

CONTROLLING WATERHEMP ESCAPES IN SUGARBEET

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Summary

1. Ultra Blazer broadcast applied, Liberty or Gramoxone applied with the hooded sprayer, or inter-row cultivation at the 10- to 12-leaf sugarbeet stage all improved escaped waterhemp control compared with ethofumesate preemergence (PRE) banded followed by repeat (3x) glyphosate plus ethofumesate applications at Blomkest and Moorhead in 2020 and 2021.
2. Treatment at the 10- to 12-leaf sugarbeet stage complemented herbicide applications applied at the PRE, 2- to 4-leaf, and 6- to 8-leaf sugarbeet stage.
3. Apply chloroacetamide herbicide mixtures with glyphosate and ethofumesate at the 2- to 4-leaf sugarbeet stage, even when following ethofumesate PRE.

Introduction

Sugarbeet growers use layered application of soil residual herbicides applied preemergence (PRE), early postemergence (EPOST), and postemergence (POST) to manage waterhemp in sugarbeet. These herbicides control waterhemp only after they are incorporated into the soil by rainfall. Soil residual herbicides do not control emerged weeds or weed escapes and must be addressed with the POST portion of a weed management program. Escaped waterhemp control is challenging since we currently do not have a POST herbicide effective for control of glyphosate-resistant waterhemp in sugarbeet.

We evaluated a series of 'ideas' to control waterhemp escapes in sugarbeet including inter-row applications of Liberty with the Redball™ 915 hooded sprayer (24c) and inter-row cultivation in 2020 as well as inter-row applications of Liberty or Gramoxone (not approved in sugarbeet) with the Redball™ 915 hooded sprayer, inter-row cultivation, and Ultra Blazer (Section 18) in 2021. The objective of these experiments was to evaluate sugarbeet tolerance and control of escaped glyphosate-resistant waterhemp using these alternative weed control methods.

Materials and Methods

Experiments were conducted on natural populations of waterhemp in a sugarbeet grower's field near Blomkest, MN in 2020 and 2021 and on our research farm near Moorhead, MN in 2020. The experimental area was prepared for planting by applying the appropriate fertilizer and conducting tillage across the experimental area at each location. Sugarbeet was seeded in 22-inch rows at approximately 63,500 seeds per acre with 4.5 inch spacing between seeds.

Herbicide treatments were designed to create waterhemp escapes in plots that would then be treated at the 10- to 12-leaf sugarbeet stage. Herbicide treatments were ethofumesate PRE broadcast or PRE band-applied followed by Dual Magnum mixtures with Roundup PowerMax plus ethofumesate POST applied at the 2-4 and 6-8 sugarbeet leaf stage. Preemergence broadcast and POST treatments were applied with a bicycle sprayer in 17 gpa spray solution through TeeJet 8002 XR-flat fan nozzles pressurized with CO₂ at 40 psi to the center four rows of six row plots 40 feet in length. Preemergence band treatments were applied in 11-inch strips over the center four rows of six row plots with a bicycle sprayer in 17 gpa spray solution through TeeJet 4002E nozzles pressurized with CO₂ at 40 psi.

Treatment for control of waterhemp escapes were applied at the 10- to 12-leaf sugarbeet stage and included: a) inter-row cultivation performed using a modified Alloway 3130 cultivator (Alloway Standard Industries, Fargo, ND) with 15-inch sweep shovels with a ground depth of 1.5- to 2-inch at 4 mph; b) inter-row application of Liberty or Gramoxone through TeeJet 8002 EVS nozzles pressurized with CO₂ at 40 psi with the Redball™ 915 hooded sprayer (Willmar Fabrication, LLC, Benson, MN) and c) broadcast application of Ultra Blazer applied with a bicycle sprayer in 17 gpa spray solution through TeeJet 8002 XR-flat fan nozzles pressurized with CO₂ at 40 psi. Herbicide treatments for 2020 experiment at Blomkest and Moorhead are found in Table 1 and herbicide treatments for the 2021 experiment at Blomkest are found in Table 2.

The Moorhead location was harvested in 2020. Sugarbeet were defoliated and the center two or three rows of each plot was harvested mechanically and weighed. Experimental design was randomized complete block with four replications. About a 20 lb. root sample was collected from each plot and analyzed for sucrose content and sugar loss to molasses by American Crystal Sugar Company (East Grand Forks, MN). Data from all experiments were analyzed with the ANOVA procedure of ARM, version 2021.2 software package.

