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Assessing Extension Agents' Nematology Knowledge Needs and Related Resource Preferences: Implications for Trainings on Complex Agricultural Topics

Abstract

Plant pathology researchers have identified a need to expand knowledge of nematology, and nematode control options in Arkansas are limited. Thus, relevant in-service trainings are warranted. In response to the plant pathology researchers' findings and findings promoting the use of technology in training Extension agents, we explored agricultural agents' nematology-related knowledge needs and their perceptions and preferences regarding relevant resources and training delivery methods. We found that county agents in Arkansas need nematology training and resources, have positive perceptions of existing training methods and materials, and are comfortable with job-related technologies, such as the Internet, computers, smartphones, and tablets. These results provide support for developing technology-based training to address nematology and other complex agricultural production topics.

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Introduction

The impacts of plant diseases are substantial. Global food production losses to plant diseases are estimated to be at least 10% annually, not including postharvest losses (Strange & Scott, 2005). Agricultural crop losses to plant diseases are estimated at $220 billion annually (Chakraborty & Newton, 2011). An estimated $8 billion in damages and losses due to plant-parasitic nematodes occur in the United States every year (Barker, 1998; Barker et al., 1994; Jagdale, 2011). The plant-parasitic nematode damage worldwide is estimated at $78 billion to $100 billion annually (Mitkowski & Abawi, 2011). Nematode control options are limited, and the primary options available in Arkansas currently include nematicides, host crop resistance, and crop rotation (Kirkpatrick & Thomas, n.d.).

Limited resources are cited across agricultural disciplines as a cause for delay in advancements. For example, a shortage of scientists in the nematology field limits research (Barker et al., 1994). Although the need to produce higher quantities of food is pressing, sustainable agricultural practices also are needed for

conserving available natural resources and the environment (Falvey & Maguire, 1997).

It is not enough to know that particular practices are needed. It also is important to consider how best to arm Extension agents to supply education on those practices. In-service trainings and professional development opportunities offered to county agents vary. Recently, various technologies have been introduced as options for training agents. For example, in-service training may be provided by means of satellite television, interactive videos, self-instructional DVDs, web-based curricula, webcasts, and podcasts (Seevers & Graham, 2012). In-service training via the Internet has been found to be effective and has been met with enthusiasm by county agents (Lippert, Plank, Camberato, & Chastain, 1998). Gains in knowledge levels achieved by Extension personnel in a multimedia-rich online in-service environment were comparable to those achieved by participants in traditional face-to-face in-service environments (McCann, 2007).

The trend of increasing technology use for county agent in-service trainings aligns with the overall trend of increasing technology use in the United States. In-service training delivery methods now include distance learning strategies that typically center on computer and web-based instruction (Seevers & Graham, 2012). Likewise, a relatively recent survey found that 70% of U.S. adults have high-speed broadband connection in their households as compared to only 3% who had high-speed broadband connections in 2000 (Zickuhr & Smith, 2013). Extension must continue to provide leadership in innovation by adopting greater use of technology to effectively meet the needs of an advancing and diverse client base in the future (Diem, Hino, Martin, & Meisenbach, 2011).

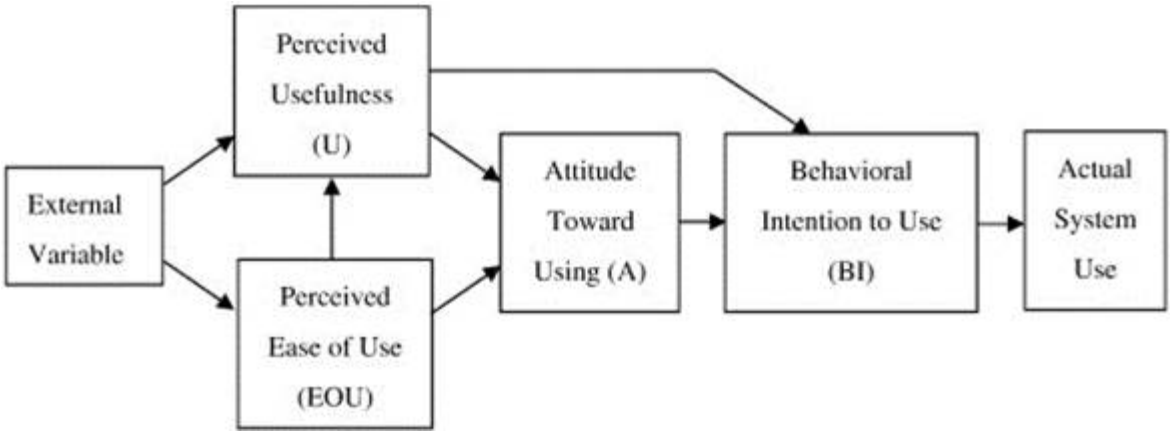
Due to the significant impacts of plant-parasitic nematodes, leading plant pathology researchers identified a need to expand the knowledge base in plant and soil nematology as well as to increase research, education, and outreach in nematology (Barker et al., 1994). Likewise, plant pathology researchers and scholars have recognized the need for "new information-transfer approaches," "innovative systems," and "distance-educational technology" to "facilitate the development, deployment, and use of new knowledge" about nematodes (Barker et al., 1994, p. 130). The needs outlined by plant pathology researchers and agricultural education researchers, combined with agricultural impacts in Arkansas, led us to select nematology as a subject of investigation. Implications of our study relate to the development of technology-based trainings on not only nematology but also other complex agricultural production topics.

