HERBICIDE INJURY IN SPECIAL CROPS FROM SPRAYER TANK RESIDUES

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ABSTRACT

Broadleaved special crops have long been known to be sensitive to phenoxy herbicides. Field trials were conducted on sunflowers, lentils and mustard. Simulated sprayer tank residues of 2%, 1%, 0.5% and 0.25% of the field rate of the broadleaved weed herbicides were applied alone and with diclofop-methyl and sethoxydim as they would be with the subsequent use of the sprayer in the special crops. The grassy weed herbicides enchanced the effect of 2,4-D, MCPA and dicamba in sunflowers and of clopyralid in lentils while the effect of chlorsulfuron alone in mustard equaled that of the grassy weed herbicide mixtures. Yields losses occurred in all three special crops from the simulated residues of herbicides used in cereal crops. Losses ranged from 0 to 92% depending on the herbicide combination, rate applied and crop tested.

INTRODUCTION

Field observations in sunflowers in Manitoba indicated that crop injury from herbicide application was not due to the grassy weed herbicide applied by the growers. Symptoms of leaf distortion, epanisty, stem swelling and splitting and distorted root growth pointed to phenoxy type herbicides as the cause of injury. Growers questioned often had used a phenoxy type herbicide prior to the use of a grassy weed herbicide in sunflower fields. These observations led to the conducting of a greenhouse research project to determine if rates of herbicide similar to residues in the sprayer could cause injury to sunflowers and several other crops. Confirmation of this hypothesis led to further field research to determine at what rates phytotoxic symptoms occur and if injury is enhanced when a grassy weed herbicide was subsequently used (as would normally be done by a grower). For this purpose Hoegrass (diclofop-methyl) and Poast (sethoxydim) plus Assist were chosen as the grassy weed herbicides. In sunflowers the broadleaved weed herbicides 2,4-D, MCPA and Banvel (dicamba) were used as potential spray tank residual herbicides while in lentils Lontrel (clopyralid) was used and in tame mustard Glean (chlorsulfuron) plus Agrol was used.

MATERIALS AND METHODS

Data presented is from 1986 field trials at the Indian Head Experimental Farm. In sunflowers field reseasrch has been conducted for 2 years, however, due to different experimental

designs being used only 1986 date is presented. Trials were conducted on an Indian Head heavy clay with a pH of 7.5 - 8.0. Rainfall was above normal during the growing season.

Table 1. Rates of Broadleaved Herbicides Used

% Field Rate	Gal. of residue in 400 gal. sprayer	Dicamba g/ha	2,4-D g/ha	MCPA g/ha	Lontrel g/ha	Glean
2.00	8	3.2	16.0	16.0	6.00	0.45
1.00	4	1.6	8.0	8.0	3.00	0.22
0.50	2	0.8	4.0	4.0	1.50	0.11
0.25	1	0.4	2.0	2.0	0.75	0.05

The sunflower experiment was conducted in a split split split split plot design with the main effect being leaf stage, subplot being broadleaved weed herbicide, the sub sub plot being grassy weed herbicide and the sub sub sub plot being rate of broadleaved weed herbicde. The smallest plots were 2.5m X 6.0 m. the trial had 4 replicates. The lentil and mustard trials were carried out as a split plot with the main effect being grassy weed herbicide and the sub plot being broadleaved weed herbicide rate. Again the smallest plots were 2.5 m X 6.0 m and the trials were replicated 4 times.

Herbicide application was done with a CO2 backpack sprayer operating at 275 kPa and delivering 110 l/ha of final herbicide solution. Since the sprayer was replaceable plastic bottles, each treatment was applied in a new bottle and the lines were cleaned out to ensure no sprayer tank residue contamination.

The leaf stages at spraying were: sunflowers 2-4 and 6-8; lentils were 11 cm in height and the mustard had 5 leaves. The plots were hand weeded once to ensure that minimal weed-crop competition occured.

