

SUGAR BEET TOLERANCE TO TANK-MIX COMBINATION OF SEVIN INSECTICIDE FORMULATIONS AND BETAMIX PROGRESS, UPBEET, AND STINGER HERBICIDES APPLIED POSTEMERGENCE TO SEEDLING SUGAR BEETS

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Purpose

To study the tolerance of seedling sugar beets when Sevin XLR and Sevin 4F formulations of insecticides are tank-mixed with Betamix Progress, Upbeet, or Stinger herbicides and applied to seedling sugar beets in the cotyledon leaf, two true leaf, and four leaf stage of growth. Sevin insecticide is applied to sugar beets for the control of adult sugar beet root maggot and crown borer.

Procedures

Sugar beet variety WS-PM9 was planted on April 10, 1995. Pelleted seed was planted at 4-inch spacing using a Beck planter equipped with shoe openers. Soils in the trial area were silt loam texture with 1.3 percent organic matter and a pH of 7.2. Stephens winter wheat had been grown during 1994. Bronate at 1 quart per acre had been applied to control weeds in the wheat. Following wheat harvest, the stubble was shredded with a steel tooth flail beater and the field was disked, corrugated, and surface irrigated. In October the field was deep chiseled, mold-board plowed, and bedded. Twenty gallons of C-17 soil fumigant was injected in the rows while bedding. One hundred lb/ac of phosphate (P_2O_5) and 60 lb/ac of nitrogen were broadcast before plowing. The seed bed in the spring was prepared by harrowing the beds twice using a spike tooth bed-harrow. Preemergence herbicides were not used. Temik was banded in a 5-inch strip over the planted row at a rate of 2.0 lb ai/ac and incorporated with a small drag chain. All treatments were replicated three times using a randomized block experimental design.

The first application of herbicide/insecticide treatments was made on May 3. Both weeds and sugar beets had small cotyledon leaves. Sugar beet cotyledon leaves were 0.5 inch long. Weed species included lambsquarters, kochia, redroot pigweed, barnyardgrass, and green foxtail. Skies were partly cloudy; air temperature was 65°F, and soil temperature at 4-inch depth was 52°F. Wind speed was 2 to 3 mph from the west. Both the sugar beets and weeds were healthy and growing rapidly.

The second application of the treatments was made on May 15. Sugar beets had two true leaves, and new emerging weeds had cotyledon leaves. Skies were partly cloudy; air temperature was 72°F, the soil temperature at 4-inches was 62°F, and the wind

was calm. The seedling sugar beets were normal without foliar injury from the previous herbicide/insecticide applications.

The third herbicide/insecticide applications were made on May 25. Sugar beets had four true leaves, and there were very few weeds in treated plots. Air temperature was 84°F and extremely warm for applying Betamix Progress herbicides. Skies were clear with the sun bright and the wind calm. Soil temperature at the 4-inch depth was 71°F.

All herbicide/insecticide treatments were applied using a single bicycle wheel plot sprayer. Individual plots were 4-rows wide and 25 feet long. Four Teejet fan nozzles were mounted on the spray boom, and a nozzle was located over the center of each row of the plot. The nozzle size was 6502. Spray pressure was 42 psi, and water as the carrier was applied at the rate of 19.5 gallons per acre. Formulations of Sevin evaluated were 4F flowable and XLR emulsifiable concentrate; each was applied at 1.5 lb ai/ac. Herbicides tank-mixed with Sevin insecticide included Betamix, Betamix Progress, Stinger, and Upbeet (were 0.25, 0.25, 0.05, and 0.0156, lb ai/ac respectively).

The sugar beets were thinned to 8-inch spacing on June 5 and 6. On June 15 the sugar beets were sidedressed with 150 lb/ac of nitrogen and another 2 lb ai/ac of Temik. Nitrogen was injected on each side of every row. Sugar beets were watered by furrow irrigation. Furrows were made between each row, and water was applied to all furrows. A total of 80 lb/ac of sulfur dust was broadcast for the control of powdery mildew. Forty lb/ac were hand broadcast on July 12, and another forty lb/ac were applied by aerial application on August 8.

The sugar beets were harvested on October 12 to obtain root yields, percent sucrose, conductivity readings, and concentrations of NO₃N in the roots. Percent extractable sugar and estimated recoverable sugar per acre were calculated. Sugar beet leaves and crowns were removed with a topping unit equipped with a flail beater and rotating disc knives. Roots from the two center rows were harvested with a single row International Harvester. A total of 46 feet of row was harvested from each plot. Two samples, each consisting of eight sugar beet roots, were taken from each plot and sent to the Amalgamated Sugar Company tare laboratory in Nyssa, Oregon, for sugar and root quality analysis. The data is summarized in Tables 1 through 4.

