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Abstract

The Collaborative and Enhanced First Detector Training program has expanded invasive species detection efforts by teaching participants to scout for, identify, and submit suspect exotic species samples. Workshops were delivered to agriculture professionals, master gardeners, and other Extension audiences. Topics included introduction pathways, regulatory agency procedures, identification of invasive pests or pathogens, monitoring procedures, and sample submission. Survey data indicated the intent of participants to augment detection efforts and the efficacy of Extension workshops in improving participants' perceptions of government agencies. Respondents perceived increases in knowledge related to particular invasive species, identification of potential future invaders, and sample submission. Other implications related to Extension programming on invasive species education are discussed.

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Introduction and Rationale

Response to invasive species involves complex, value-laden issues that affect Extension professionals and clients (Bardon et al., 2009). Invasive pests and pathogens are those that inhabit new geographic areas in which they proliferate and damage the environment by altering ecosystems, sometimes causing extinctions of native species or damaging agricultural production (Mack et al., 2000). The scope and frequency of biological invasions are increasing due to the escalating volumes of human transport and commerce (di Castri, 1989). The more than 50,000 invasive species in the United States cause nearly $120 billion in environmental damage and loss per year (Pimentel, Zuniga, & Morrison, 2005).

Public education and the use of volunteer networks can be effective tools for early detection and monitoring of invasive species (Burrack, Smith, Pfeiffer, Koeher, & Laforest, 2012; Mack et al., 2000; Pimentel et al., 2005). Previous Extension efforts affirm the value of public education. McReynolds and Howery (2001) were able to contribute to the control of Russian knapweed in their state through education and mapping. Extension professionals also have prevented the release of exotic pets through collaboration with pet stores (Lazur & Hanessian, 2008).

This article addresses an Extension program that builds capacity for the early detection of invasive species through a volunteer network: the Collaborative and Enhanced First Detector Training program (referred to hereafter as the First Detector program). The program is based on the idea that although nonexpert volunteers may have difficulty identifying certain species or recording detailed data, they can be effective during the early stages of species monitoring (Burrack et al., 2012). The First Detector program was funded by cooperative agreement initiatives of the U.S. Department of Agriculture Animal and Plant Health Inspection Service's Plant Protection and Quarantine program (USDA-APHIS-PPQ) and involved federal and state agencies and three land-grant universities in as many states.

Learning goals for First Detector program participants center on (a) the roles of the relevant agencies, (b) the identification of five to 10 invasive pests or pathogens that threaten to proliferate in their region (c) scouting methods, and (d) sample collection and submission. In an evaluation of the program, we used a questionnaire to determine the impacts of the program relative to the learning goals. Here, we discuss our results and consider implications for Extension programming related to invasive species.

Methods

We collected data by using an in-person survey method at First Detector trainings from 2012 to 2014. The 5-hr training involved lecture, discussion, and hands-on microscopy. The hosting Extension agents recruited participants. Target audiences were agriculture professionals, engaged citizens, and volunteers at parks or gardens. Workshop instructors described the purpose of the survey during introductory remarks. Informed consent forms and demographic questions were completed at that time.

After the workshop, instructors asked participants to complete a retrospective "post-then-pre" questionnaire before leaving. Although post-then-pre questionnaires are susceptible to response-shift bias, they are considered appropriate tools for detecting self-perceived changes caused by short-term programs, especially those in which participants may overestimate their understandings on a pretest (Davis, 2003; Phillips & Myers, 2013; Rockwell & Kohn, 1989). No incentives were offered for completion of the questionnaire.

We analyzed data in IBM SPSS version 20.0.0.0 using descriptive statistics, *t*-tests for paired samples, and one-way analyses of variance. Likert-type items involved a 5-point scale that ranged from *strongly disagree* (1) to *strongly agree* (5). Summated Likert scales were calculated on the basis of five to 10 individual Likert-type items. We checked scale reliability using Cronbach's alpha, with a cutoff value of 0.7 (Santos, 1999). The scales met the assumptions of *t*-tests and analyses of variance because of the approximately normal distributions, homogeneity of variances, and independence of cases.

