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: 11/16/09
Reporting Period: 2007-2009
Report Type (please check one):
☐ Progress Report ☒ Final Report

B. Grant Data

- Grant Agreement #:
- Title: Development and Demonstration of Integrated Systems for Control of Soilborne, Foliar and Viral Diseases of Potato
- Grant Type: Western Region- IPM
- Lead investigator:
  - Name: Jacobsen
  - Title: Professor of Plant Pathology
  - Institution: Montana State University
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  - Email: uplbj@montana.edu
- Team members (name, title, institution): Barry J. Jacobsen, Nina K. Zidack, Mary Burrows- all Montana State University
- State(s) involved: MT

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)

The foliar biological control agent Bacillus mycoides isolate BmJ is under commercial development. In field and greenhouse trials BmJ induced resistance (BmJ applied at emergence then on 14 day interval) reduced Potato Virus Y infection by 56 and 55% respectively. BmJ did not reduce Potato Virus X infection in greenhouse trials. In 2007 and 2008 field trials conducted at Bozeman and Ronan, MT examining the use of non treatment, two biologically based control systems with four biologiccal and chemical integrated systems and a single chemically based system, yield of all systems were statistically superior to the non treated P,0.05). The biological treatment system consisting of groundbarley, Trichoderma (T-22 product) and BmJ (emergence + 12"") and the integrated system consisting of ground barley, azoxystrobin infurrow and BmJ integrated with chlorothalonil had higher yields when compared to the chemically intensive system consisting of fludioxanil + mancozeb seed treatment, azoxystrobin infurrow and chlorothalonil foliar at the P<0.1 level. Potato scab and Rhizoctonia canker control was equivalent for all treatments and was superior to the untrewated control. The best treatments for control of these diseases were the chemically intensive system and the integrated system consisting of Muscodor albus plus, azoxystrobin infurrow and BmJ alternated with pyraclostrobin. Black dot was only controlled in the chemically intensive system and the integrated systems. In separate early blight trials BmJ alone was on better than the untreated by integrated programs alternating BmJ with either pyraclostrobin or difenoconazole werew better than the fungicides alone and superior to a chlorothalonil program. Fourty seven potato cultivars were evaluated for black dot resistance and resistance was identified based on reduced early dying, reduced stunting and colony forming units/g stem. Grower field days at field trials and an 8 hours of IPM training was conducted.

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

Objective 1. Evaluate the potential of foliar applications of Bacillus mycoides isolate BmJ for control of potato viruses PVX and PVY. In field trials in Hermiston , OR and in greenhouse trials BmJ induced resistance (BmJ applied at emergence then on 14 day interval) reduced Potato Virus Y infection by 56 and 55% respectively. The field trial data is for 2009 only since trials in 2007 and 2008 had very low infection rates, although numerically BmJ reduced PVY infection by 3% in 2008. BmJ did not reduce Potato Virus X infection in greenhouse trials. Data on mode of action are incomplete at this time although direct effects on aphids appears minimal and effects seem to be on infection and on virus multiplication since infection is reduced during both aphid and mechanical transmission studies and virus titers are always lower in BmJ induced but infected plants than in non induced plants. Objective 2. Assess biological and chemical treatment regimes fpor control of foliar and soilborne diseases in the field. In 2007 and 2008 field trials conducted at Bozeman and Ronan, MT examining the use of non treatment, two biologically based control systems with four biologiccal and chemical integrated systems and a single chemically based system, yield of all systems were statistically superior to the non treated P,0.05). The biological treatment system consisting of groundbarley, Trichoderma (T-22 product) and BmJ (emergence + 12"") and the integrated system consisting of ground barley, azoxystrobin infurrow and BmJ integrated with chlorothalonil had higher yields when compared to the chemically intensive system consisting of fludioxanil + mancozeb seed treatment, azoxystrobin infurrow and chlorothalonil foliar at the P<0.1 level. Potato scab and Rhizoctonia canker control was equivalent for all treatments and was superior to the untrewated control. The best treatments for control of these diseases were the chemically intensive system and the integrated system consisting of Muscodor albus plus, azoxystrobin infurrow and BmJ alternated with pyraclostrobin. Black dot was only controlled in the chemically intensive system and the integrated systems. In separate early blight trials BmJ alone was on better than the untreated by integrated programs alternating BmJ with either pyraclostrobin or difenoconazole werew better than the fungicides alone and superior to a chlorothalonil program. Fourty seven potato cultivars were evaluated for black dot resistance and resistance was identified based on reduced early dying, reduced stunting and colony forming units/g stem. In three years of trials on-farm and at MSU research plots, cultivars showing resistance to black dot showed no or very small responses to the stand ard black dot control (Azoxystrobin in furrow at planting plus chlorothalonil when plants were 10-12" high whereas cultivars identified as susceptible showed as much as 40% yield increases from the chemical black dot treeatment. Objective 3. Demonstrate relative effectiveness of biological and integrated disease management systems to potato growers in on farm trials. The 2007 and 2008 trials above were done in growers fields and four other demonstrations showed that BmJ integrated with either chlorothalonil or pyraclostrobin provided equal control of early blight when compared to a program where chlorothalonil and pyraclostrobin were used in an alternating program. Five grower twilight field meetings were done at these demonstration sites. Objective 4. Facilitate adoption of biological controls by key producers . In addition to the five twilight grower meetings, three Montana Potato Improvement Association Annual meetings, a 6 hours of intensive potato IPM training meeting was held. This meeting was attended by 38 of 45 seed growers. Montana growers have adopted integrated control programs for control of potato scab and the use of BioSave (Pseudomonas syringae isolate EC10) for control of silver scurf, soft rot and Fusarium dry rot. When BmJ is fully approved growers will use it in early blight and virus control programs.

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

In addition to the five twilight grower meetings, three Montana Potato Improvement Association Annual meetings, a 6 hours of intensive potato IPM training meeting was held. This meeting was attended by 38 of 45 seed growers. The growers each received copies of the APS Press publications: Potato Health Management and the Potato Disease Compendium. No publications to date but publications are in preparartion on the integrated management regiems and the black dot cultivar resistance. Reports with data have been provided to theMontana Potato Improvement Association at annual meetings in 2007, 2008 and 2009. The High PLains IPM site has been updated for these potato diseases.

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.

This research and demonstration project has clearly demonstrated that fungicide use can be reduced without sacrificing either yield or control of scab, Rhizxoctonia canker, black dot or PVY. The new control for PVY by using BmJ induced resistance is very exciting and represents a totally new control concept.

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.

Virus control by BmJ or other inducer of plant resistance could potentially reduce the use of insecticides by potato seeed producers. The identification of black dot resistance may allow growers to more selectively use chemical contrtols for black dot and may encourage potato breeders to include black dot reistance as an objective.

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:

Photos lost with hard disc crash- will send when recovered

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?