A Multidisciplinary, Hands-On Crop Management Educational Program

B. R. Durgan,* M. A. Schmitt, and B. J. Holder

ABSTRACT

Crop production questions and problems are usually best-addressed in a field setting. A 2-d field educational program was designed and conducted at the University of Minnesota Agricultural Experiment Station in Crookston. The primary objective was to educate participants in crop production management decisions via plot demonstrations. Five plot areas were designed to illustrate principles in five disciplines—weed management, soil fertility, crop morphology, entomology, and plant pathology. In each discipline's plot area, the instructors used combinations of demonstration plots, research plots, quizzes, lectures, and laboratory exercises to achieve their objectives. The administration of this program was comprised of state extension faculty, experiment station personnel, and area extension people. The budget was covered by tuition fees. Based on program evaluations, 71% of the respondents rated the overall program as excellent, and a majority of the respondents would like to have a similar program every year.

Experimental stations have used field days to showcase research projects and results to crop producers for several decades. The plot exhibits at field days attract a receptive and inquisitive audience according to Naftziger (1984). Because of widespread interest and acceptance as a teaching and learning opportunity, university personnel have added troubleshooting plots in recent years to their research plots for field days and/or special training programs in Michigan (Kells et al., 1987), Wisconsin (Carter, 1987, personal communication), and Minnesota (Ford, 1987, personal communication).

Agricultural product dealers have a critical need for field educational experience because they serve as a primary source of information for local crop producers (Funk and Downey, 1981; Chambers, 1983). Because university extension specialists are often the most requested educators for dealers (Schmitt, 1988), time and effort efficiency of extension specialists can be gained when field educational programs are designed for dealers, who in turn can convey information to the local crop producers.

The overall goal of the educational program described in this article is to have an in-field program that integrates research and teaching methods in an interactive environment. The targeted groups of this program included fertilizer suppliers who had dealerships in the region, local crop consulting firms, independent farm suppliers, and county extension agents. The specific objectives include: (i) educate participants in a comprehensive crop management program, (ii) convey field trouble shooting techniques using basic crop production principles, and (iii) demonstrate the potential for regional educational programs among neighboring states. This article will describe the logistics of conducting this type of educational program.

MATERIALS AND METHODS

Program Development

The program site was established on the University of Minnesota Agricultural Experiment Station in Crookston. To suit participants’ schedules—after postemergence herbicide applications and before small grain harvest—the field program was planned for the first week in July. The program emphasized the major crops grown in northwestern Minnesota and northeastern North Dakota.

Five disciplines were addressed at this educational program—weed management, soil fertility, crop morphology, entomology, and plant pathology. Each discipline was coordinated by one individual who determined the specific hands-on teaching method or approach. The field plots for all disciplines were arranged in a sequestered area, approximately 1.2 ha (3 acres) in size (Fig. 1).

Weed Management

The objective of the weed management section was to educate participants in herbicide mode-of-action and herbicide injury symptoms. Although producers often implicate herbicides in a crop injury situation, many times the injury is caused by another problem, such as nutrient deficiency, insect damage, or environmental stress. Therefore, recognizing the crop symptoms associated with herbicide injury is important.

The format of this session was first to educate the participants on the mode-of-action of several commonly used herbicide families. This was done in a classroom setting with a slide presentation and handouts (Gunsolus, 1989; Curran et al., 1989a, b). Then, field plots were used to illustrate the injury symptoms and herbicide modes-of-action discussed in the classroom (Fig. 2).