Results

The XLR formulation of Sevin insecticide activated Betamix herbicide and caused more foliar injury to the seedling sugar beets than the 4F formulation or the herbicides by themselves. The greatest degree of injury occurred when XLR formulation of Sevin included Betamix with Stinger or Upbeet. In early studies when sugar beet tolerance was being evaluated with low-repeat applications of Betamix and Betamix tank mixed with surfactants, sugar beet selectivity was lost, and severe injury with stand reduction often occurred. The solvents and emulsifiers used to formulate the XLR material may be acting as surfactants stimulating herbicide activity. Slightly but non-significant

improvement in weed control was also noted when XLR Sevin was tank-mixed with Betamix herbicides. Also more injury from the XLR occurred with the late application when air temperatures exceeded 84°F. Betamix is more active at higher temperatures in bright sunlight. Injury symptoms from XLR plus Betamix combinations included leaf chlorosis, necrosis of leaf margin, and reduced foliar growth. The reduced foliage growth persisted and was distinguishable from the non-XLR treated sugar beets even after thinning.

The only significant measurable reduction in yield of sugar beet roots and estimated yield of recoverable sugar was with the XLR treatment used in combination with Progress and Stinger at rates of 0.25 and 0.05 lb ai/ac. Sugar beet root yields were less in other XLR treatments, but the reduction was not great enough to be significant or to reduce the yield of recoverable sugar. The effect of lower root yields on the amount of recoverable sugar can be overcome by slightly higher percent sucrose and lower conductivity readings (Table 4).

It appears that the XLR formulation of Sevin can be used in tank combinations with Betamix and other herbicides if the application restrictions on the label for Betamix applications under specific environmental conditions are followed.

Table 1. Crop injury and percent weed control ratings of seedling sugar beets after first application of Sevin insecticide formulations tank-mixed with Betamix, Progress, Upbeet, or Stinger herbicides. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Herbicides	Rate lb ai/ac	Percent Weed control														
		Crop injury			Kochia			Pigweed			Lambsquarters			Annual grasses		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Betamix	0.25	5	0	5	98	99	98	100	100	100	100	100	100	75	70	75
Betamix + Sevin XLR	0.25 + 1.5	5	10	5	99	99	100	100	100	100	100	100	100	75	80	75
Betamix + Sevin 4F	0.25 + 1.5	0	5	0	98	98	98	100	100	100	100	100	100	70	75	70
Progress	0.25	0	5	0	98	98	98	100	100	100	100	100	100	75	70	70
Progress + Sevin XLR	0.25 + 1.5	10	5	10	100	99	99	100	100	100	100	100	100	75	75	75
Progress + Sevin 4F	0.25 + 1.5	0	5	0	99	99	99	100	100	100	100	100	100	75	75	70
Progress + Stinger + Sevin XLR	0.25 + 0.05 + 1.5	10	10	5	100	100	100	100	100	100	100	100	100	75	70	70
Progress + Stinger + Sevin 4F	0.25 + 0.05 + 1.5	5	0	0	100	100	100	100	100	100	100	100	100	70	75	70
Progress + Upbeet + Sevin XLR	0.25 + 0.0156 + 1.5	10	15	10	100	100	100	100	100	100	100	100	100	75	75	70
Progress + Upbeet + Sevin 4F	0.25 + 0.0156 + 1.5	5	0	0	100	100	100	100	100	100	100	100	100	70	70	75
Untreated check	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

First evaluation: May 7, cotyledon leaf sugar beets.

Table 2. Crop injury and percent weed control ratings of seedling sugar beets after second application of Sevin insecticide formulations tank-mixed with Betamix, Progress, Upbeet, or Stinger herbicides. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Herbicides	Rate lb ai/ac	Percent weed control														
		Crop injury			Kochia			Pigweed			Lambsquarters			Annual grasses		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Betamix	0.25	0	0	5	99	99	100	100	100	100	100	100	100	65	60	60
Betamix + Sevin XLR	0.25 + 1.5	5	5	10	100	109	100	100	100	100	100	100	100	60	65	70
Betamix + Sevin 4F	0.25 + 1.5	5	0	0	99	99	99	100	100	100	100	100	100	60	65	55
Progress	0.25	5	5	0	100	100	100	100	100	100	100	100	100	65	55	50
Progress + Sevin XLR	0.25 + 1.5	10	10	10	100	100	100	100	100	100	100	100	100	60	65	60
Progress + Sevin 4F	0.25 + 1.5	0	5	0	100	100	100	100	100	100	100	100	100	55	60	60
Progress + Stinger + Sevin XLR	0.25 + 0.05 + 1.5	10	12	10	100	100	100	100	100	100	100	100	100	65	60	60
Progress + Stinger + Sevin 4F	0.25 + 0.05 + 1.5	5	0	5	100	100	100	100	100	100	100	100	100	60	55	55
Progress + Upbeet + Sevin XLR	0.25 + 0.0156 + 1.5	10	15	15	100	100	100	100	100	100	100	100	100	65	60	60
Progress + Upbeet + Sevin 4F	0.25 + 0.0156 + 1.5	5	5	0	100	100	100	100	100	100	100	100	100	50	50	55
Untreated check	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Second evaluation: May 23, two true leaf sugar beets.

