INTRODUCTION

Globalization of agriculture, and its impact on commodity farming, is forcing growers to learn new skill sets to maximize their competitive position (Williams 1996; Flora et al. 2001). New mindsets are also needed, particularly to enhance leadership capabilities within the farm community. These changes to the way farmers view their professional skills are particularly needed for success in the arena of new crops and new markets. Growers of new crops must navigate a swamp of over-ambitious claims and expectation in both the agronomic and economic areas (Fletcher 2002). Meadowfoam, (*Limnanthes alba* Hartweg ex. Bentham, Limnanthaceae) a new oil seed crop developed at Oregon State University, is an example of this necessity (Jolliff and Hoffman 2002). The oil seed crop meadowfoam is grown under contract by OMG, the open-enrollment Meadowfoam Oil Seed Growers Cooperative. A subsidiary of the grower cooperative buys the seed and extracts, refines, and markets the oil worldwide. A grower-member board of directors, advised by specific grower committees, plays a key role in governing the activities of OMG.

While working with this grower-led cooperative we realized that trying to enhance the grower skill set is a valuable contribution to the industry. Facilitating university–grower collaborative experiments gives growers the skills to conduct replicated experiments of personal value to their farm system. This serves three functions. Many innovative growers have developed the habit of running non-replicated trials of new cultivars, management practices, or technologies that have direct impact on their farm’s profitability. Being able to execute true replicated trial increases exponentially the “information content” of their trials. Second, knowledge of experimental procedures should give them a better knowledge base to interpret the results of university agronomic research. Third, we hope that the skills the growers accumulated will give them the confidence and ability to act in a leadership position within the industry on agronomic issues, and perhaps other positions of importance. The development of farmer skills to enhance leadership is an objective of the Fund for Rural Development grant that supports this research.

This paper primarily reports the results of a collaboration with the personnel at Ioka Farms in the Willamette Valley of Oregon. Ioka Farms is a multi-family farm, which allows some specialization within their organization. Our primary collaborator was Doug Duerst. Our collaborations with other growers also helped structure the ideas we present.

OBJECTIVES OF THE COLLABORATIONS

1. Facilitate grower directed and executed farm equipment-scale trials. This includes exposing them to the concept and rational for replicated trials and the use of simple statistical programs for analyzing the data.
2. Increase grower confidence in their ability to engage in scientific research. This should result in a grower being willing to take the additional effort to conduct a trial with the expectation of getting information useful for their specific farming practices.
3. Enable the grower to evaluate university and industry research as it applies to their farming system. This could involve the choice of variables, standard management practices, as well as what is meant by statistically significant difference.
4. Enhance leadership capabilities within the OMG grower-cooperative and the larger agricultural community.
5. Learn how to better manage meadowfoam for increased profitability.

COLLABORATION RESULTS

The results of these collaborations came in two spheres: (1) university personnel and growers learned how to structure successful collaborations; and (2) information was gained on specific meadowfoam growing practices of interest to growers. We identified a number of elements that we believe are critical for successful collaboration.
**Critical Elements in a Successful Collaboration**

1. Identify potential collaborators with the interest and resources to devote time to the project. A new crop such as meadowfoam often takes secondary priority to the growers’ primary crop(s). Growers vary in the importance they place on maximizing the efficiency and production of a minor crop, as well as their innate interest and desire to devote time and energy to on-farm research. A grower who has a high interest in either of these areas can be a potential candidate for collaboration.

2. Assist the grower in focusing their question of interest. It is usually tied to economic viability of their farm. The greater their interest in the results the more effort they are willing to expend on the collaboration.

3. Introduce the concept of replicated experimental design, and the importance of using a block design in a heterogeneous field. Use the grower’s knowledge of field variability based on soil type, fertility, or harvest yields. Grower involvement in this step is critical in their gaining the experience to conduct well-designed experiments in the future.

4. Identify the appropriate field location for the experiment. Choose as homogeneous a field as possible, or a field where the appropriate blocking pattern is obvious. When the number of experimental units is small, unnecessary blocking can result in a large decline in the power of the experiment, i.e., the degrees of freedom for the error term is small. The size and shape of the field influences the layout of the plots, this in turn has an impact on farm machinery access to specific plots. The field or crop rotation sequence may dictate the field choice.

5. Keep the experimental design simple in concept, design, execution, and analysis. The time required for the grower to execute their commitments to the study is a major factor influencing their current and future involvement. Certain questions and experimental designs may be inappropriate if they require too much work by the grower.

6. Stress the importance of having a check treatment. Often this is a treatment using standard practices. Inform the grower how they can incorporate this concept into their usual production farming practices by leaving a small untreated area. This practice can help them evaluate the effectiveness of fertilizer or pesticide applications, or confirm the damage that might have resulted from those applications.

7. Test just one variable. Growers with previous experience with on-farm research will be able to cope with the greater complexity with a 2-factor experiment.

8. The grower should take the lead in designing the logistics of plot management and treatment applications, for these are influenced by the characteristics of their equipment. Plot layout and plot size are in part determined by the size of the growers equipment. Make sure the grower is aware that you value any suggestion on how to mesh the often competing demands of the proper experimental design, and the difficulty of equipment access and operation.

9. If possible avoid confusing plot layouts, e.g., stacked plots, which may lead to confusion during treatment applications or harvesting. Remember, plot management instructions may need to be passed from the primary grower-collaborator to the employee who does the work. Because a treatment may need to be applied at unpredictable times, e.g., breaks in rainy weather, or the grower’s schedule, university personnel may not be on-site to direct the operation.

10. Provide maximum insurance that a misapplication does not occur, for this may go unnoticed by the farm personnel. This insurance may require placing more flags, or developing a more detailed plot map, than would be needed if university personnel were applying the treatments. Remember the grower’s involvement and time commitment to the project is by necessity less than a university researcher.

