Sugar Beet Injury From Simulated Herbicide Drift

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Introduction and Objectives

Sugar beet injury can occur from drift when postemergence herbicides are applied to crops in adjacent fields. Visual injury patterns are often irregular and yield loss can be difficult to quantify in commercial fields. Quantitative information on extractable sugar per acre loss would assist growers and agriculturists in evaluating drift damage from common herbicides. This two-year study was conducted to assess visual sugar beet injury and losses in yield and quality from simulated postemergence herbicide drift. Photos documenting the appearance and severity of drift symptoms were compiled onto a CD-ROM in both years to augment yield and quality data.

Methods

Treatment list

Herbicide common name	Herbicide trade name	Formulation	Herbicide Group	Rate Applied[a] (g ai/ha)
UNTREATED	-	-	-	-
bromoxynil + MCPA	Buctril M	560 g/ℓ EC	4 & 6	83
2,4-D + mecoprop + dicamba	Dyvel DS	485 g/ℓ Liquid	4	80
2,4-D + dichlorprop	Estaprop	582 g/ℓ EC	4	153
MCPA + mecoprop + dicamba	Target	400g/ℓ Liquid	4	89
rimsulfuron[b]	Prism	25% DF	2	2.2
metribuzin	Sencor	75% DF	5	42
bentazon[c]	Basagran	480 g/ℓ Liquid	6	162

[a] **All rates applied were 15% of the label rate.**
[b] Agral 90 non-ionic surfactant was applied with rimsulfuron at 0.2% v/v.
[c] Assist oil concentrate surfactant was applied with bentazon at 1.0% v/v

Data was collected over 2 study years with a considerable range in environmental conditions and production potential. The 2003 test was planted earlier and harvested later than the 2004 test, with total growing days of 161 in 2003 and 146 in 2004.

Soil-applied and postemergence sugar beet herbicides were applied over all treatments in both years to represent commercial agronomic practices prior to applying herbicide drift treatments. Sugar beet herbicides applied included glyphosate (stale seedbed), ethofumesate, pyrazon and triallate (preemergence), desmedipham/phenmedipham, clopyralid and sethoxydim (postemergence).

Experiment location	Taber, Alberta	*Sugar beet variety*	Beta 1385
Experimental design	RCBD	*Previous crop*	SWS Wheat
Plot size	7.3 x 25 ft	*Method of irrigation*	Side roll
Replications	6	*Soil texture*	Sandy loam

Simulated drift treatments were broadcast using a CO_2 bicycle sprayer equipped with 8001VS nozzles at 10 U.S. gallons per acre spray volume and 40 psi pressure.

Application Information (Environmental)

Application Year	Treatment Number	Date	Time	Temp. (°F)	Wind Speed (mph)	Relative Humidity (%)	Cloud Cover	Soil Temp. at 10cm (°F)
2003	2-8	June 16	1300	79	calm – 5mph	26	clear	79
2004	2-8	June 24	1730	73	calm – 2mph	34	clear	79

Growth Stage Information

Application Year	Date	Plant	Leaf Stage		
			Minimum	Maximum	Majority
2003	June 16	Sugar beets	4-leaf	6-8 leaf	6-leaf
2004	June 24	Sugar beets	4 to 6-leaf	8-leaf	6 to 8-leaf

Rainfall and irrigation (R/I) before and after applications

Application Year	Date	R/I the week before application		R/I the week after application		Days to 1st significant R/I after application	Amount of 1st significant R/I after application	
		(in)	(mm)	(in)	(mm)		(in)	(mm)
2003	June 16	1.2	31	0	0	11	0.4	11
2004	June 24	0	0	1.5	37	2	0.75	19

