

Control of Winter Annuals in Reduced Tillage Systems



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August 2005

1. Introduction

Winter annuals germinate in the fall, over-winter as low rosettes, resume their growth following spring, and flower and go to seed in late spring or early summer. In Alberta, the commonly occurring winter annuals are stinkweed, shepherd's-purse, narrow-leaved hawk's-beard, bluebur, flixweed, downy brome and common peppergrass. In some reduced tillage fields, during mild winters, some summer annuals can over-winter and exhibit winter annual habits. Some of the examples of this abnormal growth habit are cleavers, black medic, stork's-bill, and night-flowering catchfly. Rosettes of winter annuals are strong competitors because of their rapid growth in the spring, and, if not controlled, they have the potential to cause serious yield losses in annual and perennial crops.

2. Growth and Reproductive Characteristics

- Most seedlings emerge from late August through October and form low rosettes that over-winter, grow rapidly and form flowering shoots in early spring. A few seedlings may also emerge in early spring.
- Winter annuals are prolific seed producers (Table 1) and their spread is mainly by seed.

Table 1. Seed productions of winter annuals

Weed Species	Seed Production
Stinkweed	15,000 seeds/plant
Narrow-leaved hawks-beard	3360 – 49,420 seeds/plant
Downy brome	450 kg of seed ha ⁻¹ (330,000 seeds kg ⁻¹)
Shepherd's-purse	33,509 seeds/plant
Flixweed	75,650 seeds/plant
Common peppergrass	6,009 seeds/plant

- Seeds mature from June to July and shatter within a week of maturity; depending upon the weed species
- Most of the winter annuals (e.g. narrow-leaved hawk's-beard), exhibit little or no seed dormancy, however, seeds of some winter annuals can remain dormant for a long time.

3. Geographical Distribution of Winter Annuals in Alberta

According to the 2001 Alberta weed survey, stinkweed, shepherd's-purse and narrow-leaved hawk's-beard are among the top twenty weed species occurring in Alberta (Leeson et al 2001). The frequency and density data from six different eco-regions is summarized in Table 1. In north-central Alberta (Peace Lowland, Boreal Transition and Aspen Parkland eco-regions), stinkweed, shepherd's-purse and narrow-leaved hawk's-beard are the most abundant species, whereas, in southeastern Alberta (Moist Mixed Grasslands, Fescue Grassland and Mixed Grassland eco-regions) stinkweed, flixweed, shepherd's-purse, and downy brome are the commonly occurring species.

Table 2. Distribution of winter annuals in various eco-regions of Alberta

Winter Annual Species	Frequency* and Density** (%)						
	Peace Lowland	Boreal Transition	Aspen Parkland	Moist Mixed Grassland	Fescue Grassland	Mixed Grassland	Alberta (all eco-regions)
Stinkweed	49 (11)***	32 (7)	34 (4)	24 (5)	33 (1)	8 (4)	30 (6)
Shepherd's-purse	14 (8)	22 (3)	27 (5)	4 (2)	16 (5)	1 (0.2)	16 (4)
Narrow-leaved hawk's-beard	38 (5)	23 (2)	13 (2)	6 (1)	4 (0.3)	1 (1)	14 (5)
Bluebur	16 (8)	4 (3)	2 (2)	1 (1)	4 (0.5)	1 (0.2)	4 (5)
Flixweed			2 (1)	8 (1)	13 (5)	4 (4)	4 (3)
Downy brome		1 (1)	0.2 (2)	0.4 (0.4)	1 (21)	1 (1)	0.5 (4)
Common peppergrass	1 (1)			1 (1)			0.4 (1)
Wood whitlowgrass			1 (0.3)		1 (0.2)		0.3 (0.3)

* Frequency is number of locations in which a weed was found expressed as a percentage, and density is the number of plants of a species counted in a square meter averaged over all locations. *** Frequency (%) is followed by density (%).

Adapted from: Leeson et al. 2002 Alberta Weed Survey Cereals, Oilseed and Pulse Crops

4. Winter Annuals in Reduced Tillage

Winter weed populations respond differently to reduced tillage practices. Blackshaw (2001) and Derksen and Lafond (1997) have shown that reduced tillage practices often result in an increase in winter annuals (Table 1). There are two main reasons for this increase:

- There is no fall tillage to disrupt their life cycle.
- The cool and moist conditions of reduced tillage provide ideal conditions for seed germination.