Findings

A total of 449 participants completed questionnaires at 19 workshops in Florida, California, and New York from 2012 to 2014. Cases were eliminated due to missing data on an analysis by analysis basis. Therefore, the number of respondents is reported for each analysis. Although the exact number of nonrespondents was not tracked consistently, a rough estimate of the response rate is 90%.

Demographics

Ages of participants ranged from 18 to 85 and averaged 54 (443 respondents, *SD* = 15). About 56% of the participants identified as female, and 44% identified as male. The First Detector program reached a diverse group in terms of education, with proportions almost even across those without college degrees, those with bachelor's degrees, and those with postgraduate degrees. With regard to race and ethnicity, 93% of participants were White or Caucasian, 3% were Asian, 2% were Native American, Alaskan, or Islander, and 2% were Black or African-American, and 10% of the participants also were of Hispanic, Latino, or Spanish origin.

Overall, participants' plant-related experiences and interests suggest that the target audience was reached. The average number of years of participant experience with plant-related activities was 25 (437 respondents, *SD* = 18). About one third of the respondents categorized their agricultural activities as gardening or endeavors related to a state's Extension master gardener program. Respondents included 61 professional growers and 131 volunteers or staff of public gardens or parks. The sample also included scientists, researchers, students, consultants, and government employees. Additionally, nearly half the participants had previously attended programs about invasive species (Table 1). Moreover, it is noteworthy that the program reached participants who had worked with plant materials shipped from outside their localities. About 25% stated that they had received material from outside their states, and 11% stated that they had received material from outside the United States (Table 1).

Table 1.
Previous Experiences of First Detector Program Participants

Previous experience	**Yes (%)**	**No (%)**
Attended an invasive species	56	44

workshop		
Attended a First Detector, Sentinel Plant Network, or Protect U.S. training	8	92
Interacted with U.S. Department of Agriculture, Cooperative Agricultural Pest Survey, or National Plant Diagnostic Network	32	68
Received plant material from outside state	25	75
Received plant material from outside U.S.	11	89
Sought advice from Extension	64	36

Outcomes

Outcomes were evaluated by examining results of paired *t*-tests of summated Likert scales and observing changes in the preprogram/postprogram distributions of individual items. Multiple-choice questions also provided informative data. Responses to a question about how much of the content participants already knew were "none" (4%), "a little" (59%), "quite a bit" (33%), and "most of it" (4%). These results suggest that the material was prepared at the appropriate scope for most participants.

The analysis of scales indicated that participants perceived changes in their knowledge and attitudes related to the learning objectives for the program. The scales measured the following constructs: knowledge of the roles of government organizations related to invasive species detection, trust in those organizations, knowledge of the benefits of early detection, knowledge needed for detection (how to scout, identify plant pests, and submit samples), and behavioral intent related to scouting for invasive plant pests. Table 2 shows scale reliability quotients as well as the individual items and their descriptive statistics. The scales were approximately normally distributed.

Table 2.

Items and Reliability of Scales Used for Evaluation of First Detector Program

Scale	**Likert-type item**	**α**	***M* (pre)**	***SD* (pre)**	***M* (post)**	***SD* (post)**
Roles of organizations		.90				
	Regarding new pests, I know the role of the USDA.		3.6	.93	4.2	.65
	Regarding new pests, I know the role of [state department of agriculture].		3.6	.96	4.2	.66
	Regarding new pests, I know the role of CAPS.		3.2	1.0	4.1	.70
	Regarding new pests, I know the role of land-grant universities.		3.6	1.0	4.2	.69

