Extension Education Methods

Integrating Graduate and Extension Education through Total Crop Management Training

James E. Faust,¹ Elizabeth Will,² and Millie Williams²

ADDITIONAL INDEX WORDS. graphical tracking, integrated pest management, service training

SUMMARY. Graduate students received training in total crop management (TCM) techniques including pest scouting and trapping, nutritional monitoring, and graphical tracking of crop height. In 1995, one student visited five greenhouse businesses biweekly during the poinsettia (*Euphorbia pulcherrima* Willd.) season to provide TCM training to one greenhouse employee per business. In 1996, a second student visited one greenhouse business every week during the poinsettia crop to conduct the TCM program for that business. The students benefited from the gained practical knowledge of greenhouse production techniques and TCM techniques, and they also benefited from the opportunity to visit commercial greenhouses and interact with staff throughout the production cycle for an entire crop. This program also provided the students with the opportunity to develop their teaching, communication and training skills. The participating growers benefited during this study from receiving useful production information and TCM training. An evaluation of the program conducted in 1998 indicated that four of the five participating businesses continue to use some TCM techniques, while two of the five have fully integrated the TCM program into their normal production routines.

Department of Ornamental Horticulture and Landscape Design, University of Tennessee, P.O. Box 1071, Knoxville, TN 37901-1071.

The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

¹Assistant professor.

²Graduate student.

Service learning can be defined as a method 1) under which students learn and develop skills through active participation in organized experiences that meet actual community or industry needs and that are coordinated in collaboration with the school, 2) that provides students with opportunities to use newly acquired skills and knowledge in real-life situations, and 3) that enhances what is taught in school by extending student learning beyond the classroom and into the community (Moon, 1994). The benefits of service learning include positive impacts on students' attitudes, values and skills (Eyler et al., 1997), while Osborne et al. (1998) demonstrated that service-learning students became more confident of their ability to work with others and experienced an increase in their perceived social competency.

While many of the service learning programs being developed at universities focus on community service and volunteerism, strategic alliances between universities, students and industries provide opportunities for rich educational field experiences in discipline-specific areas of study (Lenk, 1997). Within the field of horticulture, perhaps the most commonly used service approach to learning involves undergraduate landscape design courses, wherein students create designs for the surrounding community or members of the community (Davis, 1999).

While traditional graduate degree programs focus on research activities, service learning programs can provide horticulture graduate students exposure to extension training and possible extension career opportunities. So, we developed a program to allow graduate students to work closely with commercial greenhouse businesses and the extension floriculture specialist. The program involved the graduate students training commercial greenhouse employees in the proper implementation of a total crop management (TCM) program at their business site.

TCM refers to the integration of integrated pest management techniques for pest and disease control (Powell and Lindquist, 1992), nutritional monitoring (Warncke and Krauskopf, 1983), and graphical tracking of crop height (Heins and Carlson, 1990). TCM techniques are tools to assist growers in the decision-making process throughout the duration of the crop (Sanderson and Gill, 1998). Proper implementation of TCM procedures allow growers to recognize and respond to potential production problems in advance of the problem causing substantial economic losses. Thus, the TCM program served as a tool to integrate graduate student training and extension education.

The objectives of this project were 1) to provide graduate students with a practical industry experience through a service-learning program, 2) to train commercial greenhouse staff in the proper implementation of TCM techniques, 3) to record the impact of this training program on the participating businesses production methods, and 4) to determine the potential opportunity for greenhouse businesses within a specific geographical region to hire a professional scout or crop advisor to provide production and management assistance.

Procedures

In 1995, five greenhouse businesses in east Tennessee were invited to participate in a program in which a graduate student would make biweekly on-site visits during the poinsettia season to provide TCM training to one greenhouse employee per business, i.e., the trainee. The program was implemented during the poinsettia season because growers

are dealing with a primary crop, so their workload is sufficiently low that they have time available to receive and implement the training. The owners were told that the student was not to be asked for production advice, and the owners were asked to provide payment for the student's travel expenses. It was made clear that this was an educational opportunity, not a professional consultation. The businesses were chosen to represent a variety of commercial floriculture operations, e.g., wholesale and retail businesses, mid-sized production areas and relatively small production areas.

1995 Participants

- A) A 100,000 ft² (9,290 m²) wholesale greenhouse operation in business for 10 years. The trainee was a grower with 3 years of experience and a BS degree in horticulture.
- B) A 100,000 ft² wholesale greenhouse operation in business for 25 years. The trainee was a grower with 1 year of experience and a BA degree in extension education and a minor in horticulture.
- C) A 50,000 ft² (4,645 m²) wholesale greenhouse operation in business for 3 years. The trainee was a grower with 7 years of experience and no formal horticultural training.
- D) A 20,000 ft² (1,858 m²) greenhouse used to support a retail garden center that had been in business for 20 years. The trainee was the greenhouse and garden center manager who had 1 year of experience and an associate's degree in horticulture.
- E) A 15,000 ft² (1,394 m²) greenhouse used to support a retail garden center that had been in business for 5 years. The trainee was a coowner who had 5 years of experience and no formal horticulture training.

