

Knowledge and Use of Integrated Pest Management by Underserved Producers in Missouri and the Role of Extension

Abstract

In Missouri, Plain producers (groups of conservative Anabaptist faith, including the Amish and Mennonites) are one type of underserved audience that has found a niche in vegetable production. The study reported here investigated the level of knowledge and use of Integrated Pest Management (IPM) gained over a 3-year period following implementation of Extension activities by the University of Missouri and Lincoln University, the two Missouri land-grant universities. Results indicate that Extension plays an important role in the observed increased use of IPM by the target audience and highlight the need to continue using traditional methods (e.g., printed documents, one-on-one interactions).

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Introduction

According to the 2012 Census of Agriculture (USDA-NASS, 2014), Missouri's agriculture encompasses many small farms with a high diversity of cultural and ethnic groups. Differences in the production methods used and in the perceptions of the sources of information considered valuable by such a diverse group of producers, including limited resource farmers (Ngathou, Bukenya, & Chembezi, 2006), create distinct challenges for Extension personnel (Kline, Kneen, Barrett, Kleinschmidt, &

Doohan., 2012). Vegetable production is an important enterprise in Missouri, with over 63 million dollars in annual sales (USDA-NASS, 2014). Owing to its high value and lower land needs, producer groups of some Plain People (people of conservative Anabaptist faith, which include Mennonites and the Amish) (Hurst & McConnell, 2010) are shifting from dairy or other farming activities to vegetable production.

In Missouri, outreach efforts by the two land-grant universities (University of Missouri [1862] and Lincoln University [1890]) targeting Plain producers, with a focus on the Amish, have been tailored to meet the producers' needs using delivery methods that address their desire for economically and environmentally sustainable enterprises appropriate to their faith and culture. As Extension specialists, we understand that for this particular stakeholder group, current Extension programming methods, such as information posted on the Internet, computer-based technology, workshops located in cities, and even phone calls, are ineffective and sometimes culturally objectionable (Umble, 2000; Hoorman, 2002). This is because the religious beliefs of the Amish and most Mennonites dictate separation from modern society, which prevents using various modern technologies in communication and transportation (Drake & James, 1993; Hoorman, 2002). Consequently, outreach efforts need to be taken into their communities, reminiscent of Extension in the earlier part of the twentieth century, involving farm visits and tours, and small group gatherings.

Throughout the U.S., many farmers deal with agricultural pests every year (Piñero, 2013; Cuperus, Berberet, & Kenkel, 2013). In fact, pest management is one of the main challenges faced by Plain producers currently engaged in vegetable production in Missouri, and this has created the need for training on Integrated Pest Management (IPM). IPM can be defined as "an effective, long-standing, science-based, and environmentally sensitive approach to pest management that relies on a combination of common-sense practices" (EPA, 2012), and its importance has been established for many decades (Cuperus et al., 2013). Effective delivery of IPM information to potential users requires careful assessment of the target users and a commitment of resources and support on a long-term basis (García-Pabón & Lutch, 2008).

Objectives

The research reported here was designed to assess the level to which Plain producers were receptive to IPM after initial contact with university Extension. Here, we report a comprehensive evaluation conducted through a survey aimed at determining the impact Extension had on this unique group of farmers. We developed the following objectives to guide the investigation:

- Assess the level of IPM knowledge of farmers who returned the survey;
- Over the three-year reporting period, measure changes in producer farming practices especially in the area of IPM; and
- Identify the most important IPM-related resources used by Plain farmers in order to help the state's Extension educators improve their outreach methods.

Methods

We conducted Extension activities over a 3-year period (2009-2011) to introduce IPM information to Plain (mostly Amish) vegetable farmers as part of EPA-funded IPM outreach projects. Outreach involved workshop presentations at produce auctions (sales point), farm visits, and other outreach activities intended to encourage producers to learn about IPM and to use reduced-risk pesticides only if needed. The key publication around which presentations were structured was the *Midwest Vegetable Production Guide for Commercial Growers* (Egel et al., 2012), a six-state collaborative resource that is updated annually.

Working with the University of Missouri (MU) Assessment Resource Center (ARC) staff, we developed a survey comprised of 23 questions. The surveys collected information on the level of knowledge, behaviors, and sources of farmers' pest management information; reported here are the results of the questions that involve IPM. A mailing list of vegetable producers was developed over the course of the preceding 3-year period (2009-2011). Most contact names and mailing addresses were collected at various outreach events, and the rest were collected by different specialists working at the various communities where Plain producers actively grow produce. Of the total number of names collected, the majority were represented by Amish (ca. 85%) and Mennonite (ca. 10%) producers. In March 2012, 315 survey packets were mailed out. Packets included an instruction note, a four-page survey, and a business reply return mailer to ARC. This report includes the responses from the 118 completed surveys that were returned, showing an approximate response rate of 37%.