Theoretical Framework

Due to recommendations in agricultural education literature regarding the use of technology in training Extension agents, we selected the technology acceptance model (TAM) as the theoretical basis for our study. We also used Witkin and Altschuld's (1995) guide to planning and conducting needs assessments. TAM, introduced by Davis (1986), is a model of user acceptance of information systems and computers (see Figure 1). The premise of TAM is that an individual's behavioral intention to use a system is determined by "perceived usefulness" and "perceived ease of use" (Davis, 1986, p. 24). Within the context of TAM, perceived usefulness is "the degree to which an individual believes that using a particular system would enhance his or her job performance" (Davis, 1986, p. 26). Additionally, perceived ease of use is "the degree to which an individual believes that using a particular system would be free of physical and mental effort" (Davis, 1986, p. 26). Davis (1986) also theorized that perceived ease of use has a causative effect on perceived usefulness. Perceived usefulness was found to have a dominant role in TAM because it has an influential effect on attitude toward using a system and a strong direct effect on self-predicted usage behavior (Davis, 1986).

Figure 1.

Technology Acceptance Model



From "User acceptance of computer technology: A comparison of two theoretical models," by F. D. Davis, R. P. Bagozzi, and P. R. Warshaw, 1989, *Management Science*, *8*(35).

Needs assessments are tools for determining "the needs of the people for whom the organization or system exists" (Witkin & Altschuld, 1995, p. 12). Needs assessments have commonly been used in the Cooperative Extension System for assessing continuing education and training needs of county agents (Brian, Irani, Hodges, & Fuhrman, 2009; Gibson & Hillison, 1994; Kluchinski, 2012; Murphy, Coleman, Hammerschmidt, Majewski, & Slonim, 1999; Schwarz & Gibson, 2010). Assessing agricultural agents' knowledge of nematology and use of related information sources as well as their comfort with and use of technology is the first step in understanding relevant training needs.

Purpose and Objectives

The purpose of this study was threefold: to identify Arkansas agricultural county Extension agents' need for in-service training pertaining to plant-parasitic nematodes, to identify respondents' comfort level with technology as it pertains to their jobs and in-service training, and to identify areas of need for nematology training. The specific objectives guiding the study were as follows:

1. Determine Arkansas agricultural county Extension agents' comfort with technology.
2. Determine Arkansas agricultural county Extension agents' perceptions of the usefulness of job-related resources.
3. Determine the frequencies with which Arkansas agricultural county Extension agents are consulted about topics pertaining to plant-parasitic nematodes.
4. Determine Arkansas agricultural county Extension agents' levels of need for training about nematology topics.
5. Identify Arkansas agricultural county Extension agents' sources for nematology information.

6. Determine Arkansas agricultural county Extension agents' preferred types of in-service training.

Methods

We targeted agricultural county Extension agents (N = 46) and Extension staff chairs (N = 73) in Arkansas. In Arkansas, staff chairs are county Extension agents who receive a stipend to assume staff chair responsibilities in addition to their program responsibilities. The sampling frame, consisting of agricultural agents and staff chairs in Arkansas, did not include information about staff chairs' program areas; therefore, all staff chairs were surveyed. The instrument used for the study contained a question for identifying staff chairs having agricultural program area responsibilities. The instrument was assessed by two nematology experts, one Extension expert, and two agricultural education/communications experts for face and content validity. Ex post facto reliability coefficients were calculated for six constructs within the needs assessment. The constructs and their coordinating Cronbach's alpha coefficients for reliability were as follows: comfort using technology (.89), perceived utility of job-related resources (.55), job duties (.95), nematology education needs (.97), educational sources (.80), and in-service preferences (.70). Low reliability of the "perceived utility of job-related resources" construct was deemed sufficient on the basis of Nunnally's (1967) statement that a modest reliability is sufficient during the early stages of research.