Table 3. Effect of Reduced Tillage on Winter Annuals

Weed Species	Response to Reduced Tillage	References
Downy brome	Increased	Blackshaw, 2001
Narrow-leaved hawk's-beard	Increased	Blackshaw, 2001
Common peppergrass	Increased	Blackshaw, 2001
Wood whitlowgrass	Increased	Blackshaw, 2001
Flixweed	Unaffected	Blackshaw, 2001
Shepherd's purse	Unaffected	Blackshaw, 2001
Stinkweed	Unaffected	Derksen and Lafond 1997

5. Management of Winter Annuals in Reduced Tillage

The management of winter annuals in reduced tillage should focus on prevention of seed production and their recruitment to the soil seed bank.

5.1 Winter Annual Control Options

Herbicides are the most important part of a winter annual control program; however, they should be used in combination with preventative (crop sanitation), and cultural (use of certified seed, shallow seeding, using competitive crop varieties, and crop rotations) methods of control

5.1.1 Late Fall Application

Late fall applications of 2,4-D or MCPA provide the most economical and consistent control of emerged winter annuals; however, this treatment will not control spring emerging seedlings. In the fall, these weeds are small, actively growing, and are susceptible to herbicide application. Moreover, the environmental conditions in the fall are more favorable for herbicide translocation than in the early spring. A study conducted at Scott, SK, showed that fall applications of 2,4-D provided excellent control of stinkweed and flixweed as compared to spring applications (Table 4).

Table 4. Effect of application timing on dry weight (gm/m²) of stinkweed and flixweed in winter wheat.

Application Timing*	Stinkweed		Flixweed	
	Density	Dry weight	Density	Dry weight
	(Shoots/m ²)	(gm/m ²)	(Shoots/m ²)	(gm/m ²)
Untreated	11	122	8	40
September 25	1	1	1	7
October 27	0	0	0	0
April 28	1	3	1	6
May 13	6	35	5	43

*2,4-D amine 500 applied at 0.45L/acre. Weeds count (shoots m⁻²) and dry weigh (gm m⁻²) were made in late June.

Source: K. Kirkland, Agriculture and Agri-Food Canada, Scott, SK.

2,4-D Soil Residues and Sensitive Broad-leaved Rotational Crops

Under ideal growing conditions, the residues of 2,4-D in the soil may persist from 1 to 4 weeks and have the potential to cause injury to sensitive rotational crops; however, recropping studies at in the Dark Brown zones of Lethbridge and Saskatoon showed that 2,4-D applied in the fall at 0.17 kg to 0.34 kg active ingredient per acre had no effect on canola, whereas a spring application reduced canola yield. In both of these studies lentils were more sensitive to fall and spring applications of 2,4-D as compared to peas (Tables 5 – 7).

Table 5. Effects of 2,4-D and Dicamba residues from fall applications on canola, alfalfa, peas and lentils

Herbicide	Rate (L/Acre)	Yield (Check = 100)			
		Canola	Alfalfa	Peas	Lentils
Untreated	-	100	100	100	100
2,4-D amine 500	0.34	101	103	110	82
2,4-D amine 500	0.68	104	98	92	75
2,4-D LV ester 600	0.28	100	82	92	86
2,4-D LV ester 600	0.56	109	86	94	73
Banvel II	0.11	96	81	94	74

Source: J.R. Moyer, Agriculture Canada, Lethbridge, Alberta

Table 6. Effect of soil residues from 2,4-D and Dicamba applied 0 and 15 days prior to seeding on canola, alfalfa, peas and lentils

Herbicide	Rate (L/Acre)	Days before seeding	Yield (Check = 100)			
			Canola	Alfalfa	Pea	Lentil
Untreated	-	-	100	100	100	100
2,4-D LV ester 600	0.38	15	84	87	68	30
2,4-D LV ester 600	0.38	0	84	95	50	20
Banvel II	0.11	15	105	117	91	32
Banvel II	0.11	0	102	105	85	19

Source: J.R. Moyer, Agriculture Canada, Lethbridge, Alberta

Table 7. Number of years yield reduced by spring-applied 2,4-D at 0.45 L/ac (Saskatoon)

Crops	Sandy Loam	Clay Loam
Lentils	2 out of 3	1 out of 3
Canola	2 out of 3	0 out of 3
Sunola	1 out of 2	0 out of 2
Flax	2 out of 3	0 out of 3
Peas	1 out of 1	1 out of 2

Source: R. Holm, University of Saskatchewan

5.1.2 Spring Pre-seeding Weed Burndown Application

Winters annuals can be controlled in the early spring with the use of burndown herbicides, provided weeds are small, actively growing, fall rosettes have not bolted, and weather conditions are favorable for herbicide uptake and translocation (Table 8).