Table 1. Herbicide treatment, herbicide rate, application method and application timing in 2020, Blomkest and Moorhead, MN.

Herbicide Treatment	Rate (fl oz/A)	Application timing (SGBT leaf stage)
Ethofumesate (broadcast) / Roundup PowerMax ¹ + ethofumesate / Roundup PowerMax + ethofumesate	96 / 28 + 4 / 28 + 4 / 22 + 4	PRE / 4 lf / 8 lf / 10-12 lf
Ethofumesate ² / Roundup PowerMax + ethofumesate / Roundup PowerMax + ethofumesate	48 / 28 + 4 / 28 + 4 / 22 + 4	PRE / 4 lf / 8 lf / 10-12 lf
Ethofumesate ² / Dual Magnum + Roundup PowerMax + ethofumesate / Liberty ³ Hooded sprayer	48 / 16 + 32 + 12 / 32	PRE / 4 lf / 10-12 lf
Ethofumesate ² / Dual Magnum + Roundup PowerMax + ethofumesate / Liberty Hooded sprayer	48 / 16 + 32 + 12 / 32	PRE / 8 lf / 10-12 lf
Ethofumesate ² / Dual Magnum + Roundup PowerMax + ethofumesate / Inter-row cultivation	48 / 16 + 32 + 12 / mechanical	PRE / 4 lf / 10-12 lf
Ethofumesate ² / Dual Magnum + Roundup PowerMax + ethofumesate / Inter-row cultivation	48 / 16 + 32 + 12 / mechanical	PRE / 8 lf / 10-12 lf

¹Roundup PowerMax + ethofumesate was applied with Destiny HC @ 1.5 pt/A + Amsol Liquid AMS at 2.5% v/v.

²Ethofumesate applied using a banded application.

³Liberty applied with Dry AMS at 3 lb/A.

Table 2. Herbicide treatment, herbicide rate, application method and application timing in 2021, Blomkest, MN.

Herbicide Treatment	Rate (fl oz/A)	Application timing (SGBT leaf stage)
Ethofumesate (broadcast) / Roundup PowerMax ¹ + ethofumesate / Roundup PowerMax + ethofumesate	48 / 28 + 4 / 28 + 4 / 22 + 4	PRE / 4 lf / 8 lf / 10-12 lf
Ethofumesate ² / Roundup PowerMax + ethofumesate / Roundup PowerMax + ethofumesate	48 / 28 + 4 / 28 + 4 / 22 + 4	PRE / 4 lf / 8 lf / 10-12 lf
Ethofumesate ² / Dual Magnum + Roundup PowerMax + ethofumesate / Liberty ³ Hooded sprayer	48 / 16 + 28 + 6 / 16 + 28 + 6 / 38	PRE / 4 lf / 8 lf / 10-12 lf
Ethofumesate ² / Dual Magnum + Roundup PowerMax + ethofumesate / Gramoxone 3.0 SL Hooded sprayer	48 / 16 + 28 + 6 / 16 + 28 + 6 / 24	PRE / 4 lf / 8 lf / 10-12 lf
Ethofumesate ² / Dual Magnum + Roundup PowerMax + ethofumesate / Inter-row cultivation	48 / 16 + 28 + 6 / 16 + 28 + 6 / mechanical	PRE / 4 lf / 8 lf / 10-12 lf
Ethofumesate ² / Dual Magnum + Roundup PowerMax + ethofumesate / Ultra Blazer + Roundup PowerMax ⁴	48 / 16 + 28 + 6 / 16 + 28 + 6 / 16 + 22	PRE / 4 lf / 8 lf / 10-12 lf

¹Roundup PowerMax + ethofumesate was applied with Destiny HC @ 1.5 pt/A + Amsol Liquid AMS at 2.5% v/v.

²Ethofumesate applied using a banded application.

³Liberty applied with Dry AMS at 3 lb/A.

⁴Ultra Blazer + Roundup PowerMax applied with Prefer 90 NIS @ 0.25% v/v + Amsol Liquid AMS at 2.5% v/v.

Results

Dual Magnum plus Roundup PowerMax and ethofumesate applied at the 2- to 4-lf stage provided waterhemp control greater than Dual Magnum plus Roundup PowerMax and ethofumesate applied at the 6- to 8-lf stage at Blomkest and Moorhead in 2020 (data not presented). Both treatments followed ethofumesate PRE in an 11-inch band at 6 pt/A in the treated area.

