

SUGAR BEET TOLERANCE AND WEED CONTROL WITH EXPERIMENTAL HERBICIDES

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Introduction

As weed problems and management systems change, it is important to evaluate new herbicides with potential use in sugar beets. Continual review of pesticides by the U.S. Environmental Protection Agency (EPA) also may reduce the herbicides available for use in sugar beets in the future. In these trials, Outlook, oil-base formulations of Betamix and Progress, and Starane were evaluated for sugar beet tolerance. Outlook is a soil-active herbicide with potential for lay-by application in sugar beets. Oil based formulations of Betamix and Progress were evaluated in efforts to remove other carriers present in current formulations. Starane was evaluated because it could provide control of ALS-resistant kochia, which is not controlled by current sugar beet herbicide programs.

Methods

General

Trials were established at the Malheur Experiment Station to evaluate experimental herbicides for sugar beet tolerance and/or weed control efficacy. Hillehog 'WS PM-21' sugar beets were planted on April 11 in 22-inch rows. Plots were sidedressed on May 22 with 240 lb N/acre as urea. Herbicide treatments were applied with a CO₂-pressurized backpack sprayer calibrated to deliver 20 gal/acre at 30 psi. Plots four rows wide and 27 ft long were arranged in a randomized complete block design. Roundup (0.75 lb ai/acre) was applied preemergence to all trials. Sugar beet injury and weed control were evaluated throughout the season. Sugar beet yields were determined by harvesting the center two rows of each plot on October 3.

Sugar Beet Tolerance to Outlook

All plots were treated with Betamix (0.33 lb ai/acre) when sugar beets were in the cotyledon stage of growth on April 24. On May 5, Outlook alone at three rates (0.64, 1.28, and 2.56 lb ai/acre) and Outlook (0.64 lb ai/acre) in combination with Betamix (0.33 lb ai/acre) or Betamix and Upbeet (0.016 lb ai/acre) were applied to sugar beets with two leaves. Any weeds not controlled by the herbicide treatments were removed by hand to eliminate any weed competition. Outlook treatments were evaluated for sugar beet injury throughout the season. In addition to sugar beet root yield, 16 sugar beets from each plot were sent to the Hillehog Mono-Hy Research Station in Nyssa, Oregon, to determine beet pulp sugar content and purity.

Weed Control and Sugar Beet Response to Oil-based Betamix and Progress Formulations

Experimental oil-based formulations of Betamix and Progress were compared to commercial formulations for sugar beet tolerance and weed control efficacy. Both formulations were applied at three rates alone (0.125, 0.25, and 0.5 lb ai/acre) and at 0.25 lb ai/acre in combination with Scoil (methylated seed oil). The experimental and commercial formulations of Progress were also evaluated in combination with Upbeet (0.25 oz ai/acre) and Stinger (1.5 oz ae/acre). All treatments were applied three times with the first application on cotyledon beets, the second on two-leaf beets, and the third on six-leaf beets. The applications were made on April 24, May 4, and May 15.

Weed Control and Sugar Beet Response to Starane

Starane was applied at different rates (0.016, 0.031, 0.063, and 0.125 lb ae/acre) in combination with the last of three applications of Betamix (0.33 lb ai/acre) on May 15, or alone eight days after the third Betamix application on May 23. Sugar beets had 6 leaves on May 15 and 12 leaves on May 23. The first two Betamix applications were made on April 24 and May 5. Herbicide combinations including Starane were compared to Betamix alone and a hand-weeded treatment. Sugar beet injury and weed control evaluations were taken throughout the growing season and sugar beet root yield determined at harvest.

Results and Discussion

Sugar Beet Tolerance to Outlook

Combinations of Outlook (0.64 lb ai/acre) with Betamix (0.33 lb ai/acre) or Betamix and Upbeet (0.016 lb ai/acre) caused the greatest injury on May 10 and May 18 (Table 1). The highest rate of Outlook alone (2.56 lb ai/acre) caused greater injury than the lower rates. On June 14 the highest Outlook rate still exhibited greater injury than the lower rates but was not different than the combinations of Outlook with Betamix or Betamix and Upbeet. By July 7, significant injury was not apparent for any treatment. Notwithstanding the observed injury, no differences in sugar beet root yield, percent sugar, or recoverable sugar per acre were recorded. Sugar beets treated with the combination of Outlook with Betamix and Upbeet had lower extraction than any of the other Outlook treatments.

Weed Control and Sugar Beet Response to Oil-based Betamix and Progress Formulations

Sugar beet injury did not differ between experimental oil-based formulations and commercial formulations of Betamix and Progress (Table 2). In general, sugar beet injury increased as the product rates were increased, with the most significant injury occurring at the 0.5 lb ai/acre rate. The addition of Scoil to all products did not increase sugar beet injury. The different Progress formulations also had similar injury when applied in combination with Upbeet and Stinger. Little sugar beet injury was apparent after June 14. Weed control also generally improved with increasing rates, with the lowest rates (0.125 lb ai/acre) generally providing less control than the highest rates

(0.5 lb ai/acre) (Table 3). Formulations did not differ in weed control efficacy when applied at similar rates. The addition of Scoil did not improve weed control, and in the case of the commercial formulation of Progress, apparently reduced redroot pigweed and hairy nightshade control compared to no surfactant on July 6. Sugar beet yields were related to weed control: treatments that provided the greatest weed control also produced some of the highest yields (Table 2).

