Washington Grain Commission
Wheat and Barley Research Annual Progress Reports and Final Reports

Project #: 3043-3697

Progress Report Year: 1 of 2

Title: Wireworm Control in Wheat-Based Cropping Systems

Cooperators: David Crowder (WSU Entomology)
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Executive Summary: In FY 2015 our team made excellent progress on each of our four objectives related to improving wireworm management in cereal crops. Major accomplishments of our team include:

(1) Sampling 80 crop fields for wireworms. In each field we collected wireworms from 10 bait traps, with over 1,600 wireworms collected and identified in total. We also collected data on factors influencing wireworms in each field. These data are providing a clearer picture of how wireworms vary across the state both in terms of species present and their abundance.
(2) Conducting trials for over 40 new insecticidal products for wireworm management at two locations in Washington State. Data from these trials will aid registration of new products, particularly novel chemistries that are not neonicotinoids.
(3) Evaluation of wireworm damage at 8 wheat variety testing locations. Data will show the extent of damage caused by three major wireworm species, and the economic returns provided by insecticidal treatments.
(4) Large-scale experimental trials of the susceptibility of wheat, barley, and oats to wireworms. Preliminary results show that wheat is far more susceptible than barley and oats.
(5) Delivery of over 20 extension talks on wireworms
(6) Development of insect management content for the WSU small grains website

Impact: Based on previous work of our team, we estimate that wireworm management provides economic benefits exceeding $10 million/yr for the state for spring wheat crops alone. If we factor in other crops affected by wireworms (winter wheat, barley, etc) this estimate would be much higher. Our project will identify management strategies combining cultural and insecticidal controls for wireworms that can provide maximum economic benefit for growers depending on their location, the crops they produce, and the wireworm species present in their field(s). Optimizing wireworm control could provide economic benefits in the millions annually for growers throughout Washington.

Our team also delivered over 20 extension talks in 2014 concerning wireworms. With a conservative estimate of 30 attendees per talk our team thus directly communicated results to approximately 600 growers, field consultants, and industry representatives in the past year. Our development of extension bulletins and content for the smallgrains.wsu.edu website is allowing us to communicate information broadly to growers throughout the state.

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WGC project title: Wireworm Control in Wheat-Based Cropping Systems
Project PI(s): David Crowder and Aaron Esser
Project initiation date: July 1, 2014
Project year: 1

Outputs and Outcomes

Objective	Deliverable	Progress	Timeline	Communication
1 - Determine effects of climate, tillage, soil, and crop rotations on wireworms in cereal crops and develop a predictive model for wireworms	Data on wireworm distributions throughout Washington state; extension bulletin on major species present in Washington state	We have made extensive progress on this objective, with 80 fields sampled in 2014 for wireworms (40 spring wheat, 20 winter wheat, 20 CRP). From these fields we collected wireworms from 10 bait traps and identified all individuals to species (over 1,600 individuals were collected). We also collected data on 10 environmental and management factors associated with wireworms from each field. These data will complement similar data collected in 2013, and we plan for a final year of sampling in 2015. From these data we will be able to discern the geographic delineations of the three major wireworm species in Washington (Limonius infuscatus, Limonius californicus, Ctenicera pruinina) and the factors that mediate their abundances.	Sampling from the first year of the project was completed in summer 2014. We plan to put out an extension bulletin in spring 2015 with the preliminary data on the major wireworm species found in Washington and their geographic distributions. A final year of sampling is planned in year 2 of the project, which will allow us to continue to refine our predictive models for wireworms (see below).	The PhD student funded by this project, Ivan Milosavljevic, delivered over 10 talks at grower meetings, field days, or academic conferences to communicate information from this objective. In addition, PIs Esser and Crowder delivered results at several field days and the inaguaral Wheat Academy at WSU in December 2014. In spring 2015 we plant to releash an extension bulletin on the major wireworm species of economic significance in Washington. This bulletin will contain information on how to sample and identify wireworms, and describe the significance of each major species in reducing wheat and barley yields. We have also develop a page on wireworms at the WSU Small Grains Website, which contains information for growers about wireworm management (smallgrains.cahnrs.wsu.edu)
1 - Determine effects of climate, tillage, soil, and crop rotations on wireworms in cereal crops and develop a predictive model for wireworms	Risk calculator for wireworms	We currently have data from 160 fields on factors affecting wireworm species and their abundances, and will collect data on 40 more in FY 2016. After these data are collected in summer 2015 we will use our 200 total data points to determine the factors that promote or deter wireworms, and build regression models for each of the three major species. These models will form the basis of risk calculators that growers can use to assess their risk from wireworms based on their unique combination of field conditions and management practices. This is expected to be completed by the end of the second year of the project	We expect to be able to produce effective calculators that show risk from wireworms by end of FY 2016.	Risk calculators will be published on the small grains website (smallgrains.cahnrs.wsu.edu). Growers will be able to enter specific information about their fields (location, management practices, etc) and receive predictions of "risk" from wireworms. This will allow growers to proactively make management decisions based on their unique conditions.

