

# WEED CONTROL FROM ETHOFUMESATE APPLIED POSTEMERGENCE IN SUGARBEET

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## SUMMARY

1. Ethofumesate applied postemergence (POST) twice at rates ranging from 12 to 64 fl oz/A suppressed but did not control lambsquarters and redroot pigweed. Ethofumesate POST is not an effective lambsquarters or pigweed herbicide and cannot be considered a second mode of action for control.
2. Ethofumesate alone or ethofumesate plus glyphosate improved waterhemp control compared to glyphosate alone. Control might be related to timing of waterhemp germination and emergence compared to lambsquarters or redroot pigweed.
3. Ethofumesate applied twice at rates ranging from 12 to 64 fl oz/A alone or with glyphosate at 28 fl oz/A caused only minor sugarbeet injury.

## INTRODUCTION

Ethofumesate is a time-proven herbicide for grass and small-seeded broadleaf weed control in sugarbeet. Field research from Kansas and Colorado in 1970 indicated 'NC 8438' (ethofumesate) provided greater than 90% green foxtail, foxtail millet, and barnyardgrass control and near 90% redroot pigweed control (Sullivan and Fagala, 1970). Ethofumesate is soil-applied at field use rates up to 7.5 pt/A or applied postemergence up to 12 fl oz/A.

Ethofumesate is absorbed by emerging shoots and roots and is translocated to the shoots where it is believed to interfere with lipid biosynthesis (Eshel et al., 1978, Abulnaja et al., 1992). Ethofumesate is sold in the United States using the trade names 'Nortron' by Bayer CropScience, 'Ethotron SC' by UPI, and 'Ethofumesate 4SC' by Willowood USA. Willowood USA is collaborating with the Beet Sugar Development Foundation to develop a new label to expand Ethofumesate 4SC postemergence use rates from 0.8 to 8 pt/A to sugarbeet having greater than two true leaves. Ethofumesate applied in combination with glyphosate may provide an effective second mode of action to complement glyphosate, especially for difficult to control broadleaf weeds in sugarbeet including common lambsquarters, kochia, waterhemp, and common ragweed. However, little is known about postemergence broadleaf weed control from ethofumesate, especially at rates greater than 12 fl oz/A.

Probe experiments were conducted in 2017 to evaluate weed efficacy and sugarbeet safety from single or multiple ethofumesate applications alone or with glyphosate applied postemergence. These probe experiments will serve as a basis for Mrs. Alexa Lystad's MS degree research and will provide recommendations for use of ethofumesate for weed control in sugarbeet grower fields in 2018. The objectives of this research were to determine: a) is ethofumesate safe to sugarbeet; and b) does ethofumesate control weeds?

## MATERIALS AND METHODS

Experiments were conducted on indigenous populations of common lambsquarters and redroot pigweed in sugarbeet grower fields near Moorhead and Oslo, Minnesota and Grand Forks, Minto, and Prosper, North Dakota in 2017. Experimental area was prepared with a Kongskilde 's-tine' field cultivator equipped with rolling baskets or with grower cooperater tillage equipment before planting. Experiments were established in fields in 1 or 2 days after grower cooperater planted field to sugarbeet. Herbicide treatments were applied when sugarbeet was at the 2-1f and 6-leaf stage with a bicycle wheel sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with CO<sub>2</sub> at 40 psi to the center four rows of six row plots 30 feet long. Treatments consisted of two applications of ethofumesate at 6, 12, 18, 24, 32 and 64 fl oz/A either alone or with glyphosate at 28 fl oz/A. All treatments of ethofumesate alone contained Destiny HC at 1.5 pt/A. Treatments of ethofumesate plus Roundup PowerMax (glyphosate) contained Destiny HC at 1.5 pt/A plus N-Pak ammonium sulfate at 2.5% v/v. Destiny HC and N-Pak AMS were provided by Winfield United.

Sugarbeet injury and common lambsquarters and/or redroot pigweed control were a visual estimate of percent fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Experimental design was

randomized complete block with 4 replications. Data were analyzed with the ANOVA procedure of ARM, version 2017.4 software package.

## RESULTS

Common lambsquarters control from two postemergence applications of ethofumesate ranged from 0 to 78% across rates and locations (Table 1). Lambsquarters control averaged across ethofumesate rates alone ranged from 27% at Prosper to 49% at Minto. Lambsquarters control generally increased as ethofumesate rate increased from 6 to 64 fl oz/A. However, lambsquarters control was not adequate at any rate within location or at any location for ethofumesate to be considered a stand-alone herbicide for controlling lambsquarters.

