Wireworm biology and ecology in Washington cereal crops

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Wireworms (Figure 1), the subterranean larvae of click beetles, have emerged as significant pests of cereal crops. Our team has joined REACCH to address these pests, their management, and responses to climatic drivers.

Wireworms have proven difficult to manage because they are difficult to sample, and significant damage can be done to crop fields before wireworms are identified and management strategies are implemented. When wireworm densities are high, damage can reach extreme levels, including the loss of entire plots or fields. Unfortunately, producers are faced with the daunting challenge of contending with this emergent pest without the fundamental knowledge to develop new management tools. Our objectives are therefore to examine the ecology of wireworms across variable landscapes and climatic regions in the Pacific Northwest. Our research focuses on the following objectives: (1) determine the distribution of wireworm species in cereal crops; (2) develop a predictive model for wireworms; and (3) deliver information to growers.

IMPACT

Understanding climatic/land use impacts on wireworms can improve their management. This project is developing models to predict wireworm risk based on surveys and climate data. Producer surveys conducted by other teams within REACCH will help ensure models and tools are useful.

In 2013, we conducted a large-scale survey examining the distribution and ecology of wireworms in spring and winter wheat fields in the Pacific Northwest. Surveys were conducted by placing 10 baits in each of 60 cereal fields (40 spring wheat, 20 winter wheat). From these surveys, a total of 1,536 wireworm individuals were collected across samples taken from 60 field locations in 19 counties (Table 1). Three species, *Limonius infuscatus*, *L. californicus*, and *Ctenicera* sp., represented approximately 95% of wireworms collected (Table 1). The dominant species detected varied across counties, suggesting that landscapes and climate may play a role in species distribution.

With the aim of developing a predictive wireworm model, we are expanding these surveys in 2014 to continue to explore wireworm distribution across the REACCH domain. We will use these data to develop a model to allow growers to accurately assess their wireworm risk before planting, so that appropriate treatments can be applied or high-risk sites avoided. Lists of factors predictive

Table 1. *Numbers of wireworms collected from spring wheat fields in Washington.*

State	County	*Limonius infuscatus*	*Limonius californicus*	*Ctenicera* spp.	Other spp.
ID	Benewah	14	—	—	—
ID	Kootenai	—	26	—	—
ID	Latah	—	49	—	—
ID	Nez Perce	—	—	—	68
OR	Morrow	—	—	20	—
OR	Umatilla	54	14	—	—
WA	Adams	—	—	85	—
WA	Asotin	41	—	—	—
WA	Benton	—	—	5	—
WA	Columbia	44	5	—	2
WA	Douglas	—	8	3	—
WA	Franklin	—	1	21	—
WA	Garfield	172	1	—	—
WA	Grant	—	24	85	—
WA	Klickitat	—	—	49	—
WA	Lincoln	243	42	—	—
WA	Spokane	133	27	—	5
WA	Walla Walla	—	23	—	—
WA	Whitman	268	—	—	4
	Total (%)	969 (63%)	220 (14%)	268 (17%)	79 (5%)

Figure 1. *Larval wireworm sampled from a Washington wheat field. Photo by Ivan Milosavljevic.*

of wireworm risk are available, but these often seem to be based on educated guesses rather than quantitative data. In the coming years, we will use our sampling data to develop a quantitative listing of factors that affect wireworm densities.

Data on wireworm densities are being used to develop multiple regression models incorporating data on 15 environmental and operational factors proposed to affect wireworms (explanatory variables). These data will be obtained from the following sources:

- Temperature and precipitation—from agricultural weather stations (agweathernet.com)
- Soil temperature—from hobo data loggers planted in the soil next to baits (These dataloggers record temperatures every 15 minutes.)
- Land use—from the U.S. Department of Agriculture Cropland Datalayers program, which provides data on land use at a 30 x 30 m grain throughout the United States (These maps can be visualized in GIS, and land around focal fields can easily be quantified.)
- Soil properties—from soil samples taken at each bait location
- Management practices—obtained directly from growers in each sampled field

Through these analyses we will determine how grower practices and climatic variables influence wireworm risk.

Our team gave three presentations about wireworms to growers at field days. We also made contact with over 40 different growers, working directly on their farms to sample wireworms. Our network has expanded since we joined the REACCH project in 2012, and we hope to continue to expand the scope of our outreach in future years.

Figure 2. *Larval wireworm. Photo by Ivan Milosavljevic.*

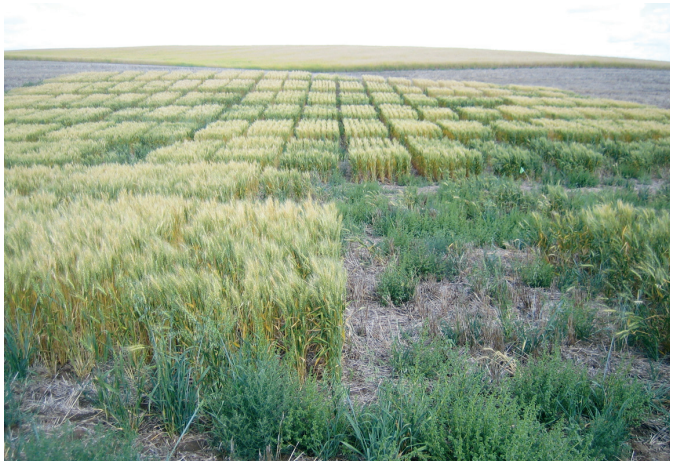

Figure 3. *Large-scale field trials for wheat yield in areas with wireworm. Photo by Ivan Milosavljevic.*