OPTIMINZING WATERHEMP CONTROL WITH FALL APPLIED RESIDUAL HERBICIDES

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Summary

1. Dual Magnum fall applied at 2 pt/A or Eptam fall applied and incorporated at 5 pt/A when soil temperature at a 4-inch depth is less than 55F and falling.
2. Chloroacetamide herbicides applied POST to sugarbeet are required regardless of fall or spring PRE application.

Introduction

We have previously discussed inconsistency with ethofumesate. We attribute this to two chemical properties related to ethofumesate. First, ethofumesate has a K_{OC} value two-fold greater with than Outlook herbicide (dimethenamid-P) another chloroacetamide herbicide. K_{OC} is a chemical property measuring how strongly herbicide binds to organic matter in the soil compared to how much remains dissolved in soil water. Stated another way, ethofumesate binds tightly to organic matter and is less prone to leaching. Second, Outlook water solubility is 10 times greater than ethofumesate indicating moderate to high mobility in soil depending on soil organic matter content. It means ethofumesate likes to be attached to organic matter and takes a lot of rain to break loose.

Ways to improve ethofumesate consistency includes increasing the ethofumesate use rate, increasing water volume at application, and incorporating ethofumesate with tillage equipment. However, we wonder if we are incorporating the best group 15 herbicide if we activate with tillage and wonder if Eptam (EPTC) or Ro-Neet (cycloate) might be better candidates. Results from 2024 experiments suggest visible sugarbeet injury was greater when Eptam or Ro-Neet was applied at planting followed with the layby program as compared to ethofumesate PRE followed with the layby program (Peters and Aberle 2025). Further, waterhemp control was similar with both herbicide treatments.

It has been suggested we try fall application to improve waterhemp control (ethofumesate) or improve sugarbeet safety (Eptam). Eptam was applied on 71%, 54% and 40% of the acreage in 1982, 1983, and 1984, respectively, and fall applied Eptam accounted for 79%, 61% and 62% of the applied Eptam during those same years. The objectives of this experiment were a) to evaluate fall vs. spring applied Eptam, *S*-metolachlor and ethofumesate and b) to evaluate Eptam applied in a program approach with Outlook and Warrant as compared to ethofumesate or *S*-metolachlor, our current waterhemp control standard.

Materials and Methods

Experiments were initiated near Renville and Moorhead, MN and Hickson, North Dakota in October and November 2024 depending on location. The experimental area was prepared for fall herbicide application using a chisel plow for primary tillage followed by a field cultivator. At Renville, Eptam was applied and immediately incorporate to the appropriate depth. Once completed, the experimental area was tilled a second time to a 2-inch depth. At Hickson and Moorhead, Eptam was applied and the experimental area was tilled to properly incorporate Eptam and to provide uniform tillage treatment across the experimental area. Fall applied ethofumesate and Dual Magnum were applied after tillage (Table 1).

Eptam was applied similarly in the spring as the fall. After application, the experimental area was uniformly tilled to a 2-inch depth to remove emerged vegetation and to create a seedbed for planting. Sugarbeet was planted May 4 at Moorhead, May 6 at Renville, and May 7 at Hickson in 22-inch rows at approximately 63,500 seeds per acre with 4.5 inch spacing between seeds. Preemergence herbicides were applied immediately after planting. Postemergence herbicides were applied at the 2- and 6-lf stage.

Visible sugarbeet growth reduction injury was evaluated using a 0 to 99% scale (0 is no visible injury and 99 is complete loss of sugarbeet stand) and visible waterhemp control was evaluated using a 0 to 99 scale (0 is no control and 99 is complete control). We focused on sugarbeet growth reduction evaluation at Renville since weed pressure was light. Notes were collected until excessive rainfall flooded the experimental area in June. Waterhemp control

Table 1. Herbicide treatment, herbicide rate, application timing.

