

## MANAGEMENT OF WATERHEMP IN GLYPHOSATE-RESISTANT SUGARBEET

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### ABSTRACT

Glyphosate-resistant waterhemp continues to increase in Minnesota and North Dakota, making waterhemp management difficult in glyphosate-resistant sugarbeet. Multiple small-plot sugarbeet research trials have been conducted from 2010 to 2012 investigating management of glyphosate-resistant waterhemp with preplant incorporated, preemergence, and/or postemergence herbicides in sequence and/or in combination with glyphosate.

Six research trials were conducted: Soil-applied herbicides; Single soil-applied herbicide followed by postemergence herbicides; Three soil-applied herbicides followed by postemergence herbicides; Postemergence ethofumesate; Ethofumesate applied postemergence at different rates; and Postemergence ethofumesate applied three times. For all research trials, plot width and length was 3.4 (2 m sprayed) and 9.1 m, respectively, all treatments were applied with a bicycle sprayer calibrated to deliver 17 gallons/A spray volume fitted with 8002 XR nozzles, sugarbeet row spacing was 55.9 cm, replications numbered four, and the glyphosate formulation used was a potassium salt (Roundup PowerMAX).

The soil-applied trial was conducted in one glyphosate-resistant waterhemp population from 2010 to 2012 and data combined over years. Ethofumesate (4.2 kg ai/ha), S-metolachlor (1.6 kg ai/ha), acetochlor (encapsulated formulation of Warrant) (1.3 kg ai/ha), cycloate (two formulations of Ro-Neet EC and Ro-Neet SB in 2011 and 2012) (4.5 kg ai/ha), and cycloate (2.8 kg/ha) plus EPTC (2.2 kg ai/ha) were applied preplant incorporated and preemergence. Preplant herbicides were incorporated once to a 5 cm depth. Only the following treatments controlled 80% or greater waterhemp 40 to 44 days after treatment (time of first POST glyphosate application): Cycloate plus EPTC applied preplant incorporated (87%); ethofumesate applied preplant incorporated and preemergence (81 and 84%, respectively), and S-metolachlor applied preemergence (80%). All other treatments controlled only 31 to 78% of waterhemp in these glyphosate-resistant populations.

For the single soil-applied herbicide followed by postemergence herbicides trial only a single site (greatest density of glyphosate-resistant waterhemp) was presented. This trial was designed as a three factor factorial having the following factors and all combinations: Factor 1 was cycloate (Ro-Neet SB) applied preplant incorporated at 0 and 4.5 kg/ha; Factor 2 was postemergence herbicides: 1. Glyphosate (1.3 followed by (fb) 0.8 fb 0.8 kg ae/ha); 2. Desmedipham (0.14 fb 0.18 fb 0.27 kg ai/ha) plus glyphosate (rates as above); and 3. Desmedipham plus phenmedipham [1:1] (0.14 fb 0.18 fb 0.27 kg ai/ha) plus ethofumesate (0.14 fb 0.14 fb 0.14 kg/ha) plus glyphosate (rates as above); and Factor 3 was the addition of layby herbicides with the postemergence herbicides: 1. No layby herbicide; 2. Aceotchlor (1.3 fb 0.8 fb 0 kg/ha); 3. Dimethenamid (0.7 fb 0.5 fb 0 kg/ha); and 4. S-metolachlor (1.6 fb 1.1 fb 0 kg/ha). Destiny HC (1.7 L/ha) and ammonium sulfate (3.8 kg/378 L of spray solution) was included in all postemergence treatments. The postemergence treatments were applied initially to two-leaf sugarbeet and sequentially every 14 days. With two factors averaged across a single factor, at the time of harvest, waterhemp was controlled 89% with cycloate compared to 68%

without cycloate, 81% with desmedipham and desmedipham plus phenmedipham plus ethofumesate compared to 74% with glyphosate alone, and the addition of acetochlor, dimethenamid, or S-metolachlor controlled 82 to 84% of waterhemp compared to 66% with no lay-by herbicide. No sugarbeet root yield loss was observed with any treatment.

