Pulse Recrop on Clopyralid Residue – Implications for Thistle Management in Saskatchewan.

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Abstract

Canada thistle and perennial sowthistle pose severe limitations to successful pulse crop production in western Canada. Currently, no herbicides are registered for the control of these weeds in crop; consequently they must be managed prior to sowing pulse crops. Clopyralid-based cereal products (Curtail M [*], Prestige [*], Prevail [*] and Spectrum[*]) offer significant control of perennial thistles in the year of treatment as well as substantive thistle reduction (average 70%) in the second year. Clopyralid soil residues can affect the growth and yield of pulse crops grown in rotation with cereal crops. Field pea recrop label restriction has recently been removed from the Curtail M, Prestige and Prevail products. Weed-free field trials were conducted in Saskatchewan between 1997 and 2001 to determine the effect on lentil, dry bean and chickpea growth and crop yield when planted the year following a clopyralid application. Clopyralid applied at 75, 100, 150 and 200 g ae/ha did not reduce stand establishment or delay crop maturity of lentils, chickpeas or dry beans sown 11 months after herbicide application. No growth inhibition or crop injury was observed in any chickpea or dry bean field trial. In 1 of 9 field sites a slight and transient effect on lentil growth was observed from clopyralid soil residue. In all field trials, lentil, chickpea and dry bean crop yield was not significantly affected by clopyralid, applied 11 months previous, at rates as high as 200 g ae/ha compared to the weed-free check. Tillage regime, zerotill and conventional tillage, prior to seeding rotational crops did not interact with clopyralid residue to affect crop injury. The data suggests that lentils, dry beans and chickpeas can be rotated the year following clopyralid application of 100 g ae/ha.

Introduction

Canada thistle and perennial sowthistle pose severe limitations to successful crop production in western Canada. In the Dark Brown Soil Zone of Saskatchewan, 44% of the lentil fields contained Canada thistle and in the Black Soil Zone Canada thistle and perennial sowthistle were found in 77% and 73% of all pea fields, respectively (Saskatchewan Weed Survey, 1995). Currently, no herbicides are registered for the control of these weeds in crop; consequently, they must be managed prior to sowing pulse crops.

Clopyralid-based cereal products (e.g. Curtail M*, Prestige*, and Prevail*) offer significant control of perennial thistles in the year of treatment as well as significant thistle reduction

[*] Trademark of Dow AgroSciences LLC.

(average 70%) in the second year (SDAF Report, 1994; DAS field trials 1994-96). When in-crop clopyralid thistle treatments are combined with pre-harvest glyphosate, thistle control is greater than when either treatment is used alone (SDAF Report, 1994; DAS field trials, 1996-99).

Clopyralid soil residues can affect the growth and yield of pulse crops grown in rotation with cereal crops. Field trials were established in Saskatchewan form 1996-2001 to determine the sensitivity of lentils, chickpeas and field beans to potential clopyralid residues grown the year after clopyralid treatment.

Materials and Methods

Lentil and Chickpea recrop field sites were established in the Brown and Dark Brown Soil Zones from 1996-2000 at Swift Current, Scott, Osler, Saskatoon, Outlook, Davidson and Indian Head. Field Bean recrop sites were established in the Dark Brown and thin Black soil zones at Saskatoon, Outlook, Osler and Rosthern. Soil characteristics and precipitation at each site are tabulated in Tables 1-3, respectively. All crops were seeded and managed in accordance to sound agronomic principles. Chickpea varieties included both Kabuli and Desi types.

Each recrop site included clopyralid rates at 75, 100, 150 and 200 g ae/ha applied to cereal crops at approximately 100 L/ha spray volume the year previous. All field trials were randomized complete block designs with four replicates.

In four trials, tillage regime, zerotill and conventional tillage, prior to seeding rotational crops were incorporated as a split-block variable.

Plant stand establishment, early crop vigour and delay in maturity were assessed either by plant counts or by visual evaluations. All visual assessments were conducted on a 0-100 scale where 0 =no effect and 100=complete or total effect. Seed yield was obtained in all but one site (Davidson).