	Regarding new pests, I know the role of the NPDN.		3.1	1.0	4.1	.75
Trust of organizations	Question stem: I would trust ________ to be considerate of my property concerns when responding to a report of a pest on my plant/crop/land.	.93				
	USDA		3.6	.96	4.0	.86
	[state department of agriculture]		3.7	.90	4.1	.75
	CAPS		3.6	.87	4.1	.74
	Land-grant universities		3.8	.88	4.3	.70
	NPDN		3.6	.86	4.1	.75
Benefits of detection		.92				
	I can benefit from early detection of new pest species.		4.1	.80	4.6	.54
	Early detection of new pests and pathogens is important.		4.3	.74	4.7	.54
	Early detection is a good way to avoid establishment of new plant pests.		4.4	.74	4.8	1.5
	Avoiding establishment of new plant pests is important.		4.4	.75	4.7	.62
	Early detection is a good way to minimize economic loss.		4.4	.75	4.7	.60
	Minimizing economic loss is important.		4.4	.77	4.7	.61
	Early detection is a good way to preserve biodiversity.		4.2	.89	4.6	.69
	Preserving biodiversity is important.		4.4	.80	4.7	.58
	Early detection is a good way to prevent plant loss.		4.4	.76	4.7	.56
	Preventing plant loss is important.		4.5	.71	4.8	.55
Knowledge for detection		.82				
	I know how to identify new pest species based on what they look like.		3.1	.96	4.0	.79
	I know how to identify new pest species by the damage they cause to plants.		3.1	.93	3.9	.78
	I know how to search for new pest species.		3.3	.98	4.1	.74
	I know how to submit samples of new pest species.		3.2	1.1	4.3	.73

	I know how to contact federal and state agencies about new pest species.		3.4	1.0	4.5	1.8
Behavioral intent		.87				
	Early detection sampling will not require more time and energy than I have available.		3.4	.93	4.1	.81
	Early detection sampling will not be too complicated a process for me.		3.4	.91	4.2	.71
	Early detection sampling will not involve too many instructions and requirements.		3.4	.91	4.1	.77
	I am likely to search for new pest species.		3.5	1.0	4.3	.67
	I am likely to report a new pest species I find to the appropriate agency.		3.7	1.0	4.6	.54

Note. USDA = U.S. Department of Agriculture. CAPS = Cooperative Agricultural Pest Survey. NPDN = National Plant Diagnostic Network.

As indicated by *t*-tests for paired samples, significant positive differences existed between the *before* data and the *after* data (Table 3). The scales were calculated as summated means, so the range of each scale is 1 to 5, as in the original items. The largest self-perceived changes occurred in participants' knowledge of detection processes (ΔM = .97, p < .01), behavioral intent (ΔM = .80, p < .01), and knowledge of the roles of government organizations (ΔM = .79, p < .01). The smallest change occurred in participants' knowledge of the benefits of detection (ΔM = .37, p < .01). This circumstance likely was due to perceived high levels of knowledge in this area before the workshop.

Table 3.

Paired *t*-Tests of Scales for Evaluation of First Detector Program

Scale	**No. of respondents**	**ΔM**	***SD***	***SEM***	***t***	***p***
Roles of organizations	366	.79	.84	.04	18	<.01
Trust of organizations	320	.51	.69	.04	13	<.01
Benefits of detection	355	.37	.59	.03	11	<.01
Knowledge for detection	350	.97	.96	.05	19	<.01
Behavioral intent	363	.80	.88	.05	17	<.01

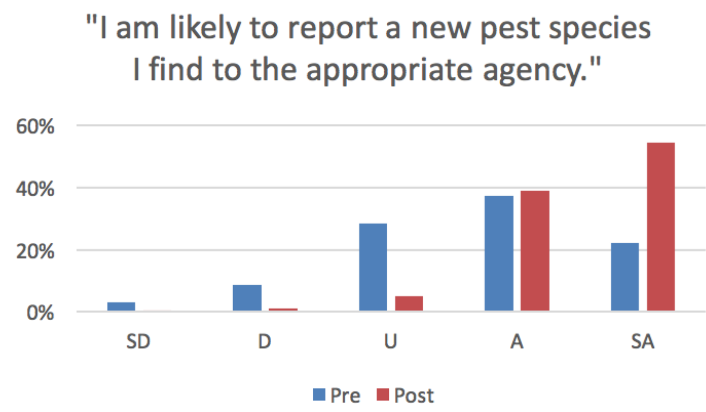
Note. SEM = Standard error of the mean.