2 - Conduct trials to support registration of new insecticides	Data on 40 or more new insecticides for wireworm control. These data will be shared with chemical companies to support registration of new products that improve upon industry standards and support mode of actions besides neonicotinoids. We are the only research group conducting these trials in the Pacific Northwest	Our team conducted trials with 40 insecticide entries at two locations in Washington in 2014. Chemical companies have been pleased with our results, and reported to PI Esser that our trials "were the best in the country". These companies have already established contact with us to continue trials in 2015. Data indicate that several new products with novel modes of action might improve on current industry standards.	As the chemical companies ultimately control registration of new products, estimating a timeline for new product registration is difficult. However, we know that without the data we are generating that new products will not be approved. We will continue to evaluate 40 or more insecticide entries at two locations in FY 2016 to support registration of these products.	While we can't reveal names of products in development, we have shared results of the trials with growers at field days, grower meetings, and the Wheat Academy. We will continue to communicate with the chemical companies to provide necessary data to support new products.
2 - Evaluate Gaucho in variety testing trials on Louise and Glee	Data on effectiveness of Gaucho and tolerance of Louise and Glee to various wireworm species throughout variety trials	In cooperation with Stephen Guy we established plots of Louise and Glee wheat varieties, with or without Gaucho, at 8 of the variety testing locations throughout Washington State. At each location we monitored the wireworm populations (species present and their abundance) four times over the course of the season. Guy has provided the team with data on yield and wheat quality at each location. These data are in the process of being analyzed to determine yield loss with and without Gaucho insecticide in both wheat varieties. Similar trials conducted in summer 2015 will provide us with two years of field data. These trials are being coordinated with cooperator Higginbotham, who is now the head of the variety testing program.	We collected meaningful data on variety x insecticide combinations that are effective for each major wireworm species in summer 2014. Experiments will be repeated in summer 2015 to control for season-to-season variability. At the end of 2015 we will have two years of excellent data on varieties and treatment options that provide optimal control for the three major wireworm species in Washington state. Growers can use these data to assess the potential returns of using Gaucho.	As the results are still being analyzed they have not been presented to growers prior to December 2014. However, in 2015 we plan to present results of our two years of trials at field days, grower meetings, and the 2015 Wheat Academy. These data will also be incorporated into an extension bulletin in 2015 that documents effectiveness of Gaucho on different wheat varieties for each major wireworm species. Finally, all of our data will be uploaded to the small grains website (smallgrains.wsu.edu) to provide an easy option for growers to view it.

3 - Examine tolerance of wheat, barley, and oats to wireworms	Data on tolerance of spring wheat compared to barley and oats to wireworms. Data on effectiveness of insecticides in each crop	In cooperation with collaborator Murphy we planted side-by-side trails evaluating damage from wireworms to wheat, barley, and oats at two locations (Dusty, WA and near Pullman, WA). These trails were conducted on the farms of participating growers, and including plots with each of the three crops that were treated with Gaucho or left untreated. From each plot we sampled wireworms four times in 2014 and collected yield data and crop quality at the end of the season. These data are currently being analyzed, although preliminary results show that oats are the most tolerant crop, followed by barley and then wheat. Trials will be repeated in 2015 to control for season-to-season variability.	The first year of experiments was completed in Fall 2014 and data are currently being analyzed. A second year of these trials to control for seasonal variability will be conducted at two locations in 2015. In Fall 2015 we will analyze all the data and publish the results.	Data from these trials will be developed into an extension bulletin by Fall 2015. This bulletin will document the relative tolerance of barley, oats, and spring wheat to wireworms. We have presented preliminary results from these studies at grower meetings and at the Wheat Academy in 2014. Similar presentations will be made to grower groups in 2015 and 2016.
4 - Develop extension materials for wireworms	Two extension bulletins, multiple academic publications, and information on the smallgrains.cahnrs.wsu.edu website	We have uploaded information on wireworm sampling and management to the small grains website. We expect to publish the first extension bulletin in spring 2015. The second extension bulletin will be published by spring 2016. Throughout the life of the project we will continue to upload materials to the smallgrains website to make them easily accessible to growers	One extension bulletins will be published by spring 2015 and the second by spring 2016. Information on website will be uploaded as available.	We have described these upcoming bulletins at grower meetings and field days. When they are published we will also print out copies and deliver them to growers during presentations at field days and grower meetings. We are in the process of building a dynamic webpage that informs growers of wireworm management through the small grain website.