SUGAR BEET RESPONSE AND WEED CONTROL WITH GOLTIX® GOLD (METAMITRON) ALONE OR IN TANK-MIXES WITH OTHER HERBICIDES

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Introduction

The evolution of herbicide-resistant weeds presents a challenge to weed management in the Treasure Valley of eastern Oregon and southwestern Idaho. Poor weed control with glyphosate (Roundup and similar products) is likely to result in reduced sugar beet yields. Preliminary results suggested outstanding control of common lambsquarters and pigweeds with metamitron herbicide.

The herbicide metamitron is marketed in Europe and other countries as Goltix® Gold for control of certain broadleaf weeds in fodder beet, sugar beet, red beet, and mangolds (ADAMA, 2020). Metamitron is coded ADA 46343 for evaluation in the United States. It is believed that metamitron will eventually be marketed in the United States as a premixture with ethofumesate (the active ingredient in Nortron®) for weed control in sugar beet. The premixture of metamitron plus ethofumesate is already being marketed in Europe and other countries as Torero® for weed management in sugar beet. Torero works both as a pre-emergence and post-emergence product to control susceptible weeds.

Metamitron belongs to a triazinone family of herbicides (WSSA/HRAC group 5) and thus it disrupts photosynthetic activities (PS II inhibitor) in susceptible plants. The premix partner, ethofumesate, belongs to the benzofurans family of herbicides (WSSA/HRAC group 15), which inhibits very-long-chain fatty acids in plants. The European labels recommend Torero use not to exceed 5.1 pt/acre (3.75 lb ai/acre) per season. Split applications involving pre-emergence and post-emergence or sequential post-emergence applications are recommended. The label suggests metamitron effectiveness on weed seedlings at the cotyledon stage.

The objectives of this study were to evaluate the response of sugar beet and weed control to metamitron alone and in tank-mixes with ethofumesate.

Materials and Methods

The study was conducted in 2020 at the Malheur Experiment Station, Ontario, Oregon, in a field previously planted to wheat. During fall 2019, the wheat stubble was flailed, the field was irrigated, disked several passes, plowed, and groundhogged. Based on the soil analysis during fall of 2019, fertilizer was applied to supply 100 lb/acre nitrogen (N), 100 lb/acre phosphorus, 100 lb/acre elemental sulfur, 9 lb/acre manganese, and 2 lb/acre boron. Thereafter, the area was fumigated using Vapam® at 15 gal/acre and beds were formed on 22-inch spacing.

Beds were harrowed on April 7, 2020, and seeds of the sugar beet hybrid 'BTS 251 RR' were planted on April 17, 2020. Pre-emergence herbicide treatments were applied on April 20, and post-emergence treatments were applied on June 3 using a CO_2-pressurized backpack sprayer fitted with a boom equipped with four EVS8002 flat-fan nozzles to provide a spray volume of 20 gal/acre. Because metamitron does not control grassy weeds, the study area was sprayed with the herbicide Poast® at 1.5 pt/acre on May 13.

The experiment followed a randomized complete-block design with 12 treatments (including an untreated control) and four replicates. Each plot was 7.33 ft wide (4 beds) and 27 ft long. Herbicide treatments are indicated in Tables 1 to 3.

The study was furrow irrigated based on calendar schedule and prevailing weather conditions. Fertilizer was sidedressed on May 27 to supply 225 lb N/acre. Other production practices, including preventative sprays for powdery mildew, followed local recommended practices.

Sugar beets were topped on September 21 and harvested on September 24, 2020, using a two-row mechanical harvester. Sugar beet weight from each plot was corrected for tare to estimate yield. Percent sugar content and other sugar yield variables were determined in a laboratory at the Amalgamated Sugar factory in Paul, Idaho. Data were subjected to analysis of variance using SAS and means compared using protected LSD at P = 0.05% level of confidence.

Results and Conclusion

Observations on May 26 indicated a variable number of weeds across treatments (Table 1). The number of kochia plants ranged from 330 to 2,420 per acre with the pre-emergence Ro-Neet® Goltix Gold treatments harboring the highest densities. These results suggest that when applied alone, metamitron does not control kochia. Generally, metamitron reduced the number of common lambsquarters plants (21,780 to 141,570/acre) when applied alone or in a tank-mixture with ethofumesate (Table 1). There was no difference in the number of pigweed plants among the treatments, which ranged from 32,670 to 185,130 per acre compared to 196,020 per acre in the untreated control.