To demonstrate a wide variety of herbicide injury symptoms, single rows of several crops and weeds were planted with a cone seeder. Ten herbicides, selected from nine herbicide families, were applied across the rows (Fig. 2). The crops and weeds used to simulate herbicide injury and selectivity were corn (*Zea mays* L.), soybean (*Glycine*...
max (L.) Merr., spring wheat (*Triticum aestivum* L.), oat (*Avena sativa* L.), sugarbeet (*Beta vulgaris* L.), canola (*Brassica napus* L.), amaranth (*Amaranthus hypochondriacus* L.), kochia (*Kochia scoparia* L.), and foxtail millet (*Setaria italica* L.). The crops canola, amaranth, and foxtail millet were included to simulate the weeds wild mustard (*Brassica kaber* (DC.) Wheeler), redroot pigweed (*Amaranthus retroflexus* L.), and foxtail (*Setaria spp.*), respectively. The crops were used instead of the weeds because it was easier to achieve adequate stands with the crops. The crops and weeds were seeded on two separate dates to achieve two growth stages, and the herbicides were applied on two dates for the same reason.

At the beginning of the field session, each participant was given a list of the herbicides and rates, then was asked to identify the herbicide applied on the basis of the visual symptoms on the crops and weeds. The participants were then divided into two groups, each led by two instructors, to discuss in detail the herbicide treatments.

**Soil Fertility**

The goals of the soil fertility section were to create an awareness of some of the current concerns in soil testing and fertility and then to address these issues in field situations. The topics addressed were soil testing and reporting, P and Zn interactions, N fertilization on soybean, and N placement with small grains.

The introductory topic was soil testing and reporting forms. This formal discussion consisted of explaining soil test information that normally would be reported in experimental write-ups or journal articles. Each of the measurements was then discussed as to how private laboratories express these soil test values and how the participants should interpret these values.

---

**Fig. 1** Overall field plot layout for the multidisciplinary hands-on educational program, Crookston, MN.

**Fig. 2.** Field plot layout for the weed management discipline. Crops were planted 1 June and 9 June. Herbicides were applied on 26 June and 30 June.
The first field plot demonstration consisted of inducement of Zn deficiency from high P fertilizer applications (18 kg P$_2$O$_5$ ha$^{-1}$; 100 lb P$_2$O$_5$ acre$^{-1}$) on soybean, dry bean (*Phaseolus vulgaris* L.), and corn, and negation of the deficiency with added Zn fertilizer. Another demonstration used liquid N fertilizer (9 kg N ha$^{-1}$; 50 lb N acre$^{-1}$) diluted with various rates of water to show effects on nodulation of soybean and leaf burn on wheat and soybean. Participants were given shovels to dig plants from the different treatments for comparison of nodulation. The leaf burn severity from the dilution ratio of the fertilizer on wheat and soybean was also discussed.

**Crop Morphology**

The crop morphology section was intended to educate participants in morphological development of selected crops so that the practical applications of such things as frost damage, hail damage, mechanical damage, yield potential, and drought effects could be addressed. The crops of corn, wheat, soybean, and alfalfa (*Medicago sativa* L.) were emphasized.

The format of this session was first to educate the participants on crop morphology and development and then to apply this on a troubleshooting exercise. The field plots used for both sections consisted of two replications each of date and rate of plantings for the crops (Fig. 3). Five dates of planting were made, starting in early May with 2-wk intervals afterward. This provided the greatest morphological differences for all crops. The two rates of plant seedings were the recommended rate and a rate low enough to approximately provide a 35% yield decrease. One set was used for learning crop morphology (Crookston, 1989; Dodds and Meyer, 1984; Simmons et al., 1989). The other set was needed to that each participant could dig and dissect the plants as the instructor directed.

The second series of plots were used for a variety of troubleshooting exercises. Within the plots, small areas were flagged, and management or environmental effects were simulated, causing a problem that participants would commonly see in their role of information disseminators. Problems, or the accompanying symptoms, included (i) planter problems, (ii) hail damage, (iii) tire damage, (iv) cultivar damage, (v) erratic populations, (vi) uneven emergence, and (vii) insect problems. All troubleshooting exercises and discussions involved plant recovery mechanisms and potential effects on yield.

**Entomology**

The goal of the entomology section was to create awareness and educate participants on scouting and control practices of current insect issues for spring wheat, potato (*Solanum tuberosum* L.), soybean, and canola. The entire section was conducted in the field demonstration area (Fig. 1).

