

Research Proposal for the Agricultural Research Foundation
Oregon Wheat Commission

Title: Beyond Resistant Jointed Goatgrass by Wheat Hybrids in Oregon Wheat Fields

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OWC Funding History: None for this project

Abstract:

The introduction of Clearfield wheat and the ability to apply the herbicide Beyond (imazamox) have provided an opportunity for control of jointed goatgrass as well as several other weed species. However, the production of imazamox resistant hybrids between jointed goatgrass and Clearfield wheat could reduce the long term benefit of this technology especially if the resistance gene is moved into jointed goatgrass populations through further crossing. We have identified hybrids and backcross generations that have the resistance gene from Clearfield wheat. Therefore, it is important to understand the factors in the field that contribute to the production of the hybrids and subsequent generations. We propose to collect hybrids and determine if they carry the Clearfield gene. We also propose to collect data on the management practices used in Clearfield wheat. It has been suggested that up to 40% of the acres planted to Clearfield wheat are not being sprayed with imazamox. If this is really the case, it could be one of the contributing factors to the production of resistant hybrids. We will cooperate with extension faculty and BASF to develop recommendations that will reduce hybrid production in order to maintain the value of the Clearfield system.

Objectives:

1. Collect jointed goatgrass by wheat hybrids in Eastern Oregon wheat fields and determine if they carry the resistance gene from Clearfield wheat.
2. Assess Clearfield management systems to determine if the production of resistant hybrids is occurring more frequently under particular production practices.

Procedures:

Objective 1. Collection sites will be selected based in prior Clearfield wheat use on fields with jointed goatgrass infestations. Each collection site will have a unique identifier number to indicate field and cooperator. Oregon State University Extension Personnel and the approved Clearfield seed providers have agreed to assist in identifying the fields. Global Positioning Systems (GPS) and Geographic Information Systems (GIS) will be used to map the fields and hybrid plant populations.

Sites will be visited in May and June while plants are still green and tissue will be collected for molecular analysis. Molecular marker analysis of the tissue from the plants will allow us to

determine how the hybrids are being produced in the field, which parent is the female parent and which parent is the pollen donor. Data such as these help us to understand the population dynamics between wheat and jointed goatgrass in the field. Hybrid spikes will be collected in July and August, prior to harvest. Germination tests will be conducted on the seed harvested from the spikes. Seedlings will be sprayed in the greenhouse and survivors tested to confirm the mechanism of resistance. Molecular markers will be used to determine whether resistance is the result of the movement of the resistance gene from Clearfield wheat or whether the resistance is from natural selection of resistant jointed goatgrass.

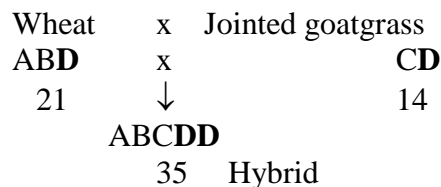
Objective 2. A survey will be developed for Clearfield wheat growers who have grown Clearfield wheat with the goal of controlling jointed goatgrass. The survey will include growers with fields that had resistant hybrids and those that did not. The assessment will include questions relating to production practices including no-till versus tilled, the number of years Clearfield wheat was grown on the field in question, the rotation of crops on the field, whether imazamox was applied, the imazamox rate applied, the timing of imazamox application, the percent of the field that was sprayed, the level of jointed goatgrass infestation, and other weed control measures used on the fields whether mechanical, cultural or other herbicides. For example, herbicides used to control jointed goatgrass in a fallow period or in a nonwheat crop. We will use the information from this survey to develop best management plans for the prevention of herbicide resistant hybrids in the field.

Timeline:

Field collections will be completed by September 2010. Plant material will be analyzed September 2010 through March 2011. A report will be submitted by the due date requested by the Wheat Commission. The survey of grower practices will be completed during January-February 2011.

Justification:

Jointed goatgrass and wheat are related species that have a common genome. Wheat originated from three parent species. These parents donated the A, B, and D genomes. Jointed goatgrass originated from two parent species. These two species donated the C and D genomes. Jointed goatgrass and wheat share a common genome, D. The common genome between wheat and jointed goatgrass allows hybrids to be produced in the field.



Hybrids of jointed goatgrass and wheat are found frequently in wheat fields, including those in Oregon. Hybrids possess a low level of female fertility that allows for natural backcrossing to occur in the field between the jointed goatgrass wheat. The close genetic relationship between

wheat and jointed goatgrass and the similarity of the two species in morphology, physiology, and phenology make this weed especially difficult to control.

Until the introduction of the herbicide resistant Clearfield wheat cultivars, there were no herbicide options to control jointed goatgrass in a wheat crop. Clearfield wheat is bred to be resistant to the herbicide imazamox (Beyond). Imazamox can be applied to fields of Clearfield wheat to control jointed goatgrass while the wheat will not be injured. Clearfield wheat has had a major impact on wheat production in Oregon. More than 450,000 acres of Clearfield wheat were produced in the Pacific Northwest in 2007; most of these acres were planted with wheat produced by the Oregon State University Wheat Breeding Program.

Hybrids between Clearfield wheat and jointed goatgrass were identified in a commercial wheat field near Moro, Oregon, in 2008. We have never considered the competition from hybrids, however, the number of resistant hybrids observed in the field could be reducing wheat yield and thus costing wheat growers lost revenue. Because the hybrids display hybrid vigor they are likely more competitive on a per plant basis than is jointed goatgrass. The competitive ability will be even more important in the wheat production areas where water is the most limiting resource. Hybrids are also important because if they can be a bridge that would allow the movement of the resistance gene to jointed goatgrass thus producing herbicide resistant jointed goatgrass populations.

We need to understand how prevalent these hybrids are especially considering how many acres of Clearfield wheat are being grown. It is important to determine if a particular production practice leads to more resistant hybrids in a field. For example, is the number of years Clearfield wheat is grown or is the application (low rates or not at all) of imazamox more important in the production of hybrids. It is interesting to note that most scientists predicted that the natural selection of imazamox resistant jointed goatgrass would occur sooner and create a larger problem than would hybridization. It appears this may not be the case.

The value of the Clearfield wheat system for jointed goatgrass control may be lost if we can not make recommendations that will help growers preserve the effectiveness of imazamox in the system. The recommendations that come from this project will help growers develop best management practices for this crop and also help BASF, the company that produces the herbicide, modify its stewardship recommendations for the Clearfield system.

Budget

Objective 1:

Graduate Student Salary	\$5,000
OPE (10%)	500
Travel Domestic (in state)	1,500
Services and Supplies	1,500

Objective 2:

Graduate Student Salary	\$1,000
OPE	100
Services and Supplies	1,000

TOTAL \$10,600

Relation to Other Research:

This project is part of ongoing research on hybridization between wheat and jointed goatgrass. We are continuing to study the relationship between wheat and jointed goatgrass. Another PhD student in the Weed Science program is studying the molecular basis for its invasiveness. However, this is not part of the statewide request for support of weed management in wheat.