Western IPM Center

Project Report Form

How to submit: Please submit this completed form electronically, as an attached Microsoft Word file, to Frank Zalom at fgzalom@ucdavis.edu. **Content:** Complete each section below, and include responses to as many of the questions listed in Attachment A as are relevant to your project. *These are guidelines.* Provide your readers with enough detail that someone who is not familiar with your project can understand what you were trying to achieve, how you went about it, and what you accomplished, but please keep it concise.

A. Report Data

Date: October 29, 2009
Reporting Period: 07-01-06 through 06-30-09
Report Type (please check one):
☐ Progress Report ☒ Final Report

B. Grant Data

- Grant Agreement #: 2006-34103-16968
- Title: Wheat Seed Quality Effects on Competitive Ability with Wild Oat
- Grant Type: CSREES grant
- Lead investigator:
  - Name: Robert Stougaard
  - Title: professor
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- Team members (name, title, institution):
- Qingwu Xue, research associate, Montana State University
- Joe Yenish, professor, Washington State University
- John Burns, extension agronomy specialist, Washington State University
- State(s) involved: Montana and Washington

C. Nontechnical Summary. An overview of the project, briefly outlining the problem(s), how your project addresses them, and your results, *written to a lay audience.* (500 words)

Wild oat is a weed of tremendous economic importance, infesting millions of wheat acres throughout the world. In combating this pest, wild oat management systems have evolved to the point that producers rely on herbicides to the virtual exclusion of all other strategies. While generally effective, herbicide use erodes profits and poses concerns with respect to environmental quality. Moreover, despite the intensive use of herbicides, wild oat populations continue to persist! Wild oat seed dormancy and variable herbicide performance contribute to this problem. However, this situation is worsened due to the wide spread occurrence of herbicide resistant biotypes.

A strict reliance on herbicides for wild oat management has not been sufficient. It is therefore critical that integrated weed management systems be employed that provide for more consistent reductions in wild oat growth and seed production. This requires a proactive approach that shifts focus to the crop rather than the weed, and thus an emphasis on improving crop competitive ability. The overall goal of this project is to improve crop competitiveness with specific consideration given to seed quality and the resultant impact on seedling vigor.

Experiments were conducted to investigate the individual and combined effects of wheat seed size, seed protein content, and plant hormone seed treatments for improving crop competitive ability. The results demonstrate that improved spring wheat seed quality significantly increases crop competitive ability and improves weed control. Seed size appears to be the most important factor. Plants established from large seed had improved stands and more vigorous growth. Protein content also had a positive impact on crop competitive ability. However, the effect of seed protein was less consistent and may vary depending on soil nitrogen concentrations and wheat market class. With the exception of a slight effect on seedling emergence, plant hormone seed treatments did not appear to have any beneficial effect on crop competitive ability. Nonetheless, the overall results demonstrate that wheat seed quality can be manipulated to favor the crop over the weed. The resultant improvement in competitive ability improves weed control, reducing yield losses and dockage penalties in the process. This technology correspondingly improves herbicide efficacy. In turn, this could reduce herbicide input costs, environmental contamination and slow the development of herbicide resistance.

D. Objectives and Progress. List your objectives and describe your progress for each objective.

1) Determine the interactive effects of seed size, protein content and GA seed treatments on spring wheat competitive ability for the suppression of wild oat.

Experiments were established at Kalispell, MT and Pullman, WA during 2007 and 2008 to evaluate the interactive effects of wheat seed protein, seed size, and gibberellic acid (GA) seed treatments on spring wheat competitive ability for the suppression of wild oat. The factorial treatment arrangement consisted of two protein levels (high and low), two seed size classes (large and small), and two GA concentrations (treated and non-treated) superimposed over two wild oat densities (0 and 175 plants per meter). The results demonstrate that improved spring wheat seed quality significantly increases crop competitive ability and weed control across a range of environments. Of the seed quality traits investigated, seed size had the greatest impact, having affected all of the early growth traits. In particular, the effect of seed size on emergence rate and final stand density appear to be important factors for suppressing wild oats. Towards that end, the positive effect of large seed size was most pronounced when grown in the presence of wild oats, reducing weed density, biomass and seed production. However, large seed occasionally produced slight yield benefits even in the absence of weed competition. Protein content also improved crop competitive ability. However, the effect of seed protein was slight. That being said, the response to seed protein may have been greater had the experiments been established in sites with low residual soil nitrogen. The potential relationship between seed protein and residual soil nitrogen levels on seedling vigor warrants further investigation. With the exception of a slight GA effect on enhanced seedling emergence, GA treatments do not appear to measurably affect any early growth traits.

2) Determine to what extent seed quality factors impact crop competitive ability and correspondingly influence the effects of variable tralkoxydim rates on wild oat control, wheat yield, and economic returns. The factorial treatment arrangement consisted of five rates of tralkoxydim (0, 1/8X, 1/4X, 15X, and 1X) superimposed on four cropping systems that varied in competitive ability. The cropping systems consisted of 1) small, low protein seed, without GA; 2) small, high protein seed with GA; 3) large, low protein seed without GA and; 4) large, high protein seed with GA. Herbicide rate had the greatest impact on wild oat control. Cropping system effects were not as consistently expressed. However, positive effects were associated with large seed size in three of four experiments, demonstrating that herbicide efficacy improves as seed size increases.