The number of weeds counted on June 8 (49 days after the pre-emergence treatments and 13 days after the 2-leaf treatments) indicated no significant difference among treatments for kochia population (Table 2). The number of kochia plants ranged from 990 to 1,650 per acre for stand-alone metamitron treatments, 1,870 per acre for the ethofumesate treatments, and 0 to 1,430 per acre for metamitron tank-mixed with ethofumesate compared to 2,420 per acre for the untreated control (Table 2). These results further confirm that metamitron does not control kochia. The number of common lambsquarters plants was highest in metamitron, ethofumesate, and Ro-Neet stand-alone treatments. Generally, metamitron plus ethofumesate provided complete control for common lambsquarters, hairy nightshade, and common purslane.

Pre-emergence application of metamitron plus ethofumesate provided the highest sugar beet root yield, ranging from 45.1 to 49 ton/acre. This compares with to 18.7 to 39.5 ton/acre for the metamitron, ethofumesate, and Ro-Neet stand-alone treatments; 45.9 ton/acre for the glyphosate treatment, and 12.6 ton/acre for the untreated control (Table 3). The yield reflected the level of weed control. There was no difference among treatments for sucrose content, which ranged from 14.09 to 15.02% across treatments, compared to 15.06% for the untreated control. Root conductivity and nitrate content was similar across treatments. The estimated recoverable sugar was generally highest (10,992.4 to 12,112.4 lb/acre) with pre-emergence applied metamitron plus ethofumesate and lowest for stand-alone herbicide treatments, reflecting the general root yield trends.

These results suggest that metamitron would be a valuable addition to the products used to manage weeds in sugar beet. However, metamitron does not control kochia and, therefore, may not contribute to efforts to manage glyphosate-resistant kochia biotypes.

References

Adama. 2020. Goltix Gold.
https://www.adama.com/documents/1313470/12263151/Goltix_Gold_label_May2020.pdf

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Table 1. Number of weeds on May 26 in response to Goltix® Gold or ADA 46343 (metamitron) alone or in tank-mixes with other herbicides to control weeds in sugar beet, Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

Treatment[a]	Product rate		Timing[b]	Number of weeds (5/26)[c] Kochia	Common lambsquarters	Redroot pigweed	Hairy nightshade	Common purslane
	units/acre			---------- no./acre ----------				
Untreated				2,090 a	424,710 a	196,020 a	163,350 a	315,810 a
Ro-Neet	4	pt	PRE	2,420 a	206,910 bcd	174,240 a	65,340 bc	108,900 bc
Ethofumesate	3	pt	PRE	1,760 a	250,470 bc	141,570 a	54,450 bcd	98,010 bc
ADA 46343	16.1	lb	PRE	2,200 a	141,570 cde	185,130 a	43,560 bcd	87,120 bc
ADA 46343	32.3	lb	PRE	660 a	32,670 e	108,900 a	10,890 cd	65,340 c
ADA 46343	40.5	lb	PRE	1,650 a	76,230 de	98,010 a	32,670 cd	54,450 c
Goltix Gold	8.1	pt	PRE	550 a	43,560 e	54,450 a	0 d	54,450 c
Ethofumesate	3	pt	PRE					
Goltix Gold	8.1	pt	PRE	1,650 a	76,230 de	32,670 a	0 d	21,780 c
Ethofumesate	3	pt	PRE					
Ethofumesate	4.5	pt	2-leaf					
Goltix Gold	8.1	pt	PRE	660 a	43,560 e	119,790 a	54,450 bcd	43,560 c
Ethofumesate	3	pt	PRE					
Warrant	1.5	pt	2-leaf					
Goltix Gold	8.1	pt	PRE	550 a	43,560 e	32,670 a	10,890 cd	65,340 c
Ethofumesate	3	pt	PRE					
Ethofumesate	4.5	pt	2-leaf					
Warrant	1.5	pt	8-leaf					
Goltix Gold	8.1	pt	PRE	330 a	21,780 e	54,450 a	10,890 cd	10,890 c
Ethofumesate	3	pt	PRE					
Warrant	1.5	pt	2-leaf					
Warrant	1.5	pt	8-leaf					
Roundup PowerMAX	2.24	pt	2-leaf	3,190 a	283,140 b	185,130 a	98,010 b	196,020 b
AMS	9	pt	2-leaf					
NIS	0.9	pt	2-leaf					
Roundup PowerMAX	2.24	pt	8-leaf					
AMS	9	pt	8-leaf					
NIS	0.9	pt	8-leaf					
LSD (P = 0.05)				NS	131,549	NS	62,817	114,059
CV				111.19	66.48	191.28	95.88	84.51
Treatment Prob (F)				0.2972	0.0001	0.2433	0.0002	0.0003