Besides perceiving improved understanding of the roles of organizations involved in invasive species detection and tracking, participants had more trust after the workshop that such organizations would be considerate of property concerns (ΔM = .51, p < .01) (see Table 3). It is notable that participants most trusted land-grant universities to respect property concerns both before and after the program (see Table 2).

On individual items, about 82% of participants agreed or strongly agreed that after the workshop they could identify the species described in the workshop, and 78% reported that they could identify the pests on the basis of the damage they cause. When asked whether they were likely to scout for pests, 89% of participants expressed agreement. Additionally, about 94% agreed that they were likely to report the detection of a new pest species (Figure 1).

Figure 1.

Participants' Levels of Agreement Regarding Reporting Pest Detection
Before and After First Detector Program



Note. Response set for 5-point Likert scale:
SD = *strongly disagree*, D = *disagree*, U = *uncertain*, A = *agree*, and SA = *strongly agree*.

Paired *t*-tests were run separately for the 23 respondents (5.8%) who disagreed that they were likely to report a detection to the appropriate agency. This group experienced no significant changes in knowledge of agency roles, trust of organizations, or knowledge related to benefits of detection. Significant decreases in knowledge for detection ($\Delta M = -.76$, $p = .02$) and behavioral intent ($\Delta M = -.68$, $p < .01$) occurred.

Nearly all participants answered multiple-choice questions about the sampling and submission process correctly, except for a question about negative results. Only 80% of the participants answered that the date, location, and host plant should be reported to the appropriate agency after scouting even if no invasive species were found. Instructors were asked to emphasize the importance of submitting these negative results in the future to ensure that participants realize the value of negative data. Negative data provide evidence that certain species are not present in the area of a search.

We used one-way analyses of variance to check for significant differences among means of the Likert scales according to categorical demographic variables. No significant differences on the outcomes occurred relative to gender, race, education, profession, or the condition of having or having not imported plant material (plants or plant products) from another state. However, those who had imported plant material from outside the country had significantly different preprogram means than those who had not related to intent to scout ($F = 6.3$, $p = .01$) and knowledge for detection ($F = 12$, $p < .01$). For their *before* responses, this group expressed having greater intent to scout and rated their knowledge of and ability to identify invasive plant pests higher as compared to those who had not imported plant material from outside the country. This finding suggests that those who had imported plant material from foreign countries were more attentive to detection before the workshop but that both groups had increased knowledge and intention to scout after the workshop.

Because those who import foreign plant material may be at higher risk for introducing invasive species, we explored the demographics of this group. No significant differences in age, experience, professional activities, or gender were found that could be used to differentiate this audience segment. However, a chi-square test of independence showed a relationship between ethnic origin and importing material from outside the United States ($\chi^2 = 17$, $p < .01$). Whereas only 8.9% of 361 non-Hispanic/Latino/Spanish participants had imported material from outside the United States, 31% of 39 Hispanic/Latino/Spanish participants had done so. However, this finding may be caused by the smaller number of Hispanic, Latino, and Spanish participants or may be more connected to the specific geographical area and agricultural context of the participants.

Discussion

The evaluation data reported herein already have been used for monitoring and improving the First Detector program. Some participants' misconceptions about the value of submitting negative scouting data as well as responses to a question about the most difficult pest to identify provided immediately useful insight to instructors. Participants' indications of trust for land-grant universities support Extension's role in invasive species education and interagency collaborations. The data also provide support for the idea that participants' trust in government agencies can be improved by learning about their roles in an interagency environment.

As risk assessment techniques and strategies evolve, the complex task of connecting future invaders to likely invasion sites may become easier (Mack et al., 2000). Education efforts could then be more specifically targeted to vulnerable communities and linked to possible future invaders. Offering voluntary educational services to those likely to import plant material from areas that harbor potentially invasive species could further increase the probability of early detection. Those conducting future research could seek to better identify audience segments likely to receive plant material from across state or national boundaries.