A University of Tennessee graduate student received training from the University of Tennessee extension floriculture, entomology, and plant pathology specialists in the areas of pest and disease scouting, nutritional monitoring, and graphical tracking prior to the first on-site visit. During the initial greenhouse visits, the extension floriculture specialist and graduate student met with one trainee at each business. The student made five to six visits per site, while the extension floriculture specialist made two to three visits per site during this same time, including a final visit to assess the implementation of this program.

The TCM program included the development of a routine for pest and disease scouting. Insect trapping was performed with yellow, sticky cards. Specific numbers of whiteflies (*Bemisia argentifolii* Bellows & Perring and *Trialeurodes vaporariorum* Westwood), thrips (*Frankliniella occidentalis* Pergande and *Heliophilthripsaemorrhoidalis* Bouche), fungus gnats (*Scatella stagnalis* Fallen), two-spotted spider mites (*Tetranychus urticae* Koch) and green peach aphids (*Myzus persicae* Sulzer) were identified and recorded on forms designed and provided by the student. The different stages of pest development, e.g., egg, larvae, nymph and adult, were also recorded. Nutritional monitoring consisted of weekly soluble salts and pH media tests conducted at the specific business. Media samples were sent to a media-testing laboratory for analysis if the media needed to be tested for specific nutrients. Graphical tracking curves were plotted for the poinsettia as a means of tracking crop height.

During each visit, the student would review the trainee's records, discuss the TCM procedures undertaken the previous 2 weeks, and discuss measures to be considered during the coming 2 weeks. For example, when pest problems were

identified, strategies for control were discussed; however, the student did not provide specific pest control recommendations, e.g., pesticide product choice and application rate. The student did provide guidance on how to address a pesticide-application decision, i.e., the factors to consider in the decision-making process. For example, the student might point out that fungus gnat populations increased in house 1 despite weekly applications of Product A and fungus gnats were found on sticky traps in house 2 for the first time. Therefore, the trainee should consider 1) choosing a pesticide from a different chemical class to use in houses 1 and 2) applying a pesticide labeled for fungus gnats in houses 2 and 3) switching application methods, e.g., from a high-volume backpack sprayer to a low-volume fogger, 4) increasing the frequency of pesticide application, e.g., from 10- to 7-d intervals, 5) creating an environment less conducive for fungus gnats, e.g., unplugging drains to reduce water puddles under the benches. The extension floriculture specialist worked with the trainee via telephone conversations when discussions concerning specific decisions were necessary.

The large amount of travel required to implement the program in 1995 led us to change the program in order to focus on one specific greenhouse in 1996. Arrangements were made for the graduate student to visit one greenhouse business every week during the poinsettia crop to actually conduct the TCM program for that business. The student worked only with Business C from the 1995 study. Business C was a relatively new and rapidly growing business, however among the five participating businesses, Business C made the least progress in 1995 due in part to a lack of an appropriate trainee.

In 1996, the graduate student was not responsible for training an individual, but rather the student actually performed the TCM procedures and wrote weekly reports on a whiteboard mounted in the business' main office. One of the goals was to demonstrate to the business owner the usefulness of having a weekly pest, disease, nutrition, and plant height report available to the greenhouse production staff in order to aid the crop decision-making process. The faculty member's expectation was that the business would recognize the value of the TCM techniques and make a greater effort to implement their own program following this study. The Extension Floriculture Specialist made monthly visits along with the student to assess the progress of the study and to answer the student's questions.

Results and discussion

During 1995, trainees at Businesses A, B, and D fully embraced the TCM program, while Business E followed through with the scouting and trapping portion of the TCM program. The trainee at Business C regularly failed to perform even the weekly scouting routine.

Three years after this study, the trainees at businesses B and D are no longer employed at that business; however, Business B continues to use many of the TCM techniques (Table 1). Business A also continues to implement many TCM techniques, however insect trapping has been reduced only to areas where problems are anticipated in order to reduce the amount of time required. Business D no longer grows poinsettias and all TCM techniques have been discontinued. Business E continues to perform a basic scouting program, however no records are kept. Business C continues to graphically track their poinsettia crop; however, they still do not routinely scout for pests or perform routine media tests. They do conduct in-house media tests when needed.

Table 1. Implementation of total crop management techniques on poinsettias 3 years after the training program was conducted.