Table 1. Site Locations and Characteristics of Pulse Recrop Trials.

Trial #	RGF9801	LTJ01020	LTJ9710	AR19710	LTJ01008	LTJ0042	LTJ01009	LTJ01007	LTJ9851	LTJ0044	LTJ01005	LTJ0043
Location	**Davidson**	**Indian Head**	**Osler**	**Osler**	**Osler**	**Outlook**	**Rosthern**	**Saskatoon**	**Scott**	**Scott**	**Scott**	**Swift Current**
Year	1999	2001	1997	1998	2001	2000	2001	2001	1999	2000	2001	2000
Soil Type	Clay Loam	Clay	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Loam	Loam	Loam	Loam	Loam	Silt Loam
% O.M.	3.9	3.5	5	5	5.7	3	7.8	5.6	4	4	4	NA
Soil pH	7.3	7	6	6	6.3	7.6	7.6	7.3	6	6	6.5	6.5
App. Date	05-Jun-98	29-Jun-00	19-Jun-96	25-Jun-97	14-Jun-00	14-Jun-99	16-Jun-00	14-Jun-00	11-Jun-98	14-Jun-99	07-Jun-00	29-Jun-99
Crop	Chickpea	Chickpea	Lentil	Lentil	Chickpea	White Beans	Dry Beans	Chickpea	Chickpea	Lentil	Chickpea	Chickpea
Variety	Sanford	B 90	Laird	Laird	Desiray	Orthello	Pintium	Desiray	Sanford	Glamis	Myles	Sanford
Crop	Lentil	Lentil			Lentil			Lentil	Lentil		Lentil	
Variety	Laird	Milestone			Laird			Sovereign	Laird		Glamis	
Crop					Dry Beans			Dry Beans				
Variety					Pintium			Pintium				

Table 2. Monthly precipitation Expressed as a Percent of the 30-year average for Trials Conducted between 1996-2000*.

Trial #	**RGF9801**		**LTJ9851**		**LTJ9710**		**AR19710**		**LTJ0043**		**LTJ0042**	
Location	**Davidson**		**Scott**		**Osler**		**Osler**		**Swift Current**		**Outlook**	
Year	**1998**	**1999**	**1998**	**1999**	**1996**	**1997**	**1997**	**1998**	**1999**	**2000**	**1999**	**2000**
April	6 mm	25.4 mm	61	204	153	182	182	37	110	114	57	124
May	61.5 mm	108.8 mm	12	178	133	58	58	19	146	87	140	48
June	159.1 mm	99.7 mm	100	62	160	104	104	119	134	109	102	82
July	68.2 mm	129.8 mm	19	204	197	67	67	54	134	243	158	143
August	40.7 mm	28.3 mm	38	110	50	98	98	101	26	25	103	128
September	57.1 mm	8.3 mm	115	19	126	168	168	84	6	145	43	130
October	63.1 mm	18.9 mm	88	13	33	70	70	295	74	90	24	31

*Precipitation for Davidson is actual precipitation data.

Table 3. Monthly precipitation Expressed as a Percent of the 30-year average for Trials Conducted in 2000-01.

Trial #	**LTJ01009**		**LTJ01007**		**LTJ01020**		**LTJ0044**		**LTJ01008**	
Location	**Rosthern**		**Saskatoon**		**Indian Head**		**Scott**		**Osler**	
Year	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**
April	102	98	209	74	126	12	156	65	165	103
May	35	65	34	49	138	3	63	97	35	59
June	96	33	95	35	130	36	56	71	148	67
July	121	122	147	66	76	68	107	56	120	139
August	126	6	95	38	122	25	176	6	147	13
September	33	23	87	3	65	50	103	44	36	23
October	4	32	2	45	58	15	0	72	8	45

Results

Lentil, chickpea or dry bean plant stand establishment was not affected by clopyralid with rates as high as 200 g ae/ha applied the previous crop year. (Table 4). Similarly, no plant injury or biomass reduction was observed at any point of the growing season with field beans or chickpeas in any field trials (Table 5). In 1 of 9 lentil field sites a slight and transient effect on plant growth was observed from clopyralid soil residue (Table 6). In all field trials, clopyralid at rates as high as 200 g ae/ha applied the year previous, did not significantly affect lentil, field bean or chickpea seed yield compared to the weed-free check (Table 7). In four lentil field sites, tillage regime prior to seeding did not interact with clopyralid residue to affect crop injury response (data not shown).

