

Project: Integrated and Biochemically-Based Management of Wheat Stem Sawfly

Brief Description: MSU will improve the economic and environmental sustainability of Montana's wheat production through integrated management approaches for the wheat stem sawfly (WSS) that incorporate biological control, improved cropping and conservation practices, and by expansion of the biochemistry of host plant resistance.

Executive Summary: The WSS management project targets the most destructive insect pest of wheat in Montana. In 2008, producers estimated that annual crop losses from WSS approached \$100 million. The WSS cannot be controlled with insecticides and traditional cultural practices have limited impact. Crop losses due to feeding by the sawfly larvae in infested stems reduces grain weight up to 20% and infested stems lodge, which increases costs at harvest. In 2008, reports of sawfly infestation in irrigated malt barley occurred for the first time. Extensive losses were also reported in fields planted to solid-stem wheat varieties which are partially resistant to lodging. In addition, substantial secondary costs occur from herbicides, fungicides or increased tillage practices needed to combat the problems arising from lodged stems.

Ongoing evaluation of the genetic basis for wheat attractant compounds is a collaboration with wheat breeders that should be expanded as it has promise to provide growers with the opportunity to create specific trap crop combinations. Compounds linked to host plant resistance from oat and other resistant species are being screened using a high throughput bioassay system. A limiting step is the analytical capacity for molecular screening of fractions, but this can be resolved with the acquisition of new instrumentation. This technology will be used to isolate these compounds, and to assess if pathways exist for their production in wheat. After identification of the molecular source of host plant resistance, it can be incorporated into existing wheat breeding programs.

Previous research from this project has shown that endemic natural enemies effectively suppress WSS at impacted locations. In the past, Federal and state funds have supported mass rearing and redistribution efforts eventually reducing sawfly damage. These findings support expansion of large-scale, statewide parasitoid redistribution. Complementary outreach efforts will focus on cultural practices incorporating minimal disturbance to enhance and sustain a grower-favorable ecological balance between crop production and natural enemy conservation.

Collectively, these approaches are the basis for an evolving integrated management strategy against the WSS in Montana directed at the \$100M losses and additional regional impacts.

Congressional Action Needed: An appropriation of \$600,000 is requested.

Importance to Montana: The WSS causes severe economic losses in Montana and in other impacted areas. Continued research will further develop strategies for WSS management, resulting in savings of millions of dollars in crop losses throughout the Northern Great Plains. This project supports the education and training of Montanans. Maintaining MSU as a leader in integrated pest management of WSS prepares graduates for careers in agriculture and biotechnology.

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Integrated and Biochemically-Based Management of Wheat Stem Sawfly – Talking Points

- Sawfly natural enemies have been established at fifty field sites in fifteen counties in Montana. Monitoring at sentinel locations documented the impact of natural enemies.
- Mass production of parasitic WSS natural enemies has been demonstrated in field nurseries and needs refinement for potential commercial development.

- Conservation of WSS natural enemies has been studied at numerous field sites throughout Montana. Resulting cultivation recommendations for natural enemy conservation are encompassed within the best current practices for sustainable production.

- Two naturally occurring isolates of entomopathogenic fungi show efficacy against other species of field insects have recently been collected from WSS populations.
- The pheromone lure for WSS has been identified and is easily synthesized. Trap development targeting a commercial market needs to be continued. A degree-day model for the sawfly flight period is available.

- Previous work refined companion planted trap cropping and its abilities to retain and destroy sawfly populations. The refinements were strategic spatial and temporal deployment of effective varieties and precisely timed intervention. Increased economic return can be gained by decreased sawfly infestation and by marketing of hay produced in the destruction of the pest population.

- Previous research evaluated the release of sawfly attractants by wheat varieties grown in Montana. This has led to the identification of varieties useful in integrated management as trap crops.

- Molecular markers have been identified for the rapid development of both unattractive and attractive wheat lines to increase the use of companion planted trap crops. More research is needed to identify the genes that regulate insect attraction in host plants.

- Laboratory work has isolated and identified a set of compound classes that are the likely sources of the host plant resistance that kills sawfly larvae feeding in oats. Further, more rapid isolation of these compounds will identify the chemical basis for future highly-resistant wheat varieties that go beyond from current “resistant” solid-stem wheat varieties that only kill some sawfly larvae.

- Research has been presented in scientific forums and popular media spanning local through international forums. This has increased grower participation, recruited students, and has yielded matching funds that total over \$2.2 million.