Results and Discussion

Age, Farming Experience, and Acreage

The age distribution of the 118 respondents is presented in Table 1A. When asked how many years they had been in vegetable production, 59% indicated that they had been farming for fewer than 10 years (Table 1B). Respondents were also asked how many acres in vegetable production they had in 2011 and the number of acres they had in production in 2009. Table 1C compares the number of acres for both time periods. Fifty-one percent of respondents reported having three acres or less in vegetable production in 2011. Overall, among the respondents who reported acreage in production in 2009 and 2011, the survey revealed an increase in total acreage in production and an increase in the number of farms in each of the size categories, except for the less than one (< 1) and the four-to-five (4-5) acreage ranges (Table 1C).

Table 1.

(A) Age, (B) Vegetable Farming Experience, and (C) Acreage in Production in 2009 and 2011

| (A) | | (B) | | (C) | | |
|------------------|-----------|------------------|-----------|------------------|-------------------|-------------------|
| Category (years) | % (count) | Category (years) | % (count) | Category (acres) | % (count) in 2009 | % (count) in 2011 |
| Under 25 | 9 (11) | 1-4 | 31 (36) | < 1 | 26 (22) | 14 (16) |
| 25-29 | 12 (14) | 5-9 | 28 (33) | 1-3 | 33 (28) | 37 (43) |

| | | | | | | |
|--------------|------------------|--------------|------------------|--------------|-----------------|------------------|
| 30-34 | 19 (22) | 10-14 | 15 (17) | 4-5 | 20 (17) | 16 (19) |
| 35-49 | 13 (16) | 15-20 | 9 (10) | 6-10 | 14 (12) | 21 (24) |
| 40-64 | 42 (49) | > 20 | 17 (20) | 11-20 | 6 (5) | 9 (5) |
| Over 65 | 5 (6) | ----- | ----- | > 20 | 1 (1) | 3 (1) |
| Total | 100 (118) | Total | 100 (116) | Total | 100 (85) | 100 (108) |

Use of Resources Provided by University Extension

Farmers were given a list of seven activities and sources of information provided by university Extension staff. They were then asked to select all of the resources they had used from 2009 to 2011. As shown in Table 2A, respondents reported comparatively moderate to high use of Extension resources, depending on the type of resource. The *Extension IPM Bulletin*, the quarterly newsletter written and distributed collaboratively by MU Extension and the Lincoln University Cooperative Extension (LUCE) IPM program, was the most cited resource (75%). The frequent use of this free resource highlights the importance of continuing with printed resources for Plain producers, an effort that has required and will continue to involve substantial coordination and financial support to cover the costs of newsletter printing and distribution. *The Midwest Vegetable Production Guide for Commercial Growers* (Egel et al., 2012) was also used by a large percentage of respondents (64%), closely followed by one-on-one interactions (farm visits) with university Extension staff (63%). The *Extension IPM Bulletin* was also used to a great extent. When respondents were asked how much of the bulletin they typically read, just over half (52%) of respondents reported that they typically read all the articles presented in each issue (Table 2B).

Table 2.

(A) Use of Extension Resources Available to Plain Vegetable Farmers in Missouri, (B) Readership of the Freely Distributed *Extension IPM Bulletin*

| (A) | |
|--------------------------------------|------------------|
| Category | % (count) |
| MU/LUCE Extension IPM Bulletin | 75 (86) |
| Midwest Vegetable Production Guide | 64 (73) |
| Individual Visits by Extension Staff | 63 (72) |
| Extension Workshop/Presentation | 59 (67) |
| Extension Handout/Fact Sheet | 57 (65) |
| Extension Event at Produce Auction | 53 (60) |
| Extension Farm Tours/Field Days | 39 (44) |

| (B) | |
|------------------|------------------|
| Category | % (count) |
| None of it | 6 (6) |
| 1-2 articles | 18 (19) |
| 3-4 articles | 24 (26) |
| All the articles | 52 (56) |
| Total | 100 (107) |

Sources of Information, Level of Knowledge, and Implementation of IPM

When farmers were asked to make a check next to all of the sources they had used to learn about IPM, the largest number of farmers (67%) selected using their own experience (trial and error) as a source of IPM information (Table 3).