11. The university researcher should be present during some of the farm operations. This will enable the researcher to assess how well the decision making process and communication between the researcher and the grower translates to the execution of tasks in the field. The grower many also find the assistance of the researcher helpful during the more time demanding tasks such as harvest.

12. Have a data sheet where management activities such as application dates, amounts, etc., can be written down as they occur. Growers do not normally gather data while applying treatments or harvesting. At the end of a plot they do not automatically think about recording data, or making sure they are oriented properly in relation to the plot layout. Help the grower design data sheets that mesh with
their practices. Even if some of these rates are specified as part of the protocol, actual rates may vary a little, and other standard practices may not be applied exactly as planned. Just as with scientists, some growers are naturally better data and note takers than others.

13. Commit decisions to paper during planning so that all parties are clear about the details in the midst of many competing time demands during the growing season. The details of the collaboration are important. Be sure the grower has a copy of the rationale for the experiment, the list and timing of all plot work, and copies of all plot maps. These records can serve the grower as a template for designing subsequent studies.

14. Facilitate growers analyzing their results using data analysis functions within Microsoft Excel, or simple statistical programs designed for on-farm research. This step ties the results back to the original experimental design.

15. Provide on-farm research guides that have been developed for use by farmers, e.g., On farm testing: a growers guide (Miller et al. 1992). These publications are a resource that can be used to reinforce and supplement the concepts discussed first hand with the grower-collaborator.

Ioka Farms Experiments

The personnel at Ioka Farms executed four on-farm experiments over a three-year period, either as collaborators with university personnel or on their own.

Harvest Method. Two experiments examined an alternative harvest method to the traditional swathing and combining of meadowfoam with equipment designed for grass seed harvest. Ioka personnel wished to test the direct combine harvest of meadowfoam, using a chemical desiccant to enhance the crop dry down prior to harvest. This method has several potential benefits: (1) reduces combine-threshing time; (2) eliminates vulnerability of swaths to being blown by high winds; (3) reduces seed head loss in windrows; and (4) less clogging of the combine sieve screens by meadowfoam residue, leading to less seed loss with the chaff. In 2000 we collaborated with Ioka Farms on a desiccate-direct cut combine harvest versus the traditional swathed-combined harvest. There were three replicates per harvest method. Ioka personnel laid out the plots, which were 20.1 m wide to accommodate their sprayer, and averaged 254 m long. Two combine passes were taken in each plot. Yield data per plot were taken using a yield monitor. These data were adjusted so the total of the 3 replicates per treatment equaled the combined weight of the 3 replicates weighed on a farm scale. In 2001 Ioka Farms repeated this experiment without our assistance.

The data of these two trials showed there was no seed yield increase with the direct harvest method. Desiccant cost and differences in thresher and combine operation time were not factored into the comparison (Fig. 1). However, in terms of our objective for our university–grower collaborations these experiments were a success in that Ioka personnel learned enough during the course of the 2000 experiments to feel comfortable running a similar trial on their own in 2001.

Planting Date. A fortuitous experience broadcast planting meadowfoam in December, rather than the traditional drilled planting in mid-October, lead us to examine variation from the traditional planting practices. Delayed planting of meadowfoam has the potential to increase grower options for weed and insect control, and changing market conditions. Ioka Farms cooperated in a study examining the effect of late planting on meadowfoam yield. Meadowfoam was no-till drill planted on three dates during the fall of 2000, Oct. 27, Nov. 10, and Dec. 5. Plots were 20.1 m wide by 185 m long. We used a complete randomized block design, with three replicates of each planting date. Other than the timing of the first post-plant herbicide application, all other management practices were the same. After each plot was harvested the combine was emptied into a series of bins on a flat bed truck. The bins were individually weighed on the farm scale.

The lack of yield differences among the dates ($P=0.1117$) that varied by up to 39 days suggest that delayed planting will not result in excessive yield loss, making this practice an option to strengthen the larger farm system (Fig. 2). The greatest yield difference was between the traditional planting date, and the November planting date. There was some damage to the flower buds as a results of a late application of Select 2EC (Clethodim) herbicide used to control grass weeds. The earlier planted treatments appeared to have been affected more than the later planted plots, which may account for the lowest yields in the earliest planted treatment.

In this experiment, which had only 9 total samples, blocking the replicates reduced the power of the test.
The blocking resulted in four rather than six degrees of freedom for the error term in the ANOVA. If we had not blocked, and the same data results were achieved, the planting date variable would have been significant at $P=0.0518$.

**Meadowfoam Fly Damage.** Ioka farm personnel’s experience with the planting date experiment encouraged them to participate in a much larger study in 2001–2002 (24 plots). Many of the studies examining the damage potential of the insect pest, the meadowfoam fly (*Scaptomyza apicalis* Hardy), suffer from the high variability that often occurs when studying a mobile insect pest using small plots. This study uses 20.1 m by 195 m plots to eliminate this problem. The study incorporates 4 control treatments, with 6 replicates per treatment. A block design was used to account for differences in field slope and aspect.

**CONCLUDING REMARKS**

A primary purpose of this type of university–grower collaboration is to give growers the confidence and skills to conduct their own replicated on-farm research. We have seen evidence of this occurring in our collaborations with Ioka Farms. We hope that this translates to an increased ability to interpret university research, and improve leadership within the grower-cooperative and larger farm community.

The question remains whether similar successes can happen with growers who are not working within a larger farming operation. The time commitment to the collaboration, and to leadership positions, may require an investment of time that growers who do not have the support of a larger operation may find difficult to muster.

**REFERENCES**