Table 8. Control of winter annuals before seeding or after seeding but prior to crop emergence

Products	Rate per Acre	Weeds Controlled	Weed Stage	Cropping restriction
<i>glyphosate</i> *	0.51 – 0.77 L	Downy brome, flixweed, stinkweed, Narrow-leaved hawk's-beard	< 6-inches tall	None
PrePass	PrePass A: 0.04 L PrePass B: 0.5 L	Downy brome	1-4 leaf stage	Only spring wheat (including durum), barley and oats may be seeded after application
		Flixweed	1-4 leaf stage	
		Narrow-leaved hawk's-beard	Up to 3 inches tall	
		Shepherd's-purse	1-4 leaf stage	
		Stinkweed	1-4 leaf stage	
Roundup Original or Roundup Transorb + Express TNG + Agral 90	Roundup Original or Roundup Transorb: 0.5 L/Ac + Express TNG: 4 g. + Agral 90: 0.35% V/V.	Narrow-leaved hawk's-beard (suppression) Flixweed	Fall rosette and spring seedling	Spring wheat (including durum) and barley may be seeded 24 hrs after application. Canola, flax, lentil, alfalfa may be planted 2 months after application
Roundup Original or Roundup Transorb + Express TNG	Roundup Original or Roundup Transorb: 0.5 L/Ac + Express TNG: 4 g.	Downy brome	Up to 6-inches	
		Flixweed	Up to 6-inches	
		Narrow-leaved hawk's-beard	Up to 3 inches	
		Stinkweed	Up to 6 inches	

*glyphosate** containing products are Credit, Factor, Glyphos, Maverick, Renegade, Roundup Dry, Roundup Original, Roundup Transorb, Roundup Ultra, Roundup WeatherMax, Touchdown iQ, Vantage, Vantage Plus.

5.1.3 Control of Winter Annuals in Herbicide Resistant Crops.

The use of herbicide resistant crops such as Roundup Ready, CLEARFIELD and Liberty Link provides another option for the control of winter weeds. For best results, applications should be made early, when weeds are small and before the rosettes have bolted (Table 9).

Table 9. Winter Annual Control in Herbicide Resistant Crops

Weed Species	Registered Crops	Registered Herbicides	Weed Stage
Flixweed	Roundup Ready canola	<i>glyphosate</i> *	Cotyledon to 6 leaf stage of RR canola
	CLEARFIELD canola	Absolute, Odyssey, Pursuit, Pursuit Ultra	Up to 4 leaf stage
	CLEARFIELD wheat	Adrenalin	Up to 4 leaf stage
Narrow-leaved hawk's-beard	Roundup Ready canola	<i>glyphosate</i>	Cotyledon to 6 leaf stage of RR canola
Stinkweed	Roundup Ready canola	<i>glyphosate</i>	Cotyledon to 6 leaf stage of RR canola
	CLEARFIELD wheat	Adrenalin	Up to 4 leaf stage
	CLEARFIELD canola	Absolute, Odyssey, Pursuit, Pursuit Ultra	Up to 4 leaf stage

*glyphosate** containing products are Credit, Factor, Glyfos, Maverick, Renegade, Roundup Dry, Roundup Original, Roundup Transorb, Roundup Ultra, Roundup WeatherMax, Touchdown iQ, Vantage, Vantage Plus.

5.1.4 Spring in-crop Application

A number of herbicides are registered for winter annual control in cereals, oil-seed and pulse crops (Table 10). These herbicides will only provide good control if the weeds are in the seedling stage. By in-crop treatment time, most of the rosettes have already bolted and will not be controlled.