The decreases in knowledge about detection and behavioral intent experienced by small percentages of participants could be explained in several ways. These participants may have left feeling confused about which agency to submit results to or lacking confidence in their identification skills. Or they may have decided that they had limited time for the task or limited access to worthwhile scouting sites.

Although participants' indications of high levels of knowledge regarding the benefits of detection may be linked to attending previous invasive species workshops, the First Detector program built on this foundation by providing participants with scouting, identification, and sample submission skills. By increasing most participants' knowledge of and intention to scout for potentially invasive species, such educational sessions can lead to earlier detection and better monitoring of target species through networks of volunteers. Early detection and monitoring provide economic and ecological benefits (Mehta, Haight, Homans, Polasky, & Venette, 2007). Relative to the study reported here, follow-up contacts will be used for collecting data related to participants' scouting and sample submission behaviors, thereby identifying participants most likely to be effective volunteers.

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References

Bardon, R., Meyer, N., Susan, M., Overholt, G., Peterson, G., Simon-Brown, V., . . . Vandenberg, L. (2009). Communication techniques for initiating discussion about complex value-laden issues. *Journal of Extension*, *47*(1), Article 1TOT1. Available at: http://www.joe.org/joe/2009february/pdf/JOE_v47_1tt1.pdf

Burrack, H. J., Smith, J. P., Pfeiffer, D. G., Koeher, G., & Laforest, J. (2012). Using volunteer-based networks to track *Drosophila suzukii* (Diptera: Drosophilidae), an invasive pest of fruit crops. *Journal of Integrated Pest Management*, *4*(3), 1–5.

Davis, G. A. (2003). Using a retrospective pre-post questionnaire to determine program impact. *Journal of Extension*, *41*(4), Article 4TOT4. Available at: http://www.joe.org/joe/2003august/tt4.php

di Castri, F. (1989). History of biological invasions with emphasis on the Old World. In J. Drake, F. di Castri, R. Groves, F. Kruger, H. A. Mooney, M. Rejmanek, & M. Williamson (Eds.), *Biological invasions: A global perspective* (pp. 1–30). New York, NY: Wiley.

Lazur, A. M., & Hanessian, R. (2008). Re-homing exotic species—A pilot program to prevent release of exotic aquatic pet species. *Journal of Extension*, *46*(1), Article 1IAW6. Available at: http://www.joe.org/joe/2008february/iw6.php

Mack, R. N., Simberloff, D., Lonsdale, W. M., Evans, H., Clout, M., & Bazzaz, F. A. (2000). Biotic invasions:

Causes, epidemiology, global consequences, and control. *Ecological Applications*, *10*(3), 689–710.

McReynolds, K. H., & Howery, L. D. (2001). Public education, mapping, and early action to control Russian knapweed in southeastern Arizona. *Journal of Extension*, *39*(2), Article 2FEA2. Available at: http://www.joe.org/joe/2001april/a2.php

Mehta, S. V., Haight, R. G., Homans, F. R., Polasky, S., & Venette, R. C. (2007). Optimal detection and control strategies for invasive species management. *Ecological Economics*, *61*(2), 237–245.

Phillips, B. K., & Myers, B. E. (2013). Response-shift bias in critical thinking. *NACTA Journal*, *57*(1), 78–81.

Pimentel, D., Zuniga, R., & Morrison, D. (2005). Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics*, *52*(1), 273–288.

Rockwell, S. K., & Kohn, H. (1989). Post-then-pre evaluation. *Journal of Extension*, *27*(2), Article 2FEA5. Available at: http://www.joe.org/joe/1989summer/a5.php

Santos, J. R. A. (1999). Cronbach's alpha: A tool for assessing the reliability of scales. *Journal of Extension*, *37*(2), Article 2TOT3. Available at: http://www.joe.org/joe/1999april/tt3.php