Results will focus on control of escaped waterhemp with inter-row cultivation, Roundup PowerMax mixed with ethofumesate, and inter-row application of Liberty with the hooded sprayer at the 10- to 12-lf stage. These POST treatments followed either ethofumesate PRE (broadcast or in a band application) and repeat applications of Roundup PowerMax plus ethofumesate, or ethofumesate PRE in a band followed by Dual Magnum plus Roundup PowerMax and ethofumesate applied at the 2- to 4-lf stage.

We observed sugarbeet injury ranging from 5% to 18%, 39 days after planting (DAP) at Blomkest in 2020 (Table 3). Injury was random within plots and seemed to be related to field variation caused by dry soil conditions; not herbicide treatment. Waterhemp control was greater than 85% across treatments at 47 DAP. Ethofumesate PRE in a band application tended to provide less control than ethofumesate PRE as a broadcast application when followed by Roundup PowerMax plus ethofumesate as well as ethofumesate PRE in a band application when followed by Dual Magnum plus Roundup PowerMax and ethofumesate. However, early season control was generally good across all treatments.

Table 3. Sugarbeet injury and waterhemp control in response to PRE and EPOST herbicides, and POST treatment control of escaped waterhemp 8 and 17 DAT, Blomkest, MN, 2020.^a

PRE / EPOST Herbicide Treatment ^b	Sgbt inj ^b Wahe ^b Control		POST Treatment ^b	Wahe Control	
	39 DAP ^c	47 DAP		8 DAT ^c	17 DAT
	-----%-----			-----%-----	
Etho (broadcast) / PM + etho / PM + etho	18	100 a	Roundup PowerMax + etho	99 a	99 a
Etho (band) / PM + etho / PM + etho/	11	89 b	Roundup PowerMax + etho	69 b	79 b
Etho (band) / Dual + PM + etho / Dual + PM + etho	5	96 ab	Liberty with Redball™ 915 hooded sprayer	93 a	91 a
Etho (band) / Dual + PM + etho / Dual + PM + etho	18	100 a	Inter-row cultivation	100 a	99 a
LSD (0.10)	NS	8		10	11

^aMeans within a column not sharing any letter are significantly different by the LSD at the 10% level of significance.

^betho = ethofumesate; PM = Roundup PowerMax; Dual = Dual Magnum; sgbt inj=sugarbeet injury; wahe = waterhemp.

^cDAP = days after plant; DAT = days after treatment.

Greater than 90% control of up to 6-inch escaped waterhemp was observed from the POST application of Roundup PowerMax plus ethofumesate, Liberty with the hooded sprayer, or with inter-row cultivation when following ethofumesate applied PRE broadcast. Control from these POST treatments was significantly greater than Roundup PowerMax plus ethofumesate when following ethofumesate PRE applied in the band. These results support the idea of controlling escaped waterhemp using either the hooded sprayer or inter-row cultivation.

Sugarbeet injury was negligible in the Moorhead experiment in 2020 (data not presented). Waterhemp control at 28 DAP was greater than 80% (Table 4). Control of escaped waterhemp was greatest with inter-row cultivation. Waterhemp control was least with inter-row application of Liberty with the hooded sprayer or from ethofumesate PRE band-applied followed by three Roundup PowerMax plus ethofumesate applications. No differences were observed in sugarbeet root yield (data not presented), % sucrose, or recoverable sucrose per acre. However, recoverable sucrose per acre following waterhemp control with cultivation tended to be greater than recoverable sucrose from other treatments.

Table 4. Waterhemp control 28 DAP in response to PRE and EPOST treatments, and POST treatment control of escaped waterhemp 16 DAT and yield parameters in response to POST treatment, Moorhead, MN, 2020^a.

PRE / EPOST Herbicide Treatment ^b	Wahe ^b Control	POST Treatment ^b	Wahe Control	Sugarbeet Yield	
	28 DAP ^c		16 DAT ^c	Sucrose	Rec. Suc. ^b
	---%---		-----%-----	---lb/A---	
Etho (broadcast) / PM + etho / PM + etho	89 ab	Roundup PowerMax + etho	84 b	13.6	6,555
Etho (band) / PM + etho / PM + etho/	81 b	Roundup PowerMax + etho	76 bc	13.3	6,796
Etho (band) / Dual + PM + etho / Dual + PM + etho	91 a	Liberty with Redball™ 915 hooded sprayer	68 c	13.5	6,425
Etho (band) / Dual + PM + etho / Dual + PM + etho	95 a	Inter-row cultivation	99 a	13.7	6,952
LSD (0.10)	8		13	NS	NS

^aMeans within column not sharing any letter are significantly different by the LSD at the 10% level of significance.