Technique	Business ^z				
	A	B	C	D	E
Pest trapping with sticky card	X	X	---	---	X
Pest and disease scouting	X	X	---	---	X
Recording pest numbers	---	---	---	---	---
Nutritional monitoring	X	X	Y	---	Y
Graphical tracking	X	X	X	---	---

^zX = Currently implemented on a regular basis during the poinsettia crop, Y = Implemented when necessary.

In all five businesses, the trainees ceased to record pest numbers after the cessation of the program. They all found this process to be too time-consuming and felt that scouting and trapping provided adequate indication of pest pressures. We view the benefits of actually writing down numbers as a means 1) to identify pesticide application effectiveness, 2) to allow the owner to supervise crop production, and 3) as a record for future reference; nevertheless, recording pest numbers was not adapted by the participants.

In comparing the 1995 and 1996 programs, each approach had its advantages. In 1995, visiting multiple businesses allowed the student to observe the different ways in which businesses respond and allowed the student to see a wider range of problems. However, the 1996 program allowed the student to closely follow the progress of an individual crop. Working with one greenhouse per graduate student was certainly the most convenient with regards to time and travel requirements. Future implementation of this program is limited by geography, i.e., there are a limited number of businesses to work with in convenient driving distance.

Implementation of this program has resulted in the development of a positive relationship between the extension specialist and the participating businesses regardless of the success achieved in permanently implementing the TCM program. These five businesses continue to be supportive of the university's extension programs and to seek technical support from the extension service. Although Business D did not follow through with the TCM program, the owner had positive comments about the program when questioned 3 years after implementation.

Originally, we had hoped that this program would stimulate the area businesses into jointly hiring a scout or crop advisor that would visit a series of greenhouses on a regular basis. However, the consensus was that the larger businesses would prefer that one of their own employees conduct the TCM program, while the smaller businesses were not interested in undertaking the additional expense of hiring a professional scout.

The process of having to teach TCM techniques to actual growers resulted in the students obtaining a thorough knowledge of the subject matter. The on-site visits helped to build the student's confidence in dealing with growers and increased their appreciation for the complexity of managing both greenhouse businesses and crops. This approach to graduate education was undoubtedly a valuable method for providing students with a challenging and useful learning experience. Both participating graduate students obtained industry positions immediately following graduation.

While the participating student undoubtedly display an increase in knowledge and confidence, the limitation of this approach to service training is that impact on individual

business depends largely on the commitment of the business management. Our results certainly underscore the variability in responses to the identical training program.

Efficient means of providing extension programming, possibility of inviting trainees to participate in a. The experience that we gained in conducting this program provided enough knowledge and expertise to develop extension publications on TCM-related issues, such as pest management and nutritional monitoring. A useful follow-up program would include a panel discussion among our trainees at a statewide meeting. The trainees could relate their positive and negative experiences with the implementing a TCM which may encourage other growers to experiment with developing their own TCM program.

Conclusion

Both graduate students reported that this service-learning opportunity was successful at providing them with a worthwhile educational experience, while the degree of success towards implementing a TCM program varied amongst the individual businesses. We believe that the deciding factor determining the successful implementation of a TCM program is the business owner's commitment to the program. If the owner perceives the program as a value to the business, then an employee will be allowed sufficient time to properly implement the program. In contrast, if the owner is not fully committed towards implementing a TCM program, then the employee will frequently be directed to more immediately pressing greenhouse duties.

Literature cited

- Davis, G.L. 1999. Landscape design courses provide opportunities for service learning. *Natl. Assn. Colleges Teachers Agr. J.* 43(1):23-24.
- Eyler, J., D.E. Giles, Jr., and J. Braxton. 1997. The impact of service learning on college students. *Mich. J. Comm. Serv. Learning* 4:5-15.
- Heins, R.H. and W.H. Carlson. 1990. Understanding and applying graphical tracking. *Greenhouse Grower* 8(5):73-80.
- Lenk, M.M. 1997. Discipline-specific knowledge in service-learning: A strategic alliance amongst universities, professional associations and non-profit organizations. *Mich. J. Comm. Serv. Learning* 4:104-108.
- Moon, A. 1994. Teaching Excellence: The role of service learning. *Mich. J. Comm. Serv. Learning* 1:115-120.
- Osborne, R.E., S. Hammerich, and C. Hensley. 1998. Student effects of service learning: Tracking change across a semester. *Mich. J. Comm. Serv. Learning* 5:5-13.
- Powell, C.C. and R.K. Lindquist. 1992. Ball pest and disease manual. Ball Publ., Batavia, Ill.
- Sanderson, J. and S. Gill. 1998. Greenhouse pests and beneficials. Ball Publ., Batavia, Ill.
- Warncke D.D. and D.M. Krauskopf. 1983. Greenhouse growth media: Testing and nutritional guidelines. *Mich. State Univ. Coop. Ext. Bul. E-1736*.