Weed Control and Sugar Beet Response to Starane

Sugar beet injury increased with increasing Starane rates (Table 4). The highest rate (0.125 lb ae/acre) had significantly higher injury compared to the two lowest rates (0.016 and 0.031 lb ae/acre) on the May and June evaluation dates. By July 3, no treatments exhibited significant injury. Weed control was not improved by the addition of Starane to Betamix treatments (Table 5). A concern with the low rates of Starane that were investigated is whether they will offer any activity against kochia. The sugar beet injury observed may be unacceptable if an increase in kochia control is not achieved. Sugar beet yield was increased by all treatments compared to the untreated plots and some treatments produced slightly lower yields than the hand-weeded check. Reduced yields appear to correlate more with weed pressure than with herbicide injury.

Table 1. Sugar beet injury, yield, and quality in response to applications of Frontier and Outlook under weed-free conditions, Malheur Experiment Station, Oregon State University, Ontario, OR, 2000.

Treatment*	Rate	Crop injury				Root yield †	Sugar	Extraction	Estimated recoverable
		5-10	5-25	6-14	7-3				
	lb ai/acre	%				tons/acre	%		lb/acre
Hand-weeded		0	1	0	3	42.9	15.87	90.33	12,299
BAS 656 07 H	0.64	6	1	8	1	43.0	15.91	90.76	12,415
BAS 656 07 H	1.28	9	7	6	5	43.9	16.15	90.75	12,876
BAS 656 07 H	2.56	15	13	13	1	41.8	16.12	91.05	12,268
BAS 656 07 H + Betamix	0.64 + 0.33	29	13	10	5	43.5	16.11	90.65	12,708
BAS 656 07 H + Betamix + Upbeet	0.64 + 0.33 + 0.0156	26	17	11	3	44.0	16.05	90.20	12,734
LSD (0.05)		3.2	5.5	7.3	NS	NS	NS	0.41	NS

*All plots received Betamix (0.33 lb /acre) on April 24 and May 1. Treatments were applied to six leaf sugar beets on May 18.

† Sugar beets were harvested on October 2 and 3.

Table 2. Sugar beet injury and yield with experimental and commercial Betamix and Progress formulations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2000.

Treatment*	Rate†	Injury					Sugar beet yield
		5-10	5-26	6-5	6-14	7-6	
	lb ai/acre	%					ton/acre
New Betamix	0.125	0	0	0	0	0	15.3
New Betamix	0.25	5	6	8	5	0	21.3
New Betamix	0.50	17	22	18	9	3	29.5
New Betamix + Scoil	0.25 + 1.5 % v/v	20	18	10	5	0	31.5
Betamix	0.125	2	8	3	3	0	18.8
Betamix	0.25	5	7	12	5	0	25.6
Betamix	0.50	20	21	17	12	4	30.2
Betamix + Scoil	0.25 + 1.5 % v/v	20	17	17	8	0	28.4
New Progress	0.125	2	7	7	0	0	17.2
New Progress	0.25	7	10	18	7	0	29.1
New Progress	0.50	18	29	21	10	3	34.1
New Progress + Scoil	0.25 + 1.5 % v/v	10	5	3	2	2	26.0
Progress	0.125	0	10	3	3	0	21.5
Progress	0.25	10	13	17	10	0	31.1
Progress	0.50	20	20	15	5	2	31.2
Progress + Scoil	0.25 + 1.5 % v/v	10	11	10	0	0	20.4
Progress + Upbeet + Stinger	0.25 + 0.016 + 0.09	17	26	17	3	2	32.6
New Progress + Upbeet + Stinger	0.25 + 0.016 + 0.09	20	28	23	7	0	35.4
New Progress + Upbeet + Stinger + Scoil	0.25 + 0.016 + 0.09 + 1.5 % v/v	13	27	22	5	2	32.9
Untreated		0	0	0	0	0	6.7
LSD (0.05)		7.8	8.2	9.0	8.9	NS	9.1

*Treatments were applied on April 24, May 4, May 15.

†Stinger rates are in lb ae/acre.

Table 3. Weed control with experimental and commercial Betamix and Progress formulations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2000.