The sampling frame used in the study was the Arkansas Extension personnel directory of April 2013. Data for the study were collected through the use of a researcher-developed survey instrument. Respondents self-administered the survey instrument via the online survey platform Qualtrics. An introductory letter containing a link to the survey instrument was emailed to agricultural county Extension agents on April 23, 2013. The introduction included the purpose of the study, institutional review board approval information, consent information, a confidentiality statement, and a statement about the voluntary nature of the study. One week later, an email reminder with a link to the survey instrument was sent to county agents. A final reminder was sent to county agents approximately 2 weeks after the initial contact (Dillman, 2007). After two email follow-up contacts, 68 usable responses were received, for a 57% response rate. Because all responses were anonymous, follow-up with nonrespondents was not possible. Therefore, a comparison of early and late respondents was conducted to test for nonresponse error (Linder, Murphy, & Briers, 2001; Miller & Smith, 1983). Agents and staff chairs responding to the initial contact (n = 30) and those responding to the follow-up contacts (n = 38) were compared through the use of t-tests relative to their comfort with technology and need for training; because no statistically significant differences were found for any variable, we concluded that nonresponse error was not a study threat.

The instrument comprised four sections. Section one consisted of Likert-type scaled questions for assessing respondents' comfort using computer technologies related to their job duties, driven by TAM. The section also included questions for determining respondents' perceptions of usefulness of various online Extension resources. Respondents who indicated that they assisted Extension clients with plant-parasitic nematode topics proceeded to section two of the instrument. Respondents who indicated that they did not assist clients with plant-parasitic nematode topics skipped to the last section of the instrument. Section two consisted of questions for determining the frequency with which agents were consulted about various topics pertaining to plant-parasitic nematodes. Section three of the instrument consisted of Likert-type scaled questions for determining respondents' need for training on various aspects of plant-parasitic nematodes. Additionally, this section included questions relating to sources respondents used to obtain information about plant-parasitic

nematodes and their preferred methods for receiving in-service training about plant-parasitic nematodes. Section four, the last section of the instrument, consisted of general demographic questions.

Analysis of data included descriptive statistics, and data are reported as frequencies, means, and standard deviations. Data were analyzed through the use of SAS 9.2.

Findings

The majority of respondents (53%) had been Extension employees for more than 15 years. Among the remaining respondents, 8% had worked for Extension for 11 to 15 years, 20% for 6 to 10 years, 11% for 2 to 5 years, and 8% for less than 1 year. A majority of respondents (81%) were male. The highest level of education completed was a master's degree for most respondents (89%), a bachelor's degree for 5% of respondents, and "some graduate work" for 6% of respondents. A majority of respondents (62%) had county staff chair responsibilities; the remaining 38% identified their position as county agent. Regarding general knowledge of plant-parasitic nematodes, 67% of respondents indicated that such knowledge was necessary to meet the needs of their clientele.

The first objective of the study was to determine comfort levels of Arkansas agricultural county Extension agents concerning technology use (Table 1). Overall, respondents agreed that they were comfortable using the job-related technologies in question. Respondents were most comfortable using a computer to search for job-related information (M = 4.43, SD = 0.77) and least comfortable using a smartphone to search the Internet (M = 3.65, SD = 1.15).

Table 1.

Arkansas Agricultural County Extension Agents' Comfort Levels in Using Job-Related Technologies

Statement	No.	*M*	*SD*
I am comfortable utilizing Internet resources to research job-related topics	65	4.38	0.80
I am comfortable utilizing a computer to search for information needed to assist Extension clientele	65	4.43	0.77
I am comfortable utilizing a smartphone to search the Internet for information needed to assist Extension clients	65	3.65	1.15
I am comfortable utilizing an iPad/tablet to search the Internet for information needed to assist Extension clients	65	4.06	1.00

Note. Likert-type scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree*.

The second objective of the study was to determine respondents' perceptions of the utility of job-related resources (Table 2). For each resource, respondents were first asked whether they had used the resource, and only respondents who had used the resource rated its utility. In general, respondents were undecided as to whether the job-related resources mentioned were useful to them; however, they did agree that the Arkansas Cooperative Extension website was useful (M = 4.22, SD = 0.83).

Table 2.

