPM guidelines in their operations and having access to IPM-related information. Because these are commercial crop managers, this finding indicates that a substantial portion of cropland in South Dakota is managed within the IPM framework. This finding was contrasted somewhat by the high percentage of respondents who indicated that they use preventive fungicide treatments. The challenge, therefore, seems to be ensuring that we place the basic IPM principles within the context of modern agriculture and successfully communicate that preventive pesticide applications pose a challenge to sustainability of pest and disease management. This perspective is highlighted by other reports, as illustrated in Bradley (2012), who found that only 38% of survey respondents in Illinois in 2009 considered disease pressure before applying a fungicide. Moreover, recent chemical company advertising promoting use of fungicides for plant health benefits in the absence of significant fungal disease pressure may be influencing crop managers to apply a fungicide under negligible disease levels (Wise & Mueller, 2011).

It is also interesting that respondents noted the need for more resources on basic pest and disease identification and economic injury thresholds. These resources are already available, particularly in online media, and the prevalence of this response seems to suggest that Extension faculty and staff may need to update the already available information to improve its clarity or to deliver it in simpler and more straightforward formats. Because online media seem to be the preferred method of communication (this survey; Drill, 2012), some sort of online database of region-specific pest identification tools and thresholds would provide the best solution to this particular need identified by the clientele.

Another interesting finding was that survey participants at locations closer to SDSU selected responses more aligned with IPM guidelines than respondents located farther away from the university. This finding suggests that the university efforts to communicate research related to sustainable pest and disease management have an effect on adoption of IPM tactics in pest management decisions. An example of such efforts is the IPM program at SDSU. Persons associated with this program have been holding IPM field schools every year, rotated between two regions in the state (Deneke, 2013).

The findings discussed here clearly identify the continuous need for university researchers and Extension personnel to communicate the extent of environmental and economic costs of preventive pesticide applications that are not warranted by pest pressure. This practice has tremendous long-term costs, and finding ways to illustrate these long-term costs is the greatest challenge of our mission.

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