Trt Num	Herbicide Treatment[a,b]	Rate	Sugarbeet Stage[c]
		(pt or fl oz /A)	(lvs)
1	Ethofumesate + Dual Magnum / Outlook + RUPM3 + etho / Warrant + RUPM3 + etho	3 + 0.75 / 12 + 25 + 6 / 3 + 25 + 6	PRE/EPOST/ POST
2	Dual Magnum / RUPM3 + etho / RUPM3 + etho	2 / 25 + 6 / 25 + 6	Fall / 2 / 6
3	Ethofumesate / RUPM3 + etho / RUPM3 + etho	7.5 / 25 + 6 / 25 + 6	Fall / 2 / 6
4	Eptam / RUPM3 + etho / RUPM3 + etho	5 / 25 + 6 / 25 + 6	Fall / 2 / 6
5	Dual Magnum / Outlook + RUPM3 + etho / Warrant + RUPM3 + etho	2 / 12 + 25 + 6 / 3 + 25 + 6	Fall / 2 / 6
6	Ethofumesate / Outlook + RUPM3 + etho / Warrant + RUPM3 + etho	7.5 / 12 + 25 + 6 / 3 + 25 + 6	Fall / 2 / 6
7	Eptam / Outlook + RUPM3 + etho / Warrant + RUPM3 + etho	5 / 12 + 25 + 6 / 3 + 25 + 6	Fall / 2 / 6
8	Eptam / ethofumesate/ Outlook + RUPM3 + etho / Warrant + RUPM3 + etho	5 / 4 / 12 + 25 + 6 / 3 + 25 + 6	Fall / PRE / 2 / 6
9	Dual Magnum / RUPM3 + etho / RUPM3 + etho	0.75 / 25 + 6 / 25 + 6	PRE / 2 / 6
10	Ethofumesate / RUPM3 + etho / RUPM3 + etho	6 / 25 + 6 / 25 + 6	PRE / 2 / 6
11	Eptam / RUPM3 + etho / RUPM3 + etho	2.5 / 25 + 6 / 25 + 6	Spring / 2 / 6

[a]Abbreviations, etho = ethofumesate; RUPM3 = Roundup PowerMax3
[b]Roundup PowerMax3 plus ethofumesate with non-ionic surfactant and Amsol liquid AMS at 0.25% + 2.5% v/v. PowerMax3 plus ethofumesate and either Outlook or Warrant with HSMOC and Amsol liquid AMS at 1 pt/A and 2.5% v/v.
[c]Fall=fall application, before or after tillage; Spring=spring application before tillage; PRE=after planting; 2=2-lf sugarbeet stage; 6=6-lf sugarbeet stage.

was collected at Hickson and Moorhead. Unfortunately, we were unable to collect sugarbeet injury at Hickson since sugarbeet stands were compromised by seed quality. Experiment was a randomized complete block design and 4 reps. Experiments were analyzed using Agricultural Research Manager (ARM) Revision 2025.5.

Results

We observed sugarbeet injury 36 days after planting (DAP) from treatments containing Outlook and Warrant applied at the 2- and 6-lf stage (Table 2). Injury was the same from Dual Magnum, ethofumesate, or Eptam fall applied in 2024 or ethofumesate mixed with Dual Magnum and applied preemergence in spring 2025. Sugarbeet injury was negligible with 2-times Roundup PowerMax3 application following fall applied Dual Magnum, ethofumesate or Eptam or Dual Magnum, ethofumesate or Eptam spring applied. Rain events on June 12, June 14, June 24, June 25 and June 28 caused flooding damage in replications one and two and caused unacceptable variability in replications three and four at the Renville location.

Waterhemp control was evaluated approximately weekly following Warrant application over 6- to 8-lf sugarbeet at Hickson and Moorhead. In general, Dual Magnum, ethofumesate, and Eptam followed by 2-times Roundup PowerMax3 treatments gave similar waterhemp control when applied in the fall and in the spring (Figure 1).