[a]Treatments = Ro-Neet 4 pt/acre = cycloate 3 lb ai/acre; ethofumesate 3 pt/acre = 1.5 lb ai/acre; ADA 46343 16.1 lb/acre = metamitron 2.5 lb ai/acre; Goltix Gold 2.87 pt/acre = metamitron 1.77 lb ai/acre; Warrant 1.5 pt/acre = acetochlor 0.56 lb ai/acre; Roundup PowerMAX 2.24 pt/acre = glyphosate 1.26 lb ae/acre; AMS = ammonium sulfate; NIS = nonionic surfactant.

[b]Application timing: PRE = pre-emergence on April 20; 2-leaf = post-emergence at 2-leaf stage on May 26; 8-leaf = post-emergence at 8-leaf stage on June 3.

[c]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 2. Number of weeds on June 8 in response to Goltix® Gold or ADA 46343 (metamitron) alone or in tank-mixes with other herbicides to control weeds in sugar beet, Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

Treatment[a]	Product rate		Timing[b]	Number of weeds (6/8)[c] Kochia		Common lambsquarters		Redroot pigweed		Hairy nightshade		Common purslane	
	units/acre			------ no./acre ------									
Untreated				2,420	a	381,150	a	206,910	a	87,120	a	217,800	a
Ro-Neet	4	pt	PRE	3,190	a	141,570	c	152,460	ab	54,450	ab	87,120	b
Ethofumesate	3	pt	PRE	1,870	a	239,580	b	119,790	bcd	54,450	ab	54,450	bc
ADA 46343	16.1	lb	PRE	2,750	a	65,340	cd	141,570	abc	32,670	bc	65,340	bc
ADA 46343	32.3	lb	PRE	1,540	a	10,890	d	76,230	b-e	0	c	43,560	bcd
ADA 46343	40.5	lb	PRE	1,650	a	10,890	d	43,560	de	0	c	0	d
Goltix Gold	8.1	pt	PRE	990	a	0	d	43,560	de	10,890	c	0	d
Ethofumesate	3	pt	PRE										
Goltix Gold	8.1	pt	PRE	1,430	a	0	d	10,890	e	0	c	0	d
Ethofumesate	3	pt	PRE										
Ethofumesate	4.5	pt	2-leaf										
Goltix Gold	8.1	pt	PRE	220	a	32,670	d	65,340	cde	21,780	bc	32670	cd
Ethofumesate	3	pt	PRE										
Warrant	1.5	pt	2-leaf										
Goltix Gold	8.1	pt	PRE	0	a	0	d	0	e	0	c	0	d
Ethofumesate	3	pt	PRE										
Ethofumesate	4.5	pt	2-leaf										
Warrant	1.5	pt	8-leaf										
Goltix Gold	8.1	pt	PRE	1,100	a	10,890	d	32,670	e	0	c	0	d
Ethofumesate	3	pt	PRE										
Warrant	1.5	pt	2-leaf										
Warrant	1.5	pt	8-leaf										
Roundup PowerMAX	2.24	pt	2-leaf	0	a	0	d	0	e	0	c	0	d
AMS	9	pt	2-leaf										
NIS	0.9	pt	2-leaf										
Roundup PowerMAX	2.24	pt	8-leaf										
AMS	9	pt	8-leaf										
NIS	0.9	pt	8-leaf										
LSD (P = 0.05)				NS		91,769		78,255		34,334		50,274	
CV				150.25		85.41		72.83		109.18		83.41	
Treatment Prob (F)				0.5164		0.0001		0.0001		0.0001		0.0001	