Arkansas Agricultural County Extension Agents' Perceptions of the Utility of Job-Related Resources

Statement	No.	*M*	*SD*
The University of Arkansas Cooperative Extension website (uaex.edu) is a useful resource for my job	64	4.22	0.83
Overall, the University of Arkansas Cooperative Extension In-Service Training website (learn.uaex.edu) is a useful resource for my job	61	3.59	0.78
The University of Arkansas Cooperative Extension "Employee Development Center" website (develop.uaex.edu) is a useful resource for my job	8	3.63	0.52
The website for the national Cooperative Extension System (eXtension.org) is a useful resource for my job	32	3.53	0.95
The in-service classes offered through the University of Arkansas Cooperative Extension In-Service Training website are a useful resource to me	60	3.88	0.61

Note. Likert-type scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree*.

The third objective of the study was to determine the frequencies with which Arkansas agricultural county Extension agents were consulted about topics pertaining to plant-parasitic nematodes (Table 3). Respondents were first asked to indicate whether nematology knowledge was necessary for meeting the needs of clientele in their area. Agents who indicated that nematology knowledge was necessary were asked to indicate the frequencies with which they were consulted about various nematology subjects.

Table 3.

Arkansas Agricultural County Extension Agents' Time Spent on Nematology-Related Assistance (*n* = 45)

Question	Never (%)	Less than once per month (%)	Once per month (%)	2–3 times per month (%)	Once per week (%)	2–3 times per week (%)	Daily (%)
On average, how often are you:							
Asked general questions about cotton and/or soybean crops	8.9	2.2	4.4	15.6	8.9	33.3	26.7
Asked general questions about plant-parasitic nematodes in cotton	11.1	33.3	13.3	24.4	8.9	8.9	0.0

and/or soybean crops							
Asked how to recognize symptoms of nematode damages in cotton and/or soybean crops	11.1	37.8	20.0	15.6	6.7	8.9	0.0
Asked how to diagnose plant-parasitic nematodes in cotton and/or soybean crops	11.1	37.8	15.6	24.4	4.4	6.7	0.0
Asked how to collect soil samples for diagnosing nematodes in cotton and/or soybean crops	13.3	53.3	15.6	11.1	4.4	2.2	0.0
Asked how to submit soil samples to the Arkansas Nematode Diagnostic Clinic	13.3	46.7	20.0	13.3	2.2	2.2	2.2
Asked about nematode management practices in cotton and/or soybean crops	11.1	42.2	15.6	20.0	6.7	2.2	2.2
Asked for assistance in developing nematode management recommendations for clients	20.0	44.4	13.3	6.7	11.1	4.4	0.0

The fourth objective of the study was to determine Arkansas agricultural county Extension agents' self-assessed levels of need for training on nematology topics (Table 4). The topic for which agents expressed the highest level of need was "developing nematode management recommendations" (M = 3.33, SD = 1.04). Respondents expressed the lowest level of need for the topic "submitting soil samples to the Arkansas Nematode Diagnostic Clinic" (M = 2.87, SD = 1.16).

Table 4.

Arkansas Agricultural County Extension Agents' Need for Nematology Training and Resources

				Likert-type scale frequencies				
Topic	**No.**	***M***	***SD***	**1**	**2**	**3**	**4**	**5**
General knowledge of plant-parasitic nematodes	45	3.24	1.03	3	5	20	12	5
Recognizing symptoms of nematode damages	45	3.31	1.20	3	6	17	12	7
Diagnosing nematodes	45	3.29	0.97	2	6	18	15	4
Collecting soil samples for nematode detection	45	2.98	1.22	6	10	13	11	5
Handling soil samples for nematode detection	45	2.93	1.16	5	12	13	11	4
Submitting soil samples to the Arkansas Nematode Diagnostic Clinic	45	2.87	1.16	6	11	15	9	4

General nematode management	45	3.29	0.97	2	6	18	15	4
Developing nematode management recommendations	45	3.33	1.04	2	7	16	14	6

Note. Likert-type scale: 1 = *no need at all*, 2 = *little need*, 3 = *some need*, 4 = *a need*, 5 = *a great need*.

The fifth objective of the study was to identify sources of nematology information used by Arkansas agricultural county Extension agents. Respondents were asked to indicate whether they obtained information from any of the sources listed on the survey instrument (Table 5). The sources respondents identified most frequently were state Extension specialists and fact sheets.

Table 5.

Arkansas Agricultural County Extension Agents' Sources for Nematology Information

Source	Yes (%)	No.
Arkansas state Extension specialists	89	45
Fact sheets	89	45
University of Arkansas Cooperative Extension Service printed materials	86	44
University of Arkansas Cooperative Extension Service website	82	45
Extension in-service training	80	45
Industry professionals	38	45
Research journal articles	31	45
Extension specialists in states other than Arkansas	18	44

The sixth objective of the study was to determine Arkansas agricultural county Extension agents' preferred types of training in the context of nematology. Table 6 shows respondents' preferred types of in-service training. The most preferred type of in-service training was face-to-face workshops with state faculty and specialists (M = 4.09, SD = 0.86). Self-paced online training modules were identified as the least preferred type of in-service training (M = 2.63, SD = 1.16).