Lambsquarters control from two applications of Roundup PowerMax (glyphosate) at 28 fl oz/A was 70% and 90% at Moorhead and Oslo, respectfully. Ethofumesate + glyphosate tended to improve lambsquarters control compared to ethofumesate or glyphosate alone.

**Table 1. Common lambsquarters control, 27 to 48 DAT, at Moorhead and Oslo, MN and Grand Forks, Minto, and Prosper, ND, 2017**

Treatment <sup>1</sup>	Rate	Application timing <sup>2</sup>	Moorhead	Oslo	Grand	Minto	Prosper
			MN	MN	Forks ND	ND	ND
	fl oz/A		-----% control-----				
Ethofumesate / Ethofumesate	6 / 6	A / B	20	20	0	25	13
Ethofumesate / Ethofumesate	12 / 12	A / B	28	35	28	40	15
Ethofumesate / Ethofumesate	18 / 18	A / B	35	38	30	48	30
Ethofumesate / Ethofumesate	24 / 24	A / B	35	40	43	60	33
Ethofumesate / Ethofumesate	32 / 32	A / B	50	40	53	55	35
Ethofumesate / Ethofumesate	64 / 64	A / B	53	58	78	63	33
PowerMax <sup>3</sup> / PowerMax	28 / 28	A / B	70	90	100	98	95
Etho + PMax / Etho + PMax	6 + 28/6 + 28	A / B	78	98	100	90	100
Etho + PMax / Etho + PMax	12 + 28/12 + 28	A / B	78	94	100	98	100
Etho + PMax / Etho + PMax	18 + 28/18 + 28	A / B	70	100	100	95	100
Etho + PMax / Etho + PMax	24 + 28/24 + 28	A / B	78	100	100	100	100
Etho + PMax / Etho + PMax	32 + 28/32 + 28	A / B	78	99	100	100	100
Etho + PMax / Etho + PMax	64 + 28/64 + 28	A / B	83	99	100	100	100
<b>LSD (0.05)</b>			<b>10</b>	<b>10</b>	<b>10</b>	<b>12</b>	<b>11</b>

<sup>1</sup>Treatments of Ethofumesate + Roundup PowerMax were applied with N-Pak AMS at 2.5% v/v and Destiny HC at 1.5 pt/A; Ethofumesate was applied with Destiny HC at 1.5 pt/A

<sup>2</sup>Application timing A=2 lf sugarbeet; B= 6 lf sugarbeet

<sup>3</sup>PowerMax or PMax=Roundup PowerMax; Etho=ethofumesate

Redroot pigweed control from ethofumesate was evaluated at Minto and Prosper, ND and Oslo, MN. Pigweed control ranged from 15% to 70% across ethofumesate rates and locations (Table 2). Pigweed control averaged across ethofumesate rates was 34%, 22%, and 41%, at Oslo, Minto, and Prosper, respectfully, or similar to lambsquarters control. As with lambsquarters, ethofumesate applied postemergence is not an effective stand-alone herbicide for controlling redroot pigweed.

Waterhemp control from ethofumesate at Moorhead was a different story than redroot pigweed or lambsquarters. Waterhemp control ranged from 95% from two applications of ethofumesate at 12 fl oz/A to 100% control from two applications at 32 fl oz/A. Waterhemp control tended to increase as the ethofumesate rate increased from 6 to 64 fl oz/A. Waterhemp control from ethofumesate was superior to control from glyphosate.

Differences in broadleaf control from ethofumesate might be related to weed species emergence patterns and application timing. We know the number of growing degree days to trigger lambsquarters and redroot pigweed germination and emergence is much less (lambsquarters) to less (redroot pigweed) than waterhemp (Werle, 2014). Also, since we know that ethofumesate does not translocate from treated leaves to new tissue in emerged vegetation (Eshel, 1978), then it is likely that ethofumesate applied postemergence does little to control emerged weeds but is effective on later flushes once activated by precipitation.