Table 2. Sugarbeet visible growth reduction injury in response to herbicide treatment, Renville MN 2025.[a]

Herbicide treatment[b]	Rate	Sugarbeet stage	24 DAP	36 DAP
	(pt/A)	Timing	(%)	(%)
Etho + Dual Magnum / Outlook / Warrant	3 + 0.75 / 0.75 / 3	PRE / EPOST / POST	23	24 a
Dual Magnum	2	Fall	10	5 b
Ethofumesate	7.5	Fall	5	5 b
Eptam	5	Fall	13	9 b
Dual Magnum / Outlook / Warrant	2 / 0.75 / 3	Fall / 2lf / 6lf	20	21 a
Etho / Outlook / Warrant	7.5 / 0.75 / 3	Fall / 2lf / 6lf	13	24 a
Eptam / Outlook / Warrant	5 / 0.75 / 3	Fall / 2lf / 6lf	15	24 a
Eptam / Etho / Outlook / Warrant	5 / 4 / 0.75 / 3	Fall / PRE / 2lf / 6lf	18	23 a
Dual Magnum	0.75	PRE	3	3 b
Ethofumesate	6	PRE	5	5 b
Eptam	2.5	Spring	15	8 b
LSD (0.10)			NS	9

[a]Sugarbeet injury followed by the same alphabetical letter indicates non-statistical differences between treatments at the 0.10 alpha level.
[b]Roundup PowerMax3 plus ethofumesate with non-ionic surfactant and Amsol liquid AMS at 0.25% + 2.5% v/v POST at V2 and V6 followed treatment. High surfactant methylated seed oil (HSMOC) at 1 pt/A was mixed with Roundup PowerMax3, ethofumesate and either Outlook or Warrant and Amsol liquid AMS.
[c]Abbreviations: etho=ethofumesate

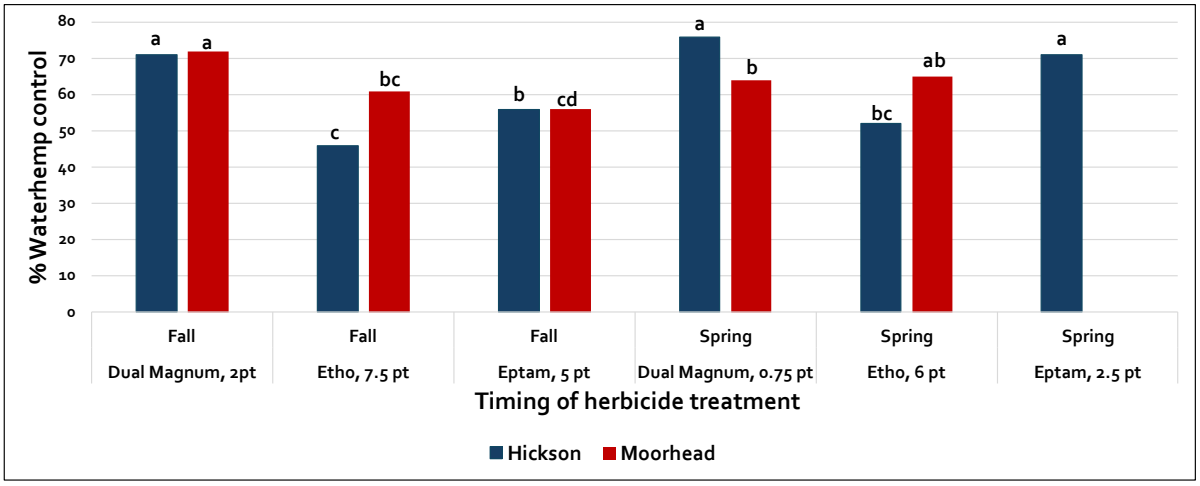

Figure 1. Waterhemp control in response to fall or spring applied treatment, 71 and 73 DAP, Hickson, ND and Moorhead, MN, 2025. Treatments sharing the same letter are the same at the 0.10 alpha level. All treatments contained 2-times Roundup PowerMax3 mixed with ethofumesate at the 2- and 6-lf stage.