Table 6.

Arkansas Agricultural County Extension Agents' Preferred Types of In-Service Training for Nematology Education

Method	No.	*M*	*SD*
Face-to-face in-service workshops with state faculty and specialists	44	4.09	0.86
Online resources (e.g., fact sheets, research publications, reporting guides, resource links)	44	3.89	0.81

One-on-one mentoring with a specialist	44	3.77	0.99
Printed instructional material (e.g., training manuals, books, lecture notes)	44	3.75	0.78
Instructor-guided online course	43	2.74	1.11
Self-paced online training module	43	2.63	1.16

Note. Likert-type scale: 1 = *very strongly avoid*, 2 = *strongly avoid*, 3 = *indifferent*, 4 = *strongly prefer*, 5 = *very strongly prefer*.

Conclusions, Discussion, and Recommendations

The purpose of our study was to identify Arkansas agricultural county Extension agents' need for in-service training about plant-parasitic nematodes and comfort level with certain job-related technology, based on TAM. A majority of the agents (67%) had a client base that needed information about plant-parasitic nematodes. Findings indicated that agents were comfortable using job-related technologies currently available and common to the scopes of their jobs. These job-related technologies and resources included the Internet, computers, smartphones, iPads, and websites and in-service opportunities administered by their state Extension organization. Additionally, the county agents were using the resources available to them with ease. Agents identified areas of nematology in-service training needs that warrant justification of future nematology in-service training development.

High proportions of agents (80%–89%) indicated that they use Arkansas Extension specialists, fact sheets, University of Arkansas Cooperative Extension Service printed materials, the Arkansas Cooperative Extension Service website, and in-service training to obtain information about nematology topics. At the same time, only small proportions of agents (18%–38%) noted that they obtained information about nematology from industry professionals, research journal articles, and Extension specialists not located in Arkansas.

The study revealed a need for the development of nematology training as well as nematode management recommendations, especially related to recognizing symptoms of nematode damages, diagnosing nematodes, and general knowledge of plant-parasitic nematodes. Respondents reported the lowest need for training in the areas of collecting, handling, and submitting soil samples for nematode detection. We conjecture that this finding aligns with that of a previous study of farmer training needs in the area of soil sampling (King, 1999). It was concluded from King's (1999) study that although farmers reported being confident in collecting soil samples, they lacked the needed skills and knowledge to accomplish the task.

Future nematology trainings should align with both ongoing technology trends and agent comfort with and perceptions of the utility of existing resources and technologies. Although online training was the least preferred in-service training method for respondents in our study, findings from other aspects of the needs assessment indicate that online training should not be removed from consideration for future development of in-service training needs. TAM posits that perceived usefulness and perceived ease of use determine an individual's intention to use a system (Davis, 1986). Results from our study indicate that agents viewed existing in-service classes and Internet resources as useful. Additionally, agents agreed that they were comfortable using Internet resources, computers, smartphones, and tablets. On the basis of these agent views, we suggest that using the mentioned resources will contribute to the success of newly developed trainings. Davis (1986) suggested that TAM can be used as a framework for development organizations, such

as Extension, to successfully design and develop new systems. According to that position, developing in-service training that is perceived to be useful and easy to use should increase the acceptance and use of developed training methods.

The findings from our study could be used to contribute to a knowledge base that will support future research in nematology education and in the professional development of county agents. Researchers should work to develop nematology educational materials as well as innovative in-service opportunities. Expanding the study population is recommended for future research. Ease of use and overall utility of new systems should be considered prior to and during development of Extension trainings.

This article provides insight into how training related to complex agricultural production topics should be developed for Extension agents. Even though electronic means of training continue to be developed, the value of face-to-face training remains important to Extension agents. Newer technologies are available for training in a synchronous face-to-face environment. Extension must focus on relevant training materials using these technologies to determine whether such delivery is suitable for Extension agents and target audiences. Additionally, needs assessments are important for understanding audience needs and must be used at ever increasing levels in Extension. Without the use of needs assessments, time and resources could be wasted. Extension must continue to be mindful of target audiences and must develop training materials based on their needs. Last, the use of technology also has implications across Extension. It is becoming increasingly important that Extension continue to assess and implement new teaching and learning technologies to ensure educational relevancy in the future.

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