The rates of broadleaved herbicide used to reflect sprayer tank residues were 2%, 1%, 0.5% and 0.25% of field rates. These rates were chosen since in a 400 gallon sprayer they represent a residue in the tank and agitation lines of 8, 4, 2, 1 gallons respectively. From these percentages rates of herbicides were calculated. See Table 1 for rates used. These rates are based on a spray solution application rate of 110 l/ha (10 gal/ac). The use of higher water volumes would dilute the residue while the use of lower volumes would concentrate the residue and magnify effects shown by the data (ie. at 5 gallons per acre of

water the residue solution would be such that for the pecent residue values the rates of product applied would be double those used in this research). The field rates chosen were: 2,4-D 800 g/ha, MCPA 800 g/ha, dicamba 140 g/ha, Lontrel 300 g/ha and Glean 22.5 g/ha. For Glean the appropriate dilution of Agrol 90 was used in treatment preparation. The use of other rates would increase or decrease the concentration in the residual spray solution accordingly.

Table 2. Sunflower Yield kg/ha

Broadleaved Weed Herbicide	Check (Water at 110 l/ha)	Hoe-Grass (0.7 kg/ha)	Poast + Assist (0.35kg/ha + 1%)	Mean
[1]	[2]			
2,4-D	1716 bcd	1168 f	1609 de	1497 b
MCPA	1942 ab	1579 de	1900 abc	1807 a
Dicamba	1697 cd	1408 e	1973 a	1693 a
	1785 a	1384 b	1828 a	

[1] Data means presented from rates of 2%, 1%, 0.5% and 0.25% of field rate as simulated sprayer tank residues (see Table 1 for rates).

[2] Means followed by the same letter are not significantly different according to the L.S.D. test (P>0.05)

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Broadleaved weed herbicide formulations used were: 2,4-D and MCPA - 500 g/l Amine, dicamba 400 g/l Amine, Lontrel 200 g/l EC and Glean 75% DF. The two grassy weed herbicide formfulations were: Hoegrass 284 g/l EC and Poast 184 g/l EC.

RESULTS AND DISCUSSION

The results from the sunflower trials show that yield losses occur from sprayer tank residues of 2,4-D, MCPA or dicamba and that losses are increased when these residues are sprayed with Hoegrass or Poast plus Assist (Table 2,3). The 6-8 leaf stage was more sensitive to these herbicide combinations than the 2 - 4 leaf stage. The leaf stage effect was highly significant according to the F test (P>0.01). These two early growth stages of sunflowers are when wild oats or green foxtail are in the appropriate stage for application of Hoegrass or Poast.

Table 3. Sunflower Yield kg/ha

Rate as % of field rate of Phenoxy Herbicides	Broadleaved Weed Herbicides Pooled check+grass herbicides 2,4-D	MCPA	Dicamba	Mean
		[1]		
0.00	1664bc	2039a	2014a	1906a
0.25	1489cde	1776b	1776b	1699b
0.50	1402de	1906a	1789b	1681b
1.00	1507cd	1555cd	1621b	1561bc
2.00	1421cde	1758bc	1262d	1480c

[1] Means followed by the same letter are not significantly different according to the L.S.D. test (P>.05).

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When the yield means are established for grass herbicide (Table 1) Hoegrass overall had the greatest effect in reducing sunflower yield when mixed with 2,4-D, MCPA or dicamba. Poast was equal to the check, however, the Poast with 2,4-D caused a significant yield loss while this didn't occur with MCPA or dicamba. When the individual rates are analyzed Poast plus dicamba or MCPA at the high residual rate (2%) did reduce yield (data now shown). The overall effect was less when Poast was applied with the spray tank residue amounts of these phenoxy herbicides when compared with Hoegrass. It should be noted that these residual amounts (applied with no greassy weed herbicides ie: water) did reduce yield.

