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Can the bioherbicide *Phoma macrostoma* control agricultural weeds?

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Bioherbicide made from *Phoma macrostoma*

- *Phoma macrostoma* is a fungus isolated from Canada thistle (*Cirsium arvense* (L.) Scop.) collected across Canada (Fig. 1).
- Symptoms: photobleaching (Fig. 2) and root inhibition (Fig. 3).
- Hosts: Asteraceae, Leguminosae, Brassicaceae are susceptible vs. Gramineae are tolerant.
- The fungus is grown on grain and formulated as a granule for broadcast application (Fig. 4).
- Under development as a bioherbicide for broadleaved weeds in turfgrass.
- Can it control agricultural weeds?

Objective One

- What broadleaved agricultural weeds are affected by *Phoma macrostoma*?

Methods and Materials

- Paired test plots (1 x 3m^2) to evaluate a single rate of bioherbicide (1.6X the standard agricultural rate) applied pre-emergently to plots sown with wheat.
- Two locations: Melfort and Prince Albert, SK.

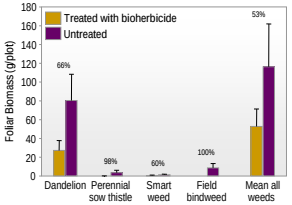

Figure 5. Foliar biomass reduction (%) of various weed species from plots treated with or without the bioherbicide at Melfort, SK in 2009.

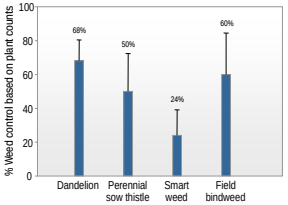

Figure 6. The % weed control of various weed species treated with or without the bioherbicide at Melfort, SK in 2009. Weed control is expressed relative to the untreated control.

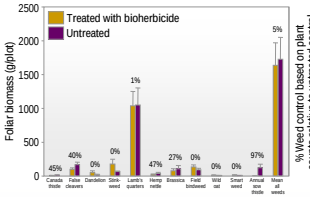

Figure 7. Foliar biomass reduction (%) of various weed species from plots treated with or without the bioherbicide at Prince Albert, SK in 2009.

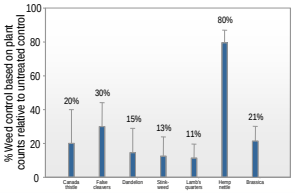

Figure 8. The % weed control of various weed species treated with or without the bioherbicide at Prince Albert, SK in 2009. Weed control is expressed relative to the untreated control.

Weeds Controlled by Phoma

- Dandelion, field bindweed, annual sow thistle were significantly reduced by >60%.
- Some reduction (40-50%) in Canada thistle, false cleavers, hemp nettle.
- No control of stinkweed, lamb's quarters, wild oat, smartweed.
- Natural weed stands showed variability among plots and sites.

Objective Two

- What is the lowest rate of the bioherbicide that provides control of Canada thistle and wild mustard?
- Methods and materials
  - Bioherbicide was broadcast as a pre-emergent or post-emergent application at 0X, 0.7X, 1.0X, 1.3X, and 1.7X the standard agricultural rate; a 2,4-D ester at 560 g ai/ha in 110 L/ha was the standard herbicide comparison for wild mustard.
  - Canada thistle was natural stands in Saskatoon, SK applied on June 2 (pre-emergent) and June 26 (post-emergent); wild mustard was seeded and treated pre-emergently on May 18 in Scott, SK.

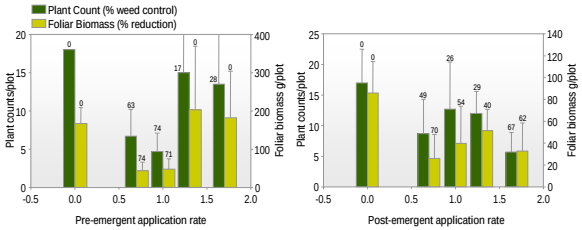

Figure 9. The plant counts (number/plot) and the foliar biomass (g/plot) of Canada thistle plants treated five rates of bioherbicide (0X, 0.7X, 1.0X, 1.3X, and 1.7X) either before weed emergence (pre-emergent on left) or after weed emergence (post emergent on right).

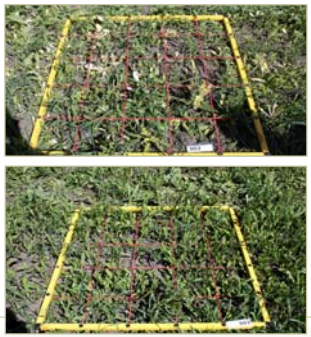

Figure 10. Canada thistle treated with a post-emergent application of the bioherbicide (upper) and the untreated control (lower).

Canada thistle control

- The soil was very dry and the emergence of Canada thistle was slow.
- The pre-emergent and post-emergent applications reduced the number of thistle and biomass (Fig. 9).
- For a pre-emergent application the 0.7X and 1.0X rates gave greater than 60% control.
- There was no clear dose response with the post-emergent applications so the lowest effective rate was not determined (Fig. 10).

Figure 11. Dry soil conditions at seeding prevented the bioherbicide from controlling the first flush of wild mustard.

Figure 11. The second flush of seeds emerged with chlorosis which indicates the bioherbicide is active.

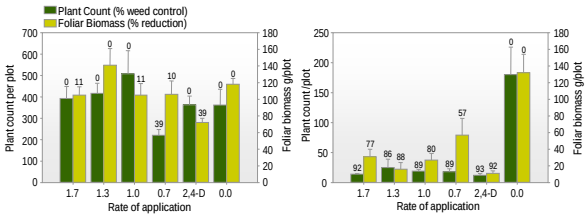

Figure 12. The plant counts (number/plot) and the foliar biomass (g/plot) of wild mustard plants treated five rates of bioherbicide applied pre-emergently and a standard 2,4-D ester applied post-emergently. The left graph shows the first flush of weeds which occurred from seeding on May 18 to its harvest on June 24. The right graph shows the second flush of weeds resulting after a rainfall on June 20 to harvest on July 29.

Wild Mustard Control

- A very dry spring prevented the bioherbicide from becoming active and having no effect on plant number or biomass (Fig. 11).
- After late season rain, the bioherbicide became active (Fig. 12) and provided greater than 80% control of emerging wild mustard seedlings at all rates of application which was the same control provided by the standard herbicide (Fig. 13).

Conclusions

- Bioherbicide controlled dandelion, field bindweed, annual sow thistle, Canada thistle, and wild mustard at level between 60-100%.
- There was no control of stinkweed, lamb's quarters, wild oat, smartweed.
- Weed control was site dependent and was affected by weather and weed pressure.
- Bioherbicide only works in moist soils, but remains dormant until conditions improve.
- Bioherbicide works best as a pre-emergent for weed seedling control.

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