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EARLY EFFECTS OF CROP ROTATION ON DOWNY BROME IN DRYLAND WINTER WHEAT

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INTRODUCTION

It is well known that changing a crop rotation sequence can be used as a means to manage particular weed problems in dryland winter wheat (Blackshaw, Lyon and Baltensperger). Advocating a crop rotation sequence different from those typically employed by commercial operators creates difficulties. Production practices are poorly defined, commodity programs restrict adoption, and most importantly, short-term profitability might be less than from more commonly practiced crop rotations, particularly if equipment purchases are necessary. Weed problems such as downy brome (*Bromus tectorum* L.) and jointed goatgrass (*Aegilops cylindrica*) in dryland winter wheat-fallow crop rotations cannot be controlled consistently by methods other than crop rotations that exclude winter wheat for more than two years. Because winter wheat/conservation tillage systems are especially susceptible to downy brome infestations, a study was initiated to investigate the agronomic and economic feasibility of utilizing crop rotation sequences other than winter wheat-fallow in conjunction with conservation practices to manage downy brome under climatic and edaphic conditions that exist in substantial areas of the dryland wheat production areas of northeastern Oregon.

METHODS AND MATERIALS

Large, replicated plots were established in spring 1993 on a commercial field near Pilot Rock, Oregon (Gilliland Site) to compare the effectiveness of several dryland wheat crop rotations for downy brome control, soil and water conservation, and economic viability. A second site with the same crop rotation treatments was established in spring 1994 (Shaw Site). A standard wheat-fallow cropping system was compared to cropping systems designed to optimize downy brome management and maintain compliance regulations. The experiment will conclude when all plots are planted to winter wheat (6 years each location). Cropping systems strategies include:

1) Winter wheat-fallow system utilizing conservation tillage without chemical fallow.

2) Winter wheat-fallow system utilizing conservation tillage with chemical fallow.

3) Winter wheat-barley-fallow rotation utilizing conservation tillage without chemical fallow.

4) Winter wheat-barley-fallow rotation utilizing conservation tillage with chemical fallow.

5) Winter or spring wheat-fallow-canola rotation utilizing conservation tillage.

6) Winter wheat-fallow system utilizing moldboard plowing (conventional practice).

7) Continuous, no-till spring wheat (Shaw site only).

Individual plots are approximately 0.5 acres in size with four replications and managed by growers and research station staff using field scale equipment. Conservation tillage treatments (1 through 5) employ chisel plowing as the primary tillage and are compared to the conventional, commercial practice of moldboard plow primary tillage (treatment 6). The chemical fallow treatments (2 and 4) consist of a currently registered herbicide treatment (Roundup, Landmaster, or

Sure-Fire) applied after grain harvest in the fall, and if necessary, again in the spring before a summer fallow period. Conventional fallow treatments (treatments 1 and 3) utilize sweep or disc tillage in the fall, and if necessary, a non-residual herbicide treatment (Roundup) in the spring.

The second site established in spring 1994 (Shaw Site) consists of the same crop rotation treatments as in the first site plus a continuous, no-till spring hard, red wheat rotation. Evaluations were made of total weed populations with emphasis on downy brome at both sites in January 1995 and again in late April. Surface residue cover measurements were made using a line transect method in December 1995. Crop yields at both sites were estimated by harvesting the entire plot area with commercial equipment and weighing .

RESULTS AND DISCUSSION

At the Shaw site, January weed counts (Table 1a) showed that downy brome and volunteer wheat were most prevalent in the wheat-barley three year rotation utilizing sweep tillage on stubble in the fall (treatment 3) and in the no-till (treatment 7) due to no herbicide application the previous fall. Downy brome and volunteer cereals were not evident at the April weed count (Table 1b) for treatments 3 and 7 where grass weeds were controlled by spring-applied Roundup. Also at the April weed count, the three year rotation utilizing chemical fallow (treatment 4) had greater levels of broadleaf and grass