Table 4. Dry Bean, Chickpea and Lentil Stand Establishment 11 months following Clopyralid Application.

		Stand Reduction*		
Treatment	Herbicide rate	Dry Bean	Chickpea	Lentil
	(g ae/ha)	(%)		
Clopyralid	75	0.0	0.0	0.0
Clopyralid	100	0.0	0.0	0.0
Clopyralid	150	0.0	0.0	0.0
Clopyralid	200	0.0	0.0	0.0
Untreated	0	0.0	0.0	0.0

*Data represents the average of 6, 7 and 8 sites for dry bean, chickpea and lentil, respectively.

Table 5. The Effect of Clopyralid Residue on Dry Bean and Chickpea Plant Injury.

		Crop Injury	
Treatment	Herbicide rate	Dry Bean	Chickpea
	(g ae/ha)	(%)	
Clopyralid	75	0.0	0.0
Clopyralid	100	0.0	0.0
Clopyralid	150	0.0	0.0
Clopyralid	200	0.0	0.0
Untreated	0	0.0	0.0

*Data represents the average of 6 and 7 sites for dry bean and chickpea, respectively.

Table 6. Lentil Crop Injury Response 11 months after Clopyralid Application.

		Crop Injury*		
Treatment	Herbicide rate	Early-Season	Mid-season	Late-Season
	(g ae/ha)		(%)	
Clopyralid	75	0.1	0.0	0.0
Clopyralid	100	0.8	0.0	0.0
Clopyralid	150	0.8	0.2	0.0
Clopyralid	200	1.6	0.8	0.8
Untreated	0	0.0	0.0	0.0

*Data represents the average of 9 sites.

Table 7. Dry Bean, Chickpea and Lentil Seed Yield 11 Months after Clopyralid Application.

		Crop Yield*		
Treatment	Herbicide rate	Dry Bean	Chickpea	Lentil
	(g ae/ha)		(% of Untreated)	
Clopyralid	75	114.9	101.4	110.0
Clopyralid	100	124.2	107.8	109.4
Clopyralid	150	121.4	106.7	106.7
Clopyralid	200	109.6	96.2	105.7
Untreated	0	100.0	100.0	100.0

*Data represents the average of 4, 6 and 8 sites for bean, chickpea and lentil, respectively.

Discussion

Clopyralid is degraded by soil microbial processes (Baloch and Grant, 1991). As such, degradation is enhanced by higher soil moisture and temperature conditions. With clopyralid, initial rate of application or starting soil concentration influences the rate of degradation. Clopyralid rates between 75 and 200 g ae/ha applied the previous growing season did not affect the recropping of treated fields to lentils, chickpeas or field beans. Precipitation and temperature between June and October in the year of application largely determines the carryover potential of clopyralid during the subsequent recrop year. In most locations precipitation was average to above average compared to their respective long-term averages during the year of clopyralid application (year of establishment – June to October; Tables 2 and 3). Trials located in Scott, SK

in 1998 and to a lessor extent in Swift Current in 1999 experienced less than normal precipitation during the growing season of the application year. However, there were no differences in crop response to clopyralid carryover between locations experiencing below average or average-above average precipitation. Similarly, tillage regime prior to seeding did not significantly impact crop response to clopyralid carryover.

Lentils, chickpeas, and field beans can be rotated the following year to fields previously treated with clopyralid at 100 g ae/ha. Additional data generated under severe drought conditions during the year of clopyralid treatment would extend the robustness of the current database.

References

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