Table 3.
Sources of Learning about IPM by Plain Vegetable
Farmers in Missouri

| Category | % (count) |
|---------------------------------------|------------------|
| Your Own Experience (Trial and Error) | 67 (77) |
| Other Farmers | 64 (74) |
| Face-to-Face with Extension Staff | 60 (69) |
| Pesticide Container or Bag Labels | 48 (55) |
| Extension Publications | 44 (51) |
| Family Members | 44 (51) |
| Extension Presentations | 37 (43) |
| Employees of Pesticide Business | 34 (39) |
| Farm Magazines | 25 (29) |
| Farm or Crop Consultants | 15 (17) |
| Other | 7 (8) |

When farmers were asked to rate their knowledge and use of IPM using a five-point rating scale (1 = Very Low, 2 = Somewhat Low, 3 = Moderate, 4 = Somewhat High, 5 = Very High), 72% of respondents reported at least a moderate level of knowledge of IPM (Table 4A). The pattern of

responses for the level of knowledge appears to match the reported level of use of IPM techniques/practices in the most recent growing season (Table 4B). Farmers were also asked to compare their use during the 2011 growing season to prior use, by thinking back to their use of IPM techniques/practices in 2009, using a five-point rating scale (1 = Much Less, 2 = A Bit Less, 3 = About the Same, 4 = A Bit More, 5 = Much More). Nearly half the number of respondents reported greater use of IPM techniques/practices in 2011 (Table 4C).

Table 4.

(A) Overall Level of IPM Knowledge, (B) IPM Use in the 2012 Season, (C) IPM use in 2011 Relative to 2009, as Reported by Plain Vegetable Farmers in Missouri

| (A) | | (B) | | (C) | |
|---------------|----------------------|---------------|----------------------|----------------|----------------------|
| Category | % (count) | Category | % (count) | Category | % (count) |
| Very Low | 4 (5) | Very Low | 9 (10) | Much Less | 1 (1) |
| Somewhat Low | 24 (27) | Somewhat Low | 21 (23) | A Bit Less | 6 (6) |
| Medium | 61 (69) | Medium | 58 (65) | About the Same | 44 (45) |
| Somewhat High | 9 (10) | Somewhat High | 12 (13) | A Bit More | 44 (46) |
| Very High | 2 (2) | Very High | 1 (1) | Much More | 5 (5) |
| Total | 100 (112) | Total | 100 (112) | Total | 100 (103) |

In order to create a measure of IPM use that can distinguish among respondents, a system that consisted of six questions and points given based on producers' answers was developed to generate an IPM score for each respondent. Table 5 outlines the system for creating this score. The range of possible IPM scores was 0-14, with higher scores indicating greater use of IPM-related practices.

Table 5.

Self-Evaluating IPM Scoring System Used by Each Survey Respondent

| Category for Level of IPM Use by Producers | Maximum points |
|---|----------------|
| Scouting <ul style="list-style-type: none"> • Our fields are scouted on a regular interval (e.g., weekly) in an organized method. (3 points) • Our fields are watched closely for pests. We inspect the crop closely and when not in the field for some time, we stop to examine the crop. (2 points) | 3 |

| | |
|--|---|
| <ul style="list-style-type: none"> • Our fields are casually scouted. When in the fields, we keep an eye out for typical problems. <i>(1 point)</i> • Our fields are never scouted. We react to problems when we see them. <i>(0 points)</i> | |
| <p>Rotating pesticides</p> <ul style="list-style-type: none"> • Yes <i>(2 points)</i> • Sometimes <i>(1 point)</i> • No <i>(0 points)</i> | 2 |
| <p>Using reduced-risk pesticides</p> <ul style="list-style-type: none"> • Yes <i>(2 points)</i> • Sometimes <i>(1 point)</i> • No <i>(0 points)</i> | 2 |
| <p>Attempting to identify pests before selecting pesticides</p> <ul style="list-style-type: none"> • Yes <i>(2 points)</i> • Sometimes <i>(1 point)</i> • No <i>(0 points)</i> | 2 |
| <p>Working to improve soil fertility</p> <ul style="list-style-type: none"> • Yes <i>(2 points)</i> • Sometimes <i>(1 point)</i> • No <i>(0 points)</i> | 2 |
| <p>Checking crops post-pesticide application</p> <ul style="list-style-type: none"> • I always go back to check the crop within a few days or a week. <i>(3 points)</i> • I usually go back to check the crop within a few days or a week. <i>(2 points)</i> | 3 |

| | |
|--|-----------|
| I sometimes go back to check the crop within a few days or a week. (1 points) | |
| <ul style="list-style-type: none"> I rarely go back to check the crop. I assume that pesticide works like it should. (0 points) | |
| Maximum number of points for all practices combined | 14 |

A Pearson product-moment correlation coefficient was computed to assess the relationship between the self-evaluating IPM scores (derived from Table 5) and the farmers' overall level of IPM knowledge (derived from Table 4A). Although the IPM score system is a somewhat subjective measure of IPM implementation, it was significantly and positively correlated with respondents' own perceptions of their use of IPM techniques and practices ($r = 0.44, p < .01$). The survey results suggest that these targeted Missouri farmers are using practices associated with IPM and that their use of these practices has increased over the 3-year period (2009-2011) that followed initial contact with university Extension.

