### Herbicide resistance survey

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As the sugar beet industry awaits the release of triple-stack (*dicamba, glufosinate, and glyphosate*) herbicide-tolerant sugar beet, most of us have been wondering how well these herbicides will work in our region. The short answer is that these herbicides appear to be very effective on most of our problematic weeds. However, there's one factor that can't be ignored: *herbicide resistance*. Currently, there are populations of kochia that are resistant to both group 2 herbicides (e.g., Upbeet<sup>®</sup>) and group 9 (*glyphosate*) within the Amalgamated Sugar Cooperative Sugar beet growing region. Although dicamba resistance has been confirmed in kochia in Idaho, it is unclear if this is widespread.

The main goal of this project was to survey weed escapes (kochia, common lambsquarters, redroot pigweed, and barnyardgrass) in sugar beet fields to evaluate the presence or spread of dicamba, glufosinate, and glyphosate-resistant weeds. This survey was expanded to include Plamer amaranth and waterhemp which were recently introduced into Idaho.

#### **Research Objectives**:

- 1. Evaluate the response of kochia, common lambsquarters, redroot pigweed, Palmer amaranth, and waterhemp to *dicamba, glufosinate, and glyphosate*
- 2. Evaluate the response of barnyardgrass to clethodim, glufosinate, and glyphosate
- 3. Create a map of herbicide-resistant weed species within the Amalgamated Sugar Cooperative Sugar beet growing region.

### Methodology

Field surveys were conducted in the summer and fall of 2023 across southern Idaho to collect seeds from common lambsquarters, kochia, redroot pigweed, and barnyardgrass. In addition, tissue and seed samples were collected from Palmer amaranth, and waterhemp across are expected to mature. A semi-stratified survey method will be used. We coordinated with Amalgamated Sugar staff and Crop Consultants to identify about 100 fields in multiple counties including Cassia, Canyon, Elmore, Gooding, Minidoka, Payette, and Owyhee. To properly identify Palmer amaranth and waterhemp, an identification guide was prepared and distributed among Amalgamated Sugar staff and Crop Consultants assisting with the project. Samples were either collected and sent to the research team or the GPS coordinates of the sites were sent to the team for sample collection. At each field site, samples were collected from multiple plants and placed in different paper bags (seed samples) or ziplok bags (tissue samples). Seeds were air-dried at the greenhouse in Kimberly, threshed, and cleaned.

### Greenhouse herbicide resistance bioassay:

About 10 seeds were planted in potting media in 4-inch plastic pots and grown under greenhouse conditions. For each weed species, a known susceptible biotype is included for comparison.

When the weeds reach about 4-inches, the broadleaf weeds were sprayed with two rates of glyphosate (Roundup PowerMax<sup>®</sup> @ 22 and 44 oz/A), glufosinate (Liberty<sup>®</sup> @ 29 and 58 oz/A), and dicamba (Xtendimax<sup>®</sup> @ 22 and 44 oz/A). For each herbicide, the lower rate represented the field use rate (1X) and the higher rate is 2X the field use rate. A non-treated control was also included for each weed species for comparison to the herbicide-treated plants.

Since dicamba has no postemergence activity on grasses, barnyardgrass is being sprayed with Roundup PowerMax<sup>®</sup>, Liberty<sup>®</sup>, and Select<sup>®</sup> Max (clethodim) @ 12 and 24 oz/A. Recommended adjuvants were included in all treatments. All herbicide applications were made using Generation 4 Research Track Sprayer.

Visible weed control was assessed at 7, 14, and 28 days after spraying. Photographs were taken to document the level of weed control. For weeds that are resistant to any of the herbicides, a full dose-response study will be established in the spring of 2024 to characterize the level of herbicide resistance in each population.

### Results

About 106 fields were surveyed for kochia, common lambsquarters, redroot pigweed, and barnyardgrass (Table 1). In addition, Palmer amaranth and waterhemp tissue and seed samples were collected from multiple farms and roadsides (Table 1, Photos 1,2,3). Out of the 23 Palmer amaranth tissue samples collected, 17, representing 70% were identified to have elevated gene copy numbers, which was indicative of glyphosate resistance. All waterhemp samples were resistant to glyphosate (Figure 1).

Survey	
Farms surveyed	106
<u>Number of samples collected</u>	
kochia	80
Common lambsquarters	61
Redroot pigweed	61
Baryardgrass	26
Palmer amaranth	23 tissue samples;
	7 seed samples
Waterhemp	3 tissue samples;
	3 seed samples

Table 1. Summary	of samples collected from	the
survey		

# Known distribution of Palmer amaranth and waterhemp



• waterhemp

Photo 1. Known distribution of Palmer amaranth and waterhemp in Idaho



Photo 2. Palmer amaranth in sugar beet in Minidoka and Owyhee counties



**Figure 1.** Glyphosate-resistance screening results for Palmer amaranth and waterhemp tissue samples collected from multiple counties in southern Idaho in 2023. For Palmer amaranth, EPSPS gene copies of >8 was identified to be glyphosate resistant. For waterhemp, EPSPS gene copies of >1 shows glyphosate resistance.

In the first round of greenhouse herbicide resistance bioassay, glyphosate resistance was confirmed in 2 out of the 7 seed collections. These samples survived 44 fl oz/A of Roundup PowerMax (Photo 3). This was not surprising as some fields surveyed showed Palmer amaranth that survived multiple applications of glyphosate (Photo 4). None of the seed collections was resistant to dicamba or glufosinate (Photo 3).



**Photo 3.** Visible Palmer amaranth control from glyphosate (Roundup), glufosinate (Liberty), and dicamba (Xtendimax) in the greenhouse herbicide resistance bioassay.

Although waterhemp and kochia were planted in the greenhouse at the same time as Palmer amaranth for the bioassay, emergence was very poor and not consistent enough for resistance screening. These weeds are being replanted for the next round of bioassays.



**Photo 5.** Suspected glyphosate-resistant Palmer amaranth in a sugar beet field. Photo by Clarke Alder

## Conclusions

Glyphosate-resistant Palmer amaranth and waterhemp have been confirmed from multiple counties in Idaho. None of the Palmer amaranth collected showed resistance to glufosinate or dicamba. Greenhouse herbicide resistance bioassays and subsequent dose-response studies will show the levels of resistance and the distribution of glyphosate, glufosinate, and dicamba resistance in southern Idaho.

### What's next?

Kochia, common lambsquarters, redroot pigweed, barnyardgrass are currently being grown in the greenhouse and will be sprayed in January 2024 to assess resistance to dicamba, glufosinate, and glyphosate, and clethodim (for barnyardgrass). Waterhemp seeds will also be scarified for improved germination, planted, and sprayed in the spring of 2024 to assess resistance to dicamba, glufosinate, and glyphosate. Both Palmer amaranth and waterhemp will be screened for resistance to some soil-applied herbicides including Treflan (trifluralin), Warrant (acetochlor), Dual Magnum (s-metolachlor), and Outlook (dimethenamid-p).

Special thanks: Dr. Joel Felix, Amalgamated Sugar agronomist, Dr. Todd Gaines, Andre Araujo