The first field demonstration dealt with determining economic thresholds for grasshopper (*Romalea* sp.) control in spring wheat and soybean. Various populations of grasshoppers were released into small enclosed areas within the plots 1 wk before the sessions. Participants were then asked to make grasshopper counts and determine if and when grasshopper control was necessary.

Another demonstration dealt with determining economic thresholds for European corn borer (*Ostrinia nubilalis* Hubner) control. Corn borer egg masses were placed in corn whorls approximately 1 mo prior to the session. Participants were instructed on proper methods of scouting and control.

The last two field demonstrations were designed to demonstrate the effectiveness of several insecticides for control of flea beetle (*Chaetocnema pulicaria* Melsheimer) in canola and Colorado potato beetle (*Leptinotarsa decemlineata* Say) in potato. These demonstrations facilitated discussion on insecticide efficacy, use, and appropriateness for these crops.

**Plant Pathology**

The plant pathology section objective focused on diagnosing and identifying fungal pathogens of spring wheat. Only spring wheat was used, because many of the techniques can be transferred to other cereal crops. This
section purposely included general exposure to and basic instruction on using microscopes. A secondary objective was to evaluate chemical control methods for common root rot in wheat. This section was conducted in a teaching laboratory and in the field demonstration plots (Fig. 1).

The laboratory component exposed the participants to microscope use. The life cycles, morphology, and symptomology of such fungal pathogens as smuts, rusts, leaf spots, scabs, and powdery mildew were studied. All of the materials were collected and brought in from fields in the region.

One field demonstration exemplified the control of several spring wheat seed treatments on the control of common root rot in wheat. After proper scouting and identification procedures were discussed, participants dug plants and evaluated the severity of symptoms on the diseased plants.

Administration

Planning

Because of the number of people involved with this program (13 instructors), planning for this type of educational program must be done well in advance. A planning committee that included two state extension specialists (from Minnesota and North Dakota), one county extension agent, one area IPM agent, and one agronomist from the experiment station began meeting 1 yr in advance of the program. The planning committee's responsibilities included: (i) determine the subject matter to be covered, (ii) identify instructors for the specific areas, (iii) determine land and labor needs, (iv) delegate responsibility to the various instructors, (v) set the budget, and (vi) promote the program. At one of the first planning meetings, an advisory committee composed of representatives of the various groups that would attend the program was formed. The advisory committee gave additional input into the types of subject matter to cover, scheduling of the program and cost, and also made suggestions on instructors for the event. This proved to be an excellent method of gaining local industry input into the program. The planning committee met monthly prior to the program.

Budget

The cost of the program was $140/participant—with an expected registration of 60 participants. Sixty-five people registered; thus, there was no undercrowding, overcrowding, or budget problems. The fee covered the cost of all meals and breaks, transportation to and from the field plots, and the cost of a three-ring binder containing handouts and reference material for each participant. The fee also covered the cost of establishing and maintaining the field plots and the instructors' travel costs to attend the program. The equivalent of one undergraduate student was hired for the summer to prepare, treat, and maintain the field plots. The program fee was set to cover program costs, and not to make a profit.

Fig. 4. Time and schedule rotations for the field educational program. Participants were divided into four color-coded groups.
Promotion

The program was promoted through the Minnesota and North Dakota extension services. A brochure was prepared and distributed to potential participants from mailing lists of the two extension services. The program was also promoted by various agribusinesses, such as Cenex/Land O' Lakes, through their newsletters. A preregistration form was sent with the brochure to facilitate an estimate of the number of participants.

Educational Program Activities

The educational program was scheduled for 2 d. The first day was scheduled from 0830 to 1730 h (8:30 a.m. to 5:30 p.m.), with a barbecue for participants at 1830 h (6:30 p.m.). The second day was scheduled from 0800 to 1530 h (8:00 a.m. to 3:30 p.m.). Participants were divided into four subgroups by color-coded name tags. This allowed smaller working groups (the instructor/participant ratio was 1:5) and facilitated the busing of participants between the classroom and field. Each discipline required a different amount of time because of the varying amounts of material covered. The time schedule for the entire program is listed in Fig. 4.