The next set of analyses uses data from each respondent and looks at the association between the number of sources of learning about IPM such as Extension publications, face-to-face advice provided by agents, etc. (Table 3) and the use of IPM practices using the scoring system (Table 5). The new variable was found to be positively correlated with their IPM score ($r = 0.38, p < 0.01$). The positive correlation between the level of exposure to Extension resources and the use of IPM practices suggests that the objective of promoting IPM practices through Extension has been successful, although such a relationship does not necessarily indicate causality. It is conceivable that farmers who adopted these recommended management practices might have also been actively engaged in seeking out advice and information from a variety of sources, not just university Extension.

Preferred Sources of Information

Farmers were given a list of seven Extension resources and asked how likely they were to use each source of information in the future to learn more about vegetable production issues. Overall, respondents reported a fairly high likelihood of engaging with Extension in a variety of ways. With the exception of MU Extension farm tours, the majority of respondents reported being at least somewhat likely to use each of the different resources. The *Extension IPM Bulletin* published jointly by MU Extension and the LUCE IPM program and the *Midwest Vegetable Production Guide for Commercial Growers* (Egel et al., 2012) received the highest mean scores (Table 6). The top three sources of IPM information indicate that Plain vegetable producers are very receptive to getting appropriate research-based IPM information using traditional methods (printed documents, one-on-one interactions).

Our findings indicate that Extension is considered a trusted source of information by Plain producers. Therefore, the Extension methods of choice for this group should be more interpersonal, with extra one-on-one communication methods used in an attempt to reach the needs of Missouri's small and limited-resource farmers.

Table 6.

Likely Future Use of Extension Resources by Plain Vegetable Farmers in Missouri

| Extension Source of IPM Information | Likelihood* | | | | | Total (count) |
|---|-------------------------------|-----------------------------------|-------------------------|---------------------------------|-----------------------------|------------------|
| | Very Unlikely % (count) | Somewhat Unlikely % (count) | Neutral % (count) | Somewhat Likely % (count) | Very Likely % (count) | |
| Midwest Vegetable Production Guide for Commercial Growers | 3 (3) | 6 (7) | 13 (15) | 32 (36) | 46 (53) | 100 (114) |
| MU/LUCE Extension IPM Bulletin | 1 (1) | 3 (4) | 15 (17) | 42 (48) | 39 (45) | 100 (115) |
| Individual Visit with an Extension Agent | 3 (3) | 5 (6) | 19 (22) | 37 (43) | 36 (41) | 100 (115) |
| Handouts | 6 (7) | 4 (4) | 22 (24) | 38 (43) | 30 (34) | 100 (112) |
| Organized Event at a Produce Auction (Sales Point) | 9 (10) | 13 (15) | 7 (8) | 43 (48) | 28 (32) | 100 (113) |
| Workshops/Presentations | 5 (6) | 13 (14) | 22 (24) | 44 (48) | 16 (17) | 100 (109) |
| Farm Tours | 17 (19) | 16 (18) | 27 (31) | 27 (31) | 13 (14) | 100 (113) |
| * Producers were asked, "In the future, how likely are you to use the following sources of information from Extension to learn more about vegetable production issues?" Data were sorted according to the "very likely" category. | | | | | | |

Conclusions

Based on reported planted acreage, vegetable production among Plain producers has expanded over a 3-year period (2009-2011). Respondents who reported accessing a greater variety of Extension resources also reported a greater use of IPM practices. The *Extension IPM Bulletin*, published and distributed jointly by MU Extension and the LUCE IPM program, and the *Midwest Vegetable Production Guide for Commercial Growers* (Egel et al., 2012) were the two most widely used sources of IPM information. These two resources, therefore, should continue to be made readily available and should be recognized by Extension as valuable resources for providing information to this particular audience. Our results highlight the importance of providing Plain producers with relevant, culturally sensitive Extension programming through traditional delivery systems, such as newsletters, publications, small group workshops, and field days. The production costs of traditional outreach materials provided at no cost to Plain producers can be justified, as exemplified by Missouri's two land-grant universities working in partnership to serve underserved audiences in Missouri.

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