Treatment*	Rate†	Weed control							
		Pigweed		Lambsquarters		H. Nightshade		Barnyardgrass	
		6-14	7-6	6-14	7-6	6-14	7-6	6-14	7-6
	lb ai/acre	%							
New Betamix	0.125	33	48	83	73	67	77	18	45
New Betamix	0.25	85	77	95	95	96	86	48	59
New Betamix	0.50	98	100	98	100	97	93	80	82
New Betamix + Scoil	0.25 + 1.5 % v/v	98	84	98	88	67	87	87	77
Betamix	0.125	48	48	90	85	53	75	27	57
Betamix	0.25	91	85	91	93	88	87	68	71
Betamix	0.50	95	88	98	96	97	95	68	82
Betamix + Scoil	0.25 + 1.5 % v/v	97	87	98	97	96	92	63	74
New Progress	0.125	57	50	77	63	77	72	45	63
New Progress	0.25	98	85	98	83	98	89	63	75
New Progress	0.50	98	100	98	100	98	100	67	78
New Progress + Scoil	0.25 + 1.5 % v/v	71	75	80	77	91	94	63	78
Progress	0.125	45	50	75	71	58	70	40	66
Progress	0.25	89	84	95	90	98	98	68	71
Progress	0.50	97	96	98	100	98	100	65	62
Progress + Scoil	0.25 + 1.5 % v/v	57	47	90	78	94	82	55	67
Progress + Upbeet + Stinger	0.25 + 0.016 + 0.09	95	100	98	100	93	100	75	79
New Progress + Upbeet + Stinger	0.25 + 0.016 + 0.09	98	98	98	100	96	97	80	85
New Progress + Upbeet + Stinger + Scoil	0.25 + 0.016 + 0.09 + 1.5 % v/v	90	87	94	92	94	92	84	87
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		19	22	15	17	23	11	23	19

*Treatments were applied on April 24, May 4, and May 15.

†Stinger rates are in lb ae/acre.

Table 4. Sugar beet injury and yield in response to Starane applications, Malheur Experiment Station, Oregon State University, Ontario, OR, 2000.

Treatment	Rate*	Timing†	Injury				Sugar beet yield ton/acre
			5-26	6-5	6-14	7-3	
			%				
Betamix Starane	0.25 0.016	1, 2, 3 3	8	8	3	0	27.8
Betamix Starane	0.25 0.031	1, 2, 3 3	13	13	3	7	26.2
Betamix Starane	0.25 0.063	1, 2, 3 3	17	17	8	0	26.5
Betamix Starane	0.25 0.125	1, 2, 3 3	33	33	12	3	28.7
Betamix Starane	0.25 0.016	1, 2, 3 4	23	23	3	2	31.0
Betamix Starane	0.25 0.031	1, 2, 3 4	17	13	3	3	34.8
Betamix Starane	0.25 0.063	1, 2, 3 4	27	27	13	3	37.3
Betamix Starane	0.25 0.125	1, 2, 3 4	40	40	17	0	25.9
Betamix No Starane	0.25	1, 2, 3	10	10	5	0	33.8
Betamix Starane Starane	0.25 0.016 0.016	1, 2, 3 3 4	13	13	3	2	36.2
Hand-weeded			0	0	3	3	39.0
Untreated			0	0	0	0	2.5
LSD (0.05)			11	12	7	NS	11.7

*Starane rates are in lb ae/acre.

†Applications were made on April 24 (1), May 5 (2), May 15 (3), and May 23 (4).

Table 5. Weed control with Betamix and Starane combinations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2000.

Treatment*	Rate	Timing †	Weed control							
			Pigweed		Lambsquarters		H. Nightshade		Barnyardgrass	
			6-14	7-3	6-14	7-3	6-14	7-3	6-14	7-3
lb ai or ae/acre			%							
Betamix	0.25	1, 2, 3	84	82	98	95	98	100	68	73
Starane	0.016	3								
Betamix	0.25	1, 2, 3	80	78	89	90	89	95	68	67
Starane	0.031	3								
Betamix	0.25	1, 2, 3	62	80	98	93	92	100	68	56
Starane	0.063	3								
Betamix	0.25	1, 2, 3	93	92	98	97	98	100	77	62
Starane	0.125	3								
Betamix	0.25	1, 2, 3	86	80	94	93	94	100	75	72
Starane	0.016	4								
Betamix	0.25	1, 2, 3	98	86	98	99	98	100	82	79
Starane	0.031	4								
Betamix	0.25	1, 2, 3	94	91	98	95	98	100	87	87
Starane	0.063	4								
Betamix	0.25	1, 2, 3	89	84	93	87	94	100	72	63
Starane	0.125	4								
Betamix	0.25	1, 2, 3	63	97	97	97	97	100	78	75
No Starane										
Betamix	0.25	1, 2, 3	89	99	98	93	98	100	76	71
Starane	0.016	3								
Starane	0.016	4								
Handweeded			95	88	98	97	98	100	97	99
Untreated			-	-	-	-	-	-	-	-
LSD (0.05)			NS	19	NS	NS	NS	NS	16	NS

*Starane rates are in lb ae/acre.

†Applications were made on April 24 (1), May 5 (2), May 15 (3), and May 23 (4).