[a]Treatments = Ro-Neet 4 pt/acre = cycloate 3 lb ai/acre; ethofumesate 3 pt/acre = 1.5 lb ai/acre; ADA 46343 16.1 lb/acre = metamitron 2.5 lb ai/acre; Goltix Gold 2.87 pt/acre = metamitron 1.77 lb ai/acre; Warrant 1.5 pt/acre = acetochlor 0.56 lb ai/acre; Roundup PowerMAX 2.24 pt/acre = glyphosate 1.26 lb ae/acre; AMS = ammonium sulfate; NIS = nonionic surfactant.
[b]Application timing: PRE = pre-emergence on April 20; 2-leaf = post-emergence at 2-leaf stage on May 26; 8-leaf = post-emergence at 8-leaf stage on June 3.
[c]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 3. Root and other sugar yield components in response to Goltix® Gold (metamitron) alone or in tank-mixes with other herbicides at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

Treatment[a]	Product rate		Timing[b]	Yield		Sucrose	Conductivity	Nitrate	Gross sugar		ERS[c]	
	units/acre			ton/acre[d]		%[d]	mmho[d]	ppm[d]	lb/acre[d]		lb/acre[d]	
Untreated				12.6	f	15.06a	0.76a	198.42a	3,817.2	f	3,214.3	e
Ro-Neet	4.0	pt	PRE	21.7	e	14.46a	0.85a	365.15a	6,250.3	def	5,183.4	de
Ethofumesate	3.0	pt	PRE	18.7	ef	14.24a	0.79a	372.13a	5,320.4	ef	4,458.8	e
ADA 46343	16.1	lb	PRE	31.3	d	14.66a	0.83a	255.38a	9,202.6	cde	7,680.1	cd
ADA 46343	32.3	lb	PRE	36.9	cd	14.93a	0.79a	280.21a	11,033.8	bcd	9,274.7	abc
ADA 46343	40.5	lb	PRE	39.5	bcd	14.09a	1.83a	289.68a	17,807.1	a	7,901.0	bcd
Goltix Gold	8.1	pt	PRE	47.5	ab	15.02a	0.75a	262.48a	14,301.6	ab	12,112.4	a
Ethofumesate	3.0	pt	PRE									
Goltix Gold	8.1	pt	PRE	47.3	ab	14.73a	0.79a	307.12a	13,920.7	abc	11,694.7	a
Ethofumesate	3.0	pt	PRE									
Ethofumesate	4.5	pt	2-leaf									
Goltix Gold	8.1	pt	PRE	45.4	abc	14.69a	0.91a	283.48a	13,343.9	abc	10,992.4	ab
Ethofumesate	3.0	pt	PRE									
Warrant	1.5	pt	2-leaf									
Goltix Gold	8.1	pt	PRE	49.0	a	14.14a	0.92a	371.50a	13,847.9	abc	11,371.2	a
Ethofumesate	3.0	pt	PRE									
Ethofumesate	4.5	pt	2-leaf									
Warrant	1.5	pt	8-leaf									
Goltix Gold	8.1	pt	PRE	45.1	abc	14.81a	0.87a	239.47a	13,418.5	abc	11,223.2	a
Ethofumesate	3.0	pt	PRE									
Warrant	1.5	pt	2-leaf									
Warrant	1.5	pt	8-leaf									
Roundup PowerMAX	2.24	pt	2-leaf	45.9	ab	14.57a	0.89a	307.99a	13,317.9	abc	10,981.8	ab
AMS	9.0	pt	2-leaf									
NIS	0.9	pt	2-leaf									
Roundup PowerMAX	2.24	pt	8-leaf									
AMS	9.0	pt	8-leaf									
NIS	0.9	pt	8-leaf									
LSD (P = 0.05)				8.7		NS	NS	NS	4,919.95		3,152.0	
CV				16.44		34.61	66.68	29.94	30.16		24.69	
Treatment Prob(F)				0.0001		0.4310	0.5196	0.1715	0.0001		0.0001	

[a]Treatments = Ro-Neet 4 pt/acre = cycloate 3 lb ai/acre; ethofumesate 3 pt/acre = 1.5 lb ai/acre; ADA 46343 16.1 lb/acre = metamitron 2.5 lb ai/acre; Goltix Gold 2.87 pt/acre = metamitron 1.77 lb ai/acre; Warrant 1.5 pt/acre = acetochlor 0.56 lb ai/acre; Roundup PowerMAX 2.24 pt/acre = glyphosate 1.26 lb ae/acre; AMS = ammonium sulfate; NIS = nonionic surfactant.

[b]Application timing: PRE = pre-emergence on April 20; 2-leaf = post-emergence at 2-leaf stage on May 26; 8-leaf = post-emergence at 8-leaf stage on June 3.

[c]ERS = Estimated recoverable sugar.

[d]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).