

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

Project #: AWD005358

Progress Report Year: 1 of 3

Title: Herbicide Resistance Monitoring in Eastern Washington Wheat

Researcher(s): Ian C. Burke

Cooperators:

Executive summary: In 2022, a collection of downy brome was completed, and a survey of prickly lettuce and Russian thistle was completed in 2023. We will focus on mayweed chamomile and Italian ryegrass in 2024. We also continue to test farmer and consultant submitted samples. The herbicide resistance testing program continues to receive new samples and new kinds of resistance – to date 8 novel types of herbicide resistance have been identified that were previously unknown, including Russian thistle and downy brome resistant to glyphosate. In 2023, we identified two biotypes of downy brome potentially resistant to Aggressor herbicide, widespread Maverick and Powerflex resistance, a much higher incidence of imazamox and glyphosate resistance than expected, and we also identified the first case of multiple resistant downy brome – resistant to both glyphosate and Group 2 herbicides. Resistance testing and our outreach efforts have raised awareness that leads to incorporation of integrated strategies and more rapid responses to issues as they arise, which will lead to longer term system sustainability.

Introduction: Monitoring key weed species for herbicide resistance is a critical component of integrated weed management. The size of the region and the variety of problematic weed species means that we must focus on only a subset species each year. Testing submitted farmer-submitted samples for resistance often results in bias or overestimation of a resistance issue in a region. Samples collected from a randomized array of points from a large number of farms willing to participate would mitigate bias in the collection and facilitate an assessment reflective of the actual resistance situation for common weeds in eastern Washington.

Approach: Testing submitted farmer-submitted samples for resistance often results in bias or overestimation of a resistance issue in a region. Samples collected from a randomized array of points from a large number of farms would mitigate bias in the collection and facilitate an assessment reflective of the actual resistance situation eastern Washington. Each field sampled will be assessed by entering the field and walking a large M shaped pattern. Approximately 20 plants of the targeted weed will be collected if present. The seeds will be allowed to after-ripen, and then are grown and tested for resistance to commonly used herbicides for their control.

Results: In 2022, a collection of downy brome was completed, and a survey of prickly lettuce and Russian thistle was collected in the summer and fall of 2023. Screening of the downy brome collection was completed in 2023. We identified two biotypes of downy brome potentially resistant to Aggressor herbicide, widespread Maverick and Powerflex resistance, a much higher

incidence of imazamox and glyphosate resistance than expected, and we also identified the first case of multiple resistant downy brome – resistant to both glyphosate and Group 2 herbicides. We have purchased a new phenotyping tool to allow us to collect digital biomass instead of more traditional methods, which should increase throughput of the testing program. Herbicide resistance in weeds is likely to only increase, as we are continuing to use the same active ingredients year after year. Testing for resistance will ideally be an integrated part of a management system.