EVALUATION AND SUMMARY

Participants’ Comments

Based on an evaluation survey, 71% of the respondents rated the overall program as excellent, with a majority of the respondents indicating that they would like to have a similar program offered every year. Comments from the participants included: “Good hands-on training,” “The instructors were very knowledgeable—and well prepared,” “One of the best field workshops I’ve been to.” The participants particularly seemed to enjoy the interaction with the many instructors from the various disciplines. Because most agronomic disciplines were represented, participants were able to get an answer on most questions.

The participants were asked to rate each discipline for content on a scale of 1 to 7, with 1 being poor and 7 being excellent (Table 1). For the weed management and plant disease disciplines, an indoor and field session were conducted. Participants’ evaluations showed that both indoor sessions were not rated as highly as were the field sessions (mean 5.5 vs. 6.1). This demonstrated that participants prefer hands-on field sessions at this time of year, with a majority of others receiving a 5.7 rating. These ratings may be confounded by the participants’ perceived need for and interest in the disciplines (Schmitt, 1988). Because participants generally have a lower demand for information on pathological and entomological issues, their perceived knowledge is lower in these disciplines and their willingness to learn may also be lower.

The participants also contributed many good suggestions for improving the program. They would like portable toilets in the field and a tent available for sun protection during the discussions.

Instructors’ Comments

All instructors were satisfied with results of the educational program. Each instructor repeated his/her program four times, making it important that the material was fresh and that there was still enthusiasm in each presentation. Ensuring that the field plots and the laboratory material remained in good condition was sometimes difficult, especially if the exercises involved hands-on participation.

A frustration for some instructors was having to take a specific plot exercise of demonstration off the program at the last minute due to the lack of desired symptoms or effects. A N rate-wheat lodging and a foliar fungicide-wheat demonstration each were cancelled due to lack of desired results. This emphasized the need for diversity in plot demonstrations and flexibility in planning for this type of educational program.

The instructors also had many good suggestions for improving the programs. This site does not have irrigation, and it would be better to conduct this program where irrigation is possible. The instructors also stressed the need for having adequate plant material available.

Future plans are to conduct this type of program in northwest Minnesota or northeast North Dakota every other year. Plans are to rotate the program between other experiment stations to enable people in other locations in the state to attend a program tailored to local production practices. This would also make it possible for Minnesota to cooperate with another state, such as Iowa or South Dakota, on such a program.

ACKNOWLEDGMENTS

The authors would like to acknowledge the other instructors who participated in the program. They are: Jeffrey Gunsolus, extension agronomist; Roger Becker, extension agronomist; Steven Simmons, agriculturist; Roger Jones, extension plant pathologist; David Noetzel, extension entomologist, all at the University of Minnesota, St. Paul; Carlyle Holen, area crop pest management extension agent, and Lisa Axton, county extension agent, Minnesota Extension Service; John Lamb, soil scientist, University of Minnesota Experiment Station, Crookston; Dallas Peterson, extension agronomist, and Marcia McMullen, extension plant pathologist, North Dakota State University, Fargo. Special thanks to Larry Smith, superintendent of the

Table 1. Participants’ evaluation of the field educational program.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weed Management (indoor-lecture)</td>
<td>6.0</td>
</tr>
<tr>
<td>Weed Management (field session)</td>
<td>6.5</td>
</tr>
<tr>
<td>Crop Morphology</td>
<td>6.1</td>
</tr>
<tr>
<td>Soil Fertility</td>
<td>5.7</td>
</tr>
<tr>
<td>Plant Pathology (indoor-lab)</td>
<td>6.0</td>
</tr>
<tr>
<td>Plant Pathology (field session)</td>
<td>5.7</td>
</tr>
<tr>
<td>Entomology</td>
<td>5.7</td>
</tr>
</tbody>
</table>

† Scale of 1 to 7, with 1 = poor and 7 = excellent.
REFERENCES