However, what stands out is the consistency across locations from Dual Magnum, spring and fall applied. Waterhemp control from ethofumesate tended to be better at Moorhead than Hickson. Ethofumesate fall applied did not improve waterhemp control as compared to spring application. Eptam followed by 2-times Roundup PowerMax3 also appeared to provide consistent waterhemp control but control was less than Dual Magnum with fall application. We misapplied the Eptam spring application at Moorhead. Dual Magnum, Eptam and ethofumesate followed by 2-times Roundup POST treatments averaged 60% from fall application and 66% from spring applications.

Fall applied herbicides followed by the layby program was compared to our commercial standard, Dual Magnum plus ethofumesate followed by Outlook and Roundup PowerMax3 at the 2-lf stage and Warrant at the 6-lf stage standard (Figure 2). Fall applied Eptam, ethofumesate and Dual Magnum followed by Outlook mixed with Roundup PowerMax3 at the 2-lf stage and Warrant mixed with Roundup PowerMax3 provided waterhemp control similar to our Dual Magnum plus ethofumesate followed by Outlook and Roundup PowerMax3 at the 2-lf stage and Warrant at the 6-lf stage standard (Figure 2). Waterhemp control at Moorhead was better than Hickson but exceeded 90% with the exception of ethfomesate fall applied followed by the spring layby program at Hickson.

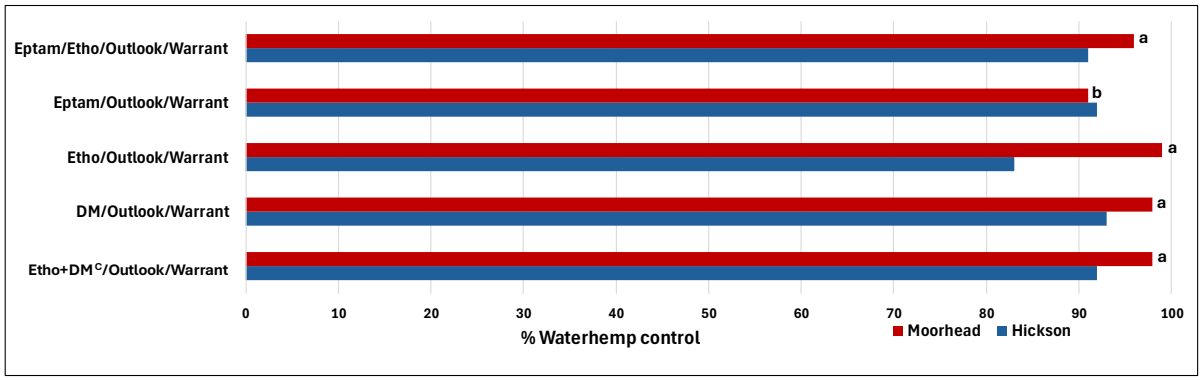

Figure 2. Waterhemp control in response to fall fb spring soil residual herbicides, Moorhead MN and Hickson ND, 2025. Treatments sharing the same letter are the same at the 0.10 alpha level. All treatments contained 2-times Roundup PowerMax3 mixed with ethofumesate at the 2- and 6-lf stage. Etho+DM was applied in the spring as a pre-emerge. All other treatments were fall applied.

Discussion

We observed lack of consistency with ethofumesate across locations when 2-times Roundup PowerMax 3 followed ethofumesate or when Outlook mixed with Roundup PowerMax3 at the 2-lf stage and Warrant mixed with Roundup PowerMax3 at the 6-lf stage. This is consistent with grower experiences. We observed more sugarbeet injury when chloroacetamide herbicides followed soil residual herbicides. There was no difference in sugar beet injury between fall and spring applied soil residual herbicides.

We recommend delaying the fall application for cool temperatures to reduce microbial degradation. Logic would indicate that delay may cause sugar beet injury in the spring. We are not certain that fall application replaces an at planting application. We also don't understand the accumulative effect of multiple soil residual herbicide applications on sugarbeet safety.

Literature Cited

Peters TJ, Aberle Adam (2025) Integrating Ro-Neet and Eptam Back into the Waterhemp Control Program in Sugarbeet. Sugarbeet Res. Ext. Rept. 55:12-17