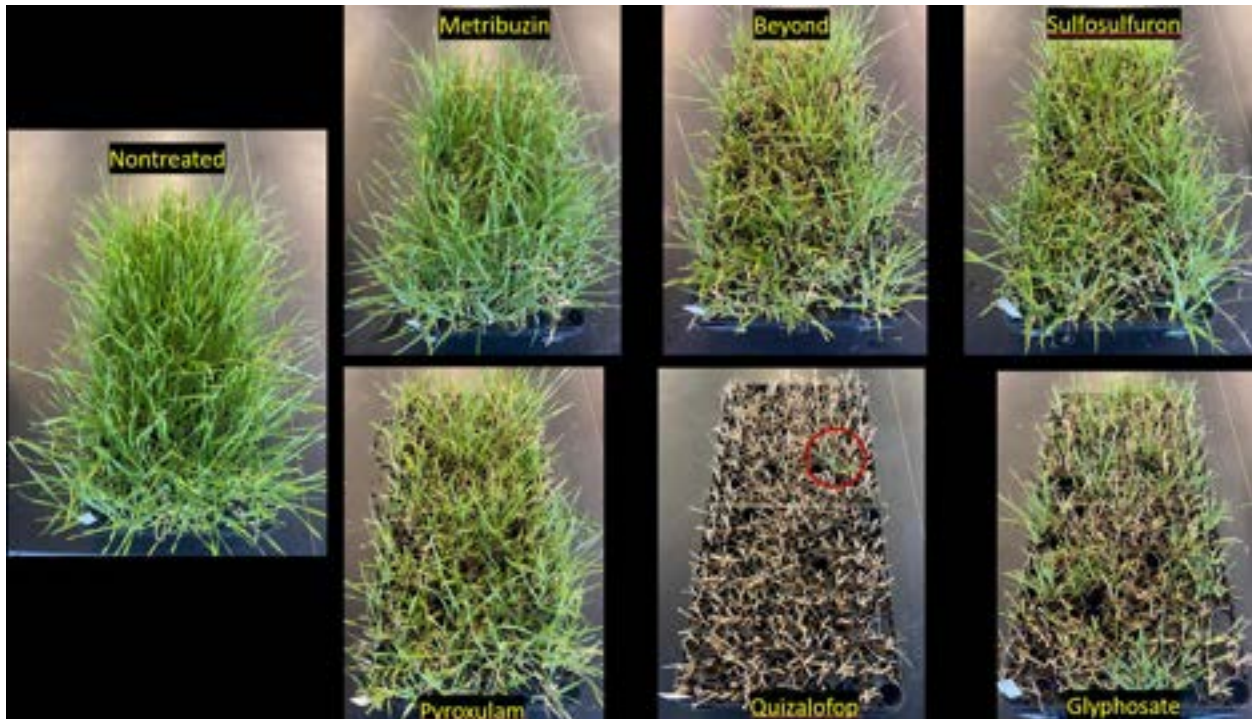


Figure 1. Example responses of downy brome biotypes to applications of metribuzin, Beyond, Maverick (sulfosulfuron), Powerflex (pyroxulam), and Aggressor/Assure II (quizalofop), and glyphosate. Each individual plant is from a different wheat field.

Impact: Reporting of resistance occurs through extension presentations, bulletins, podcasts, and through the smallgrains website. Short term impacts include regular and frequent updates on our knowledge of herbicide resistance in important species in Washington. Longer term, farmers, agronomists, and consultants in the PNW are, in general, aware of herbicide resistance and typically respond by seeking to test weeds or by thoughtfully modifying their cropping system to improve management outcomes. Agronomists and consultants in the region have indicated to us that awareness generally leads to open conversations about incorporation of new techniques or formulation of long term management plans. Ultimately, the resistance testing and our out reach efforts has raised awareness that leads to incorporation of integrated strategies and more rapid responses to issues as they arise, which will lead to longer term system sustainability.

WGC project number:AWD005358

WGC project title: Herbicide Resistance Monitoring in Eastern Washington Wheat

Project PI(s): Ian C. Burke

Project initiation date: July 1, 2023

Project year (3 of 3-yr cycle): 1

Objective	Deliverable	Progress	Timeline	Communication
<p>1) conduct a regional survey of resistance in mayweed chamomile and Italian ryegrass using standard methodology.</p>		<p>Statewide screening of downy brome using 2400 assessments from a total of 80 sites in WA occurred in 2022 and 2023. Downy brome was screened for resistance to the main herbicides used in winter wheat systems in the PNW (sulfosulfuron, pyroxulam, quizalofop, imazamox, glyphosate, and metribuzin). Many genotypes were found to be resistant to group 2 herbicides and these herbicides are inefficient for downy brome control at sites where downy brome was collected from. Genotypes with multiple herbicide resistance were found in the process as well as genotypes resistant to glyphosate. A single genotype from most likely CoAXium wheat systems was found resistant to Assure II (group 1) herbicide.</p>	<p>Initial screening was completed in 2023/23.</p>	<p>Annual weed control report, extension articles (WSU Timely Topic), annual meetings.</p>
		<p>Statewide collection of Russian thistle occurred in the fall/winter of 2023. Similar to Downy Brome, 80 sites were visited and the same screening process will occur in the spring/ summer of 2024. We collected seed bank samples from each site at the time of plant collection. These samples are stored in the freezer and will be processed to assess seed bank across WA state. The same collection of Prickly Lettuce is planned for the summer of 2024.</p>	<p>Collection was completed in 2023 and screening is going to be completed in the year of 2024</p>	<p>Annual weed control report, extension articles, annual meetings.</p>

<p>2. Operate a high-throughput herbicide resistance testing program for weeds in wheat.</p>	<p>Rapid reliable program to test weeds for herbicide resistance.</p>	<p>Two methods have been used: Genetic testing, and herbicide efficacy (spraying). Herbicide efficacy: 297 biotypes have been received, given an identification number, entered into a spreadsheet, and have (or will) undergone an initial screening for possible plant tolerances/resistance to screened herbicides. After satisfactory data is collected from an initial screening, the biotypes are then given a dose response of up to 128X the recommended rate. A report of procedure and results are then written up and delivered to the submitters. Methods for screening have been developed so all biotype undergo the same testing in a timely manner. We have also created methods to help deal with downy brome dormancy. The primary weeds tested are currently downy brome, wild oats, Italian ryegrass, common windgrass, and some broadleaf weeds. We receive approximately 15 - 30 new biotypes each year.</p>	<p>Continue refining methods. Research has emphasized important herbicide resistance cases, including glyphosate resistant Russian thistle, downy brome, and kochia, as well as Beyond resistant jointed goatgrass and clopyralid resistant mayweed chamomile. Rapid tests have been devised for older well know resistance cases, but are relatively more expensive compared to spraying. Aims to rapidly collect DNA and screen for specific resistances remain a goal of the program. The turnaround time for sample processing has continued to decrease, with submitters receiving results within 6 months of submission, or faster if requested. Advances in experimental methods have allowed us to overcome seed dormancy and increase sample</p>	<p>Journal articles; articles in Wheat Life, trade magazines and/or posted to WSU smallgrains website; winter Extension meetings. Interview on the WSU WheatBeat Podcast. Submitters receive full report for all samples submitted.</p>
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