Table 3. Crop injury and percent weed control ratings of seedling sugar beets after third application of Sevin insecticide formulations tank-mixed with Betamix, Progress, Upbeet, or Stinger herbicides. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Herbicides	Rate	Percent Weed control																
		Crop injury			Kochia			Pigweed			Lambsquarters			Annual grasses				
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3		
	lb ai/ac	— % —			— % —													
Betamix	0.25	5	0	5	100	100	100	100	100	100	100	100	100	100	100	45	50	50
Betamix + Sevin XLR	0.25 + 1.5	15	20	15	100	100	100	100	100	100	100	100	100	100	100	50	45	50
Betamix + Sevin 4F	0.25 + 1.5	5	0	5	100	100	100	100	100	100	100	100	100	100	100	55	60	55
Progress	0.25	5	5	5	100	100	100	100	100	100	100	100	100	100	100	50	45	45
Progress + Sevin XLR	0.25 + 1.5	20	20	15	100	100	100	100	100	100	100	100	100	100	100	65	60	65
Progress + Sevin 4F	0.25 + 1.5	5	0	5	100	100	100	100	100	100	100	100	100	100	100	55	45	40
Progress + Stinger + Sevin XLR	0.25 + 0.05 + 1.5	20	15	25	100	100	100	100	100	100	100	100	100	100	100	60	55	55
Progress + Stinger + Sevin 4F	0.25 + 0.05 + 1.5	5	5	5	100	100	100	100	100	100	100	100	100	100	100	45	50	45
Progress + Upbeet + Sevin XLR	0.25 + 0.0156 + 1.5	25	20	20	100	100	100	100	100	100	100	100	100	100	100	50	55	65
Progress + Upbeet + Sevin 4F	0.25 + 0.0156 + 1.5	5	0	5	100	100	100	100	100	100	100	100	100	100	100	45	50	45
Untreated check	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Evaluated June 4, 4-leaf sugar beets.

Grass species include green foxtail and barnyardgrass.

Ratings: 0 - 50 indicates degree of plant injury from stunting, leaf chlorosis, and minor leaf necrosis.

50 - 100 indicates stand reduction from 5 to 100 percent. In this trial a reduction in stand loss did not occur.

Table 4. Root yields, sugar yields, and root quality data of sugar beets treated with two formulations of Sevin insecticide in tank-mix combinations of Betamix Progress, Upbeet, and Stinger herbicides. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Herbicides	Rates	Sugar beet yield and quality							
		Root yield	Sucrose	Conductivity	Nitrate-N	Extraction	Gross sugar	Recoverable sugar	
		t/a	%	µmho	ppm	%	lb/ac	lb/ac	lb/t
Betamix	0.25	44.5	16.02	883	422	83.02	14,250	11,830	266.0
Betamix + Sevin XLR	0.25 + 1.5	43.6	15.99	892	416	82.90	13,940	11,550	265.2
Betamix + Sevin 4F	0.25 + 1.5	44.7	15.54	925	485	82.35	13,920	11,470	256.0
Progress	0.25	44.7	15.61	925	477	82.36	13,950	11,490	257.3
Progress + Sevin XLR	0.25 + 1.5	43.7	16.06	861	372	83.32	14,040	11,700	267.6
Progress + Sevin 4F	0.25 + 1.5	45.0	15.86	886	413	82.94	14,280	11,840	263.1
Progress + Stinger + Sevin XLR	0.25 + 0.05 + 1.5	42.0	15.58	963	503	81.84	13,090	10,710	255.0
Progress + Stinger + Sevin 4F	0.25 + 0.05 + 1.5	43.7	15.62	893	405	82.80	13,660	11,310	258.7
Progress + Upbeet + Sevin XLR	0.25 + 0.0156 + 1.5	44.7	15.75	903	455	82.69	14,070	11,630	260.4
Progress + Upbeet + Sevin 4F	0.25 + 0.0156 + 1.5	44.5	15.64	916	452	82.49	13,920	11,480	258.0
Untreated check	—	45.40	15.82	914	447	82.56	14,360	11,850	261.3
Mean		44.2	15.77	905	440	82.66	13,950	11,530	260.8
LSD (0.05)		1.9	ns	88	ns	ns	754	732	ns
CV (%)		2.5	2.3	5.7	16.5	0.9	3.2	3.7	3.1