E. Outputs. List your project's outputs, which might include publications, information, data, meetings held, attendance at meetings held, etc.

Results have so far been presented to the Northwestern Agricultural Research Center advisory committee during 2007 and 2008, and at field days held during 2007 and 2008 at both Pullman, WA and Kalispell, MT.

F. Impacts and Potential Impacts. The "impacts" and "potential impacts" sections of your report will help the Western IPM Center highlight the value of IPM research and education by detailing the real-world impacts of Center-funded projects. We will use the information in news articles, reports, and informational brochures to showcase the impacts of projects that our program supports. *See Attachment A at end of form for questions to assist you in describing the impacts of your project.*

1. Impacts. Describe any impacts of your work. ***Impacts*** are specific changes in condition for those affected by your work. Impacts include adoption of technology, creation of jobs, reduced cost to the consumer, less pesticide exposure to farmers, access to more nutritious food, and a cleaner environment and healthier communities.

The overall results demonstrate that wheat seed quality can be manipulated to favor the crop over the weed. The resultant improvement in competitive ability improves weed control, reducing yield losses and dockage penalties in the process. This technology correspondingly improves herbicide efficacy. In turn, this could reduce herbicide input costs, environmental contamination and slow the development of herbicide resistance.

2. Potential impacts. Describe your project's potential impacts. ***Potential impacts*** are the ways that your project's outputs could directly lead to changes in condition that will unfold in the future.

The associations between these seed quality factors and competitive ability could ultimately be used to initiating a breeding program directed towards enhancing these traits to develop competitive small grain varieties.

G. Appendices

1. With your report, please attach ***at least two (2) photographs*** that illustrate your project. Please describe the photo and indicate the name and institution of the person who took the photo. (If you submit more than two photographs, please include those additional descriptions and photo credits under "H. Additional Information," below.)

Photo #1 description:

Photo #1 credit (photographer's name and institution):

Photo #2 description:

Photo #2 credit (photographer's name and institution):

2. Also attach any printed fact sheets or other publications resulting from your work that will enhance our understanding of your project and its impacts. Please provide a description of each attached publication below.

Document #1 description:

Document #2 description:

Document #3 description:

H. Additional Information

Credit: *Some of the language about impacts and potential impacts was adapted from a PowerPoint presentation by H. Michael Harrington, Executive Director, Western Association of Agricultural Experiment Station Directors, Colorado State University.*

Attachment A

Questions to Help in Reporting Impacts and Potential Impacts

Below are some questions that will guide you in assessing and then describing the impacts and potential impacts of your project. The relevance of each question may vary depending on whether yours is a research or extension project. Please answer as many as you can to the best of your ability, and feel free to describe any additional types of impacts not mentioned below. Remember to identify any potential impacts.

1. ***Innovations in IPM:***
   Are there new IPM practices that have been (impacts) or could be (potential impacts) adopted as a direct result of your project? What is the total number of acres (or homes, schools, greenhouses, nurseries) on which these practices could realistically be implemented?
2. ***Safeguarding human health and the environment:***
   a. Has the project reduced risk (or could it potentially do so) by changing the use of pesticides on farms, in homes, in schools, etc.? For example, could it result in fewer sprays per season or a switch to lower-risk pesticides? If possible, quantify the changes in condition. (Since there is no unanimous definition of *high* and *low risk,* investigators selecting this indicator are asked to categorize the pesticides they are reporting on as *high* or *low risk* according to the particular situation [e.g., lower risk to natural enemies]).
   b. Are there any other impacts or potential impacts on human health or the environment as a result of your project?
3. ***Economic benefits:***
   a. What is (or could be) the economic benefit (e.g., dollars saved) for clientele who adopt IPM strategies and systems you studied? Do you envision potential commercialization or mass production of these systems?
   b. How many clients are satisfied with IPM results (such as improved yield, improved quality of yield, reduced pest populations, more effective pest control, greater preservation of nonpest species)?
   c. Are there other financial benefits that might be realized (potential impact) as a result of your project?
4. ***Implementation of IPM:***
   a. How many IPM strategies and systems have been validated through this project (e.g., through on-farm trials, large plot tests, or other methods used to confirm efficacy)?
   b. How many educational materials were delivered? To whom? And what are the impacts or potential impacts?
   c. What is the number of growers/personnel trained? And what are the impacts or potential impacts?
   d. For a Web site, what volume of traffic and type of use has the site experienced? (For example, number of visitors per day or month; number of page views; number of unique user sessions; change in volume during growing season; average viewing time.) And what are the impacts or potential impacts?
   e. How many more people adopted IPM practices as a direct result of your project, or how many people adopted new IPM practices?
   f. Are there other ways in which your work will result in improved use or increased implementation of IPM strategies in your region or across the West?
5. Has your project or study increased collaboration among stakeholders interested in the development and implementation of improved IPM strategies and systems?