Table 10. Registered herbicides for the in-crop control of winter annuals

Weed species	Crop	Registered Herbicides
Bluebur	Barley	Achieve Liquid Gold, Ally, Attain, <i>bromoxynil</i> *, <i>bromoxynil + 2,4-D ester</i> ** , <i>bromoxynil + MCPA ester</i> ***, 2,4-D, 2,4-D + <i>dichlorprop</i> ***, MCPA.
	Wheat	Above products plus Frontline 2,4-D, Horizon BTM
	Oats	<i>bromoxynil</i> , <i>bromoxynil + MCPA</i> , MCPA (All formulations)
	Flax	<i>bromoxynil + MCPA</i> , Elite, MCPA,
Flixweed	Barley	Achieve Liquid Gold, Ally, Attain, Banvel II, <i>bromoxynil + 2,4-D ester</i> , <i>bromoxynil + MCPA</i> , Curtail M, DyVel, DyVel DSp, 2,4-D, 2,4-D + <i>dichlorprop</i> , Express Pack, Frontline, MCPA, <i>MCPA + mecoprop + dicamba</i> , Prestige, Prevail, Spectrum, Refine Extra, Trophy.
	Wheat	Above products plus Frontline 2,4-D, Harmony Total, Horizon BTM, K2, Unity
	Oats	<i>bromoxynil + MCPA ester</i> , Banvel II, Curtail M, DyVel, Frontline, MCPA, Refine Extra, Spectrum, <i>MCPA + mecoprop + dicamba</i> *****.
	Canola (conventional)	Muster, Muster Gold II
Narrow leaved-hawk's-beard	Barley	Ally + 2,4-D, 2,4-D, 2,4-DB, Express Pack, Refine Extra
	Wheat	Above products plus Harmony Total, K2.
	Oats	2,4-DB, Refine Extra
Shepherd's-purse and Stinkweed	Barley	Achieve Liquid Gold, Ally, Assert, Attain, <i>bromoxynil + 2,4-D ester</i> , <i>bromoxynil + MCPA</i> , Champion Extra, Crossfire, Curtail M, DyVel, DyVel DSp, 2,4-D, 2,4-D + <i>dichlorprop</i> , 2,4-DB, Express Pack, Frontline, Hoe-Grass II, Koril, MCPA, <i>MCPB + MCPA</i> ****, <i>MCPA + mecoprop + dicamba</i> , Prestige, Prevail, Refine Extra, Sencor, Spectrum, Trophy.
	Wheat	Above products plus Frontline 2,4-D, Horizon BTM, K2.

	Oats	<i>bromoxynil + 2,4-D</i> , <i>bromoxynil + MCPA</i> , Banvel II, Curtail M, DyVel, 2,4-DB, Frontline, MCPA, <i>MCPB + MCPA</i> , <i>MCPA + mecoprop + dicamba</i> , Refine Extra, Spectrum,
	Canola (conventional)	Muster, Muster Gold II (stinkweed only)
	Flax	<i>bromoxynil + MCPA</i> , Basagran, Elite, FlaxMax, MCPA.
	Lentils	Basagran (Shepherd's-purse only), Sencor (stinkweed only)
	Field corn	<i>bromoxynil + 2,4-D</i> , <i>bromoxynil + MCPA</i> , Basagran, Basagran Forte, DyVel DS, 2,4-D, 2,4-D B, MCPA amine, MCPA K-salt MCPA Na-salt, <i>MCPB + MCPA</i> .
Shepherd's-purse	Peas	Basagran, Basagran Forte, <i>MCPB + MCPA</i> , MCPA amine, MCPA Na-salt, Pursuit.
Stinkweed	Peas	Basagran, Basagran Forte, <i>MCPB + MCPA</i> , MCPA amine, MCPA Na-salt, Odyssey, Pea Pack, Pursuit, Pursuit Ultra, Sencor.

* *bromoxynil* = Pardner, Koril; ** *bromoxynil + 2,4-D* = Approve, Thumper, *** *bromoxynil + MCPA* = Buctril M, Badge, Mextrol; **** *2,4-D + dichlorprop* = Estaprop, Turboprop 600, Dichlorprop-D; ; *2,4-DB* = Embutox 625, Caliber 400, Cobutox 600; ***** *MCPB + MCPA* = Tropotox Plus, Clovitox Plus, Topside; ***** *MCPA + mecoprop + dicamba* = Target, Sword

6 Summary

Winter annuals germinate in the fall, over-winter as low rosettes, resume their growth the following spring, and flower and go to seed in late spring or early summer. Winter annuals can be most effectively and economically controlled in the late fall (before soil freeze-up) by using phenoxy herbicides (2,4-D and MCPA). The risk of crop injury on sensitive broad-leaved crops is far less than with a spring application. Weed burndown applications prior to seeding and early spring applications in herbicide resistant crops are other options for the control of winter annuals; however, the results will vary according to weed size and prevailing environmental conditions.

7 References:

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