Results

In both study years, simulated herbicide drift treatments resulted in significant reductions in extractable sugar per acre (ESA) and beet yield compared to an untreated check (Tables 1 and 2). 2,4-D + dichlorprop also significantly reduced ESA relative to all other herbicide treatments in both years. The average 2-year percent reduction in ESA relative to the check treatment for the 7 herbicides tested was: 2,4-D + dichlorprop = 35%, rimsulfuron = 21%, bromoxynil + MCPA = 16%, 2,4-D + mecoprop + dicamba = 16%, metribuzin = 15%, bentazon = 14% and MCPA + mecoprop + dicamba = 12%. Percent ESA reduction from herbicide treatments was greater in 2004 than in 2003. ESA reductions increased an average of 9% in 2004 and increases were observed for all treatments compared to 2003 values. The greatest differences in ESA reduction occurred for 2,4-D + dichlorprop, rimsulfuron and metribuzin with differences of 16% to 17% when comparing the 2 study years. Differences for the other 4 herbicides ranged from 3 to 5% between the 2 years of study.

Extractable sugar per ton and percent sugar were reduced for selected treatments in 2004, but not in 2003 (Tables 1 and 2). In both study years, sugar beet stand after treatment application was significantly reduced with bentazon. Metribuzin reduced established stand in one of two years, while other treatments had no effect on stand.

Photos documenting early season leaf injury symptoms, late season trumpeting and crown deformity at harvest were compiled in order to relate visual symptoms to quantitative yield and quality measurements. Injury symptoms are not reported in this document. Sugar beet leaf injury symptoms were most pronounced 5 to 7 days after simulated drift application. The severity of visual sugar beet leaf injury was similar in both years of study.

Growing season conditions varied considerably between the two years of study. In 2003, weather conditions in July and August were warmer than normal resulting in very high root yields that averaged 36.4 tons per acre for the untreated check. In 2004, summer weather conditions were cooler and the untreated check averaged 25.6 tons per acre.

Summary

- Simulated herbicide drift treatments resulted in reductions of 12 to 35% in extractable sugar per acre relative to untreated beets.

- Photo documentation of the appearance and severity of drift symptoms was compiled as a tool to relate visual assessments to quantitative loss.

Table 1. Yield and quality results for the simulated herbicide drift test - 2003.

Treatment	Extractable Sugar		Sugar	Molasses Loss	Beet Yield	Beet Stand
	lbs/acre	lbs/ton	%	%	tons/acre	pl/100ft
UNTREATED	11728	355.4	18.05	1.93	36.4	137
bromoxynil + MCPA	10176	356.5	18.14	1.97	31.5	134
2,4-D + mecoprop + dicamba	10042	357.1	18.15	1.95	31.1	137
2,4-D + dichlorprop	8616	349.4	17.93	2.08	27.2	139
MCPA + mecoprop + dicamba	10624	358.5	18.21	1.95	32.7	136
rimsulfuron	10198	354.3	18.02	1.95	31.8	134
metribuzin	11003	354.7	18.06	1.96	34.2	140
bentazon	10280	352.5	18.02	2.03	32.2	120
LSD (.05)	534	NS	NS	NS	1.8	10
LSD (.01)	716	NS	NS	NS	2.5	13
C.V. (%)	4.4	2.9	1.8	9.9	4.9	6.2

Table 2. Yield and quality results for the simulated herbicide drift test - 2004.

Treatment	Extractable Sugar		Sugar	Molasses Loss	Beet Yield	Beet Stand
	lbs/acre	lbs/ton	%	%	tons/acre	pl/100ft
UNTREATED	7681	331.6	16.88	1.83	25.6	125
bromoxynil + MCPA	6261	325.4	16.59	1.83	21.2	122
2,4-D + mecoprop + dicamba	6367	323.9	16.67	1.98	21.7	126
2,4-D + dichlorprop	4284	308.4	15.99	2.01	15.3	118
MCPA + mecoprop + dicamba	6634	327.2	16.69	1.85	22.3	124
rimsulfuron	5492	311.7	16.13	1.99	19.4	115
metribuzin	5919	316.8	16.40	2.03	20.6	102
bentazon	6488	326.5	16.71	1.89	22.0	110
LSD (.05)	538	10.6	0.36	NS	1.7	15
LSD (.01)	721	14.1	0.48	NS	2.3	NS
C.V. (%)	7.5	2.8	1.8	10.1	7.0	10.5