**Table 2. Redroot pigweed and waterhemp (Moorhead) control, 30 to 41DAT, at Moorhead and Oslo, MN and Minto, and Prosper, ND, 2017**

Treatment <sup>1</sup>	Rate	Application timing <sup>2</sup>	Waterhemp		Redroot pigweed	
			Moorhead MN	Oslo MN	Minto ND	Prosper ND
	fl oz/A		-----% control-----			
Ethofumesate / Ethofumesate	6 / 6	A/ B	83	25	15	23
Ethofumesate / Ethofumesate	12 / 12	A/ B	95	35	15	28
Ethofumesate / Ethofumesate	18 / 18	A/ B	95	33	18	38
Ethofumesate / Ethofumesate	24 / 24	A/ B	98	28	20	40
Ethofumesate / Ethofumesate	32 / 32	A/ B	100	33	25	45
Ethofumesate / Ethofumesate	64 / 64	A/ B	99	50	40	70
PowerMax <sup>3</sup> / PowerMax	28 / 28		68	93	95	100
Etho + PMax / Etho + PMax	6 + 28/6 + 28	A/ B	95	100	90	100
Etho + PMax / Etho + PMax	12 + 28/12 + 28	A/ B	98	95	95	100
Etho + PMax / Etho + PMax	18 +28/18 + 28	A/ B	100	100	93	100
Etho + PMax / Etho + PMax	24 +28/24 + 28	A/ B	100	100	90	100
Etho + PMax / Etho + PMax	32 +28/32 + 28	A/ B	100	99	94	100
Etho + PMax / Etho + PMax	64 +28/64 + 28	A/ B	100	100	98	100
<b>LSD (0.05)</b>			<b>8</b>	<b>10</b>	<b>8</b>	<b>15</b>

<sup>1</sup>Treatments of Ethofumesate + Roundup PowerMax were applied with N-Pak AMS at 2.5% v/v and Destiny HC at 1.5 pt/A; Ethofumesate was applied with Destiny HC at 1.5 pt/A

<sup>2</sup>Application timing A=2 lf sugarbeet; B= 6 lf sugarbeet

<sup>3</sup>PowerMax or PMax=Roundup PowerMax; Etho=ethofumesate

Sugarbeet injury from two applications of ethofumesate alone was negligible across locations in these experiments (Table 3). Sugarbeet injury was negligible even when ethofumesate rate increased from 6 to 64 fl oz/A. Sugarbeet injury from ethofumesate plus glyphosate was similar to injury from either ethofumesate or glyphosate alone.

**Table 3. Sugarbeet injury, 27 to 48 DAT, at Moorhead and Oslo, MN and Grand Forks, Minto, and Prosper, ND, 2017**

Treatment <sup>1</sup>	Rate	Application timing <sup>2</sup>	Moorhead	Oslo	Grand	Minto	Prosper
			MN	MN	Forks ND	ND	ND
	fl oz/A		-----% injury-----				
Ethofumesate / Ethofumesate	6 / 6	A/ B	8	3	0	0	3
Ethofumesate / Ethofumesate	12 / 12	A/ B	0	5	0	0	0
Ethofumesate / Ethofumesate	18 / 18	A/ B	3	3	0	0	3
Ethofumesate / Ethofumesate	24 / 24	A/ B	3	3	0	0	3
Ethofumesate / Ethofumesate	32 / 32	A/ B	3	3	3	5	0
Ethofumesate / Ethofumesate	64 / 64	A/ B	3	8	0	0	10
PowerMax / PowerMax	28 / 28	A / B	0	3	0	0	3
Etho + PMax / Etho + PMax	6 + 28/6 + 28	A/ B	3	5	0	0	0
Etho + PMax / Etho + PMax	12 + 28/12 + 28	A/ B	3	3	0	3	0
Etho + PMax / Etho + PMax	18 +28/18 + 28	A/ B	0	3	0	3	3
Etho + PMax / Etho + PMax	24 +28/24 + 28	A/ B	7	5	3	0	8
Etho + PMax / Etho + PMax	32 +28/32 + 28	A/ B	13	5	0	0	0
Etho + PMax / Etho + PMax	64 +28/64 + 28	A/ B	5	10	5	3	8
<b>LSD (0.05)</b>			<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

<sup>1</sup>Treatments of Ethofumesate + Roundup PowerMax were applied with N-Pak AMS at 2.5% v/v and Destiny HC at 1.5 pt/A; Ethofumesate was applied with Destiny HC at 1.5 pt/A

<sup>2</sup>Application timing A=2 lf sugarbeet; B= 6 lf sugarbeet

<sup>3</sup>PowerMax or PMax=Roundup PowerMax; Etho=ethofumesate

## **LITERATURE CITED**

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