For the three soil-applied herbicides followed by postemergence herbicides trial, three locations (2 glyphosate-resistant and one susceptible to glyphosate) were established in 2012. The trial was designed as a two factor factorial having the following factors: Factor 1. Soil-applied herbicides: Cycloate (3.4 and 4.5 kg/ha) and ethofumesate (3.4 and 4.2 kg/ha) applied pre-plant incorporated and S-metolachlor (1.1 and 1.6 kg/ha) applied preemergence and Factor 2. Postemergence herbicides: 1. Glyphosate (1.3 followed by (fb) 1.0 fb 0.8 kg ae/ha); 2. Ethofumesate (0.14 fb 0.14 fb 0.14 kg/ha) plus glyphosate (rates as above); 3. Desmedipham plus phenmedipham [1:1] (0.14 fb 0.18 fb 0.27 kg ai/ha) plus ethofumesate (0.14 fb 0.14 fb 0.14 kg/ha) plus glyphosate (rates as above); and 4. Desmedipham plus phenmedipham [1:1] (0.14 fb 0.18 fb 0.27 kg/ha) plus ethofumesate (0.14 fb 0.14 fb 0.14 kg/ha) plus dimethenamid (0.7 fb 0.5 fb 0 kg/ha) plus glyphosate (rates as above). Destiny HC (1.7 L/ha) and ammonium sulfate (3.8 kg/378 L of spray solution) was included in all postemergence treatments. The postemergence treatments were applied initially to two-leaf sugarbeet and sequentially every 14 days. The waterhemp control data at the time of the first postemergence application (2-leaf sugarbeet) was combined across all locations. Ethofumesate (4.2 and 3.4 kg/ha), S-metolachlor (1.6 and 1.1 kg/ha), and cycloate (4.5 and 3.4 kg/ha) controlled 90, 86, 81, 77, 81, and 74% of waterhemp at two-leaf sugarbeet, respectively. At harvest at one of the glyphosate-resistant waterhemp sites (Moorhead, MN) with data combined across the postemergence treatments, ethofumesate (4.2 and 3.4 kg/ha), S-metolachlor (1.6 and 1.1 kg/ha), cycloate (4.5 and 3.4 kg/ha), and no soil-applied herbicides controlled 97, 97, 94, 88, 89, 81, and 57% of waterhemp, respectively and when combined across the soil-applied treatments, glyphosate, glyphosate plus ethofumesate, glyphosate plus desmedipham plus phenmedipham [1:1] plus ethofumesate, and glyphosate plus desmedipham plus phenmedipham [1:1] plus ethofumesate plus dimethenamid controlled 84, 88, 83, and 89% of waterhemp, respectively. Extractable sucrose yield was maximized with ethofumesate and glyphosate alone.

The postemergence ethofumesate trial was conducted at only one glyphosate-resistant waterhemp site in 2010. Ethofumesate (4.2 kg/ha) plus glyphosate (1.3 kg/ha) applied to 1.3 cm waterhemp, ethofumesate (4.2 kg/ha) plus glyphosate (1.3 kg/ha) applied to 11.4 cm waterhemp, and ethofumesate (2.4 kg/ha) plus glyphosate (1.3 kg/ha) fb (15 DAT) ethofumesate (1.8kg/ha) plus glyphosate (0.8 kg/ha) controlled 84, 85, and 99% of glyphosate-resistant waterhemp, respectively, on July 28<sup>th</sup> compared to glyphosate applied alone at the same time which controlled 16, 64, and 56% of glyphosate-resistant waterhemp, respectively.

The ethofumesate applied postemergence at different rates trial was conducted at only one glyphosate-resistant waterhemp site in 2011. Ethofumesate was applied twice (initially to 1.3 cm waterhemp and then 14 days later) at 0.14, 0.56, 1.12, 1.68, and 2.1 kg/ha plus glyphosate (1.3 fb 0.8 kg/ha) and ethofumesate was applied three times (initially to 1.3 cm waterhemp and then 14 fb 14 DAT) plus glyphosate (1.3 fb 0.8 fb 0.8 kg/ha). Near harvest (August, 2011) ethofumesate applied twice at 0.14, 0.56, 1.12, 1.68, and 2.1 kg/ha and ethofumesate applied three times at 0.14 and 0.56 kg/ha controlled 49, 51, 70, 78, 77, 51, and 65% of waterhemp, respectively, compared to glyphosate applied twice alone controlling 42% of waterhemp and glyphosate applied three times alone controlling 62% of waterhemp.

The postemergence ethofumesate applied three times trial was conducted at only one glyphosate-resistant waterhemp site in 2012. Ethofumesate (0.8 fb 0.8 fb 0.8 kg/ha) plus glyphosate (1.3 fb 1.0 fb 0.8 kg/ha), ethofumesate (1.1 fb 1.1 fb 1.1 kg/ha) plus glyphosate (1.3 fb 1.0 fb 0.8 kg/ha), and ethofumesate (1.7 fb 1.7 fb 1.7 kg/ha) plus glyphosate (1.3 fb 1.0 fb 0.8 kg/ha) controlled 92, 97, and 97% of glyphosate-resistant waterhemp, respectively on August 27.

The use of soil-applied herbicides, especially ethofumesate and the inclusion of lay-by herbicides improved waterhemp control. Postemergence ethofumesate mixed with glyphosate can improve control of glyphosate-resistant waterhemp, but control was variable over the three years.