^betho = ethofumesate; PM = Roundup PowerMax; Dual = Dual Magnum; wahe = waterhemp, Rec. Suc. = recoverable sucrose.

^cDAP = days after plant; DAT = days after treatment.

Inter-row cultivation controlled 2- to 4-inch escaped waterhemp at Blomkest (Table 3) and Moorhead (Table 4) in 2020. Inter-row application of Liberty with the hooded sprayer controlled escaped waterhemp at Blomkest but not at

Moorhead. Inconsistent results with the hooded sprayer may have been related to an equipment malfunction at Moorhead rather than the herbicide treatment.

Planned program treatments applied PRE, EPOST, and POST caused negligible sugarbeet injury and provided similar waterhemp control 40 DAP at Blomkest in 2021 (Table 5). Waterhemp control ranged from 75% to 94% with ethofumesate PRE broadcast followed by Roundup PowerMax plus ethofumesate applied at the 4- and 8-lf stages giving the greatest waterhemp control.

Table 5. Waterhemp control 40 DAP in response to PRE and EPOST treatments and POST treatments control of escape waterhemp 2 and 24 DAT, Blomkest, MN, 2021.^a

PRE / EPOST Herbicide Treatment ^b	Sggt Inj. ^b	Wahe ^b Control	POST Treatment ^b	Sggt Inj.	Wahe Control	
	40 DAP ^c	40 DAP		16 DAT ^c	2 DAT	24 DAT
	-----%-----			-----%-----		
Etho (broadcast) / PM + etho / PM + etho	0	94	Roundup PowerMax + etho	0 b	79 bc	78 bc
Etho (band) / PM+etho / PM+etho/	0	79	Roundup PowerMax + etho	0 b	73 c	70 c
Etho (band) / Dual+PM+etho / Dual+PM+etho	4	75	Liberty with Redball™	3 b	75 c	86 ab
Etho (band) /Dual+PM+etho / Dual+PM+etho	4	79	915 hooded sprayer Gramoxone with Redball™ 915	3 b	90 ab	87 ab
Etho (band) / Dual+PM+etho / Dual+PM+etho	4	78	hooded sprayer Inter-row cultivation	0 b	96 a	93 a
Etho (band) / Dual+PM+etho / Dual+PM+etho	0	85	Ultra Blazer+PM+ NIS+ AMS	18 a	81 bc	90 ab
LSD (0.10)	NS	NS		9	14	13

^aMeans within a column not sharing any letter are significantly different by the LSD at the 10% level of significance.

^betho = ethofumesate; PM = Roundup PowerMax; Dual = Dual Magnum; sggt Inj. = sugarbeet injury; wahe = waterhemp.

^cDAP = days after plant; DAT = days after treatment.

Inter-row application of Gramoxone with the Redball 915 hooded sprayer or inter-row cultivation provided immediate control of 90% and 96%, respectively, 3- to 12-inch escaped waterhemp at 2 DAT. Waterhemp control from Gramoxone via the hooded sprayer was similar to Ultra Blazer plus Roundup PowerMax and similar to Roundup PowerMax plus ethofumesate when following ethofumesate broadcast PRE. Escaped waterhemp control from Gramoxone with the hooded sprayer, inter-row cultivation, Ultra Blazer plus Roundup PowerMax, and Liberty with the hooded sprayer was or tended to be greater than waterhemp control from Roundup PowerMax plus ethofumesate at 24 DAT.

Conclusions

Waterhemp control challenges in sugarbeet is forcing agriculturalists to reconsider weed management strategies and evaluate 10- to 12-lf sugarbeet growth stage treatments. Escaped waterhemp did not reduce yield (Moorhead, 2020) but produced seed that developed into a production challenge for crops grown in sequence with sugarbeet. This research found there are multiple useful tools to control escaped waterhemp including inter-row cultivation, the hooded sprayer, and Ultra Blazer.

A secondary outcome of these experiments was applying ethofumesate PRE in an 11-inch band. This application method could be utilized to save money while maintaining waterhemp control, especially if the producer is using layered residuals or herbicides applied at the 2- to 4- and 6- to 8-lf stage in sugarbeet. Also, observations suggest that the first in-season chloroacetamide application should be timed to 2- to 4-lf stage sugarbeet, even if ethofumesate PRE is applied.