Of the three broadleaved herbicides applied alone (with water) 2,4-D and dicamba caused the greatest yield reduction. When analyzed with the check, Hoegrass and Poast data pooled 2,4-D had the greatest effect while MCPA and Banvel were equal. This difference is due to the differential interaction of the grassy weed herbicides with the broadleaved weed herbicides. Poast plus 2,4-D decreased yield more than Poast plus MCPA or dicamba while Hoegrass reduced yield with all three but to a greater extent with 2,4-D. Over the rates tested a significant reduction in yield was noted as the rate of residue increased (Table 3).

The effect of Lontrel on the simulated spray tank residue on lentils was similar to the broadleaved herbicides in the sunflower trials in that yield reduction occured from these rates. Lontrel alone reduced lentil yield but only at 3 and 6 g/ha (Table 4). Phytotoxicity was increased to the same degree by Poast plus Assist and Hoegrass, and was significant at the lowest rate tested of 0.75 g/ha. As the rate of Lontrel mixed

with Poast or Hoegrass increased to 6.00 g/ha a 94% yield loss occured.

The effect of Glean plus Agrol simulated spray tank residues on tame mustard were similar to residue effects on lentils and sunflowers in that yield reductions occured even at 0.25% of field rate (0.05 g/ha) (Table 5). In this case the addition of either Poast plus Assist or Hoegrass did not enhance phytotoxicity but followed the same yield reducing pattern as Glean alone.

Table 4. Lentil Yield (kg/ha)

Lontrel Rate g/ha	Check (Water at 110 l/ha)	Hoe-Grass (0.7 kg/ha)	Poast + Assist (0.35 kg/ha + 1%)	Mean
		[1]		
0.00	2017 ab	2097 ab	1785 abc	1966 a
0.75	2218 ab	1269 cde	1436 cd	1681 a
1.50	2285 a	745 ef	1142 de	1353 b
3.00	1696 bc	361 fg	470 fg	842 c
6.00	874 ef	132 g	146 g	384 d
	1819 a	921 b	996 b	

1.Means followed by the letter are different according the LSD test (P>0.05)

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CONCLUSION

Spray tank residues reduced yield in the three herbicide crop combinations tested. Yield reductions were increased with these simulated residue rates in sunflowers and lentils by the addition of a grassy weed herbicide. In sunflowers simulated residues of 2,4-D, MCPA and dicamba resulted in greater yield losses when mixed with Hoegrass than with Poast. In lentils both Poast plus Assist and Hoegrass decreased yield to the same extent compared with the residue rates alone. In tame mustard the addition of either grassy weed herbicide to Glean simulated residues did not increase yield losses compared with Glean alone.

Yield losses from rates of 2.00%, 1.00%, 0.50% and 0.25% of the field rates of broadleaved weed herbicides overall were greatest in lentils followed by mustard and then sunflowers. Since both Poast plus Assist and Hoegrass are registered in or safe on lentils mustard and sunflowers it is imparative the

growers clean spray tanks when switching from using 2,4-D, MCPA, dicamba, Lontrel or Glean into sensitive crops such as sunflowers, lentils or mustard. As was stated earlier a decrease in water volume per acre from the 110 l/ha (10 g/ac), or an increase or decrease in rates of broadleaved weed herbicide will consequently increase or decrease effects found in these trials.

Table 5. Mustard Yield (kg/ha)

Glean + Agrol g/ha (1%)	Check (Water @ 110 l/ha)	Hoe-Grass (0.70 kg/ha)	Poast + Assist (0.35 kg/ha + 1%)	Mean
0.00	2538 a[1]	2677 a	2751 a	2655 a
0.05	1505 bcde	1763 b	1719 bc	1662 b
0.11	1349 bcde	1309 bcde	1628 bcd	1429bc
0.22	1223 cde	1391 bcde	1570 bcde	1395bc
0.45	1123 e	1379 bcde	1192 de	1231 c
	1548 a	1772 a	1704 a	

[1] Means followed by the same letter are not significantly different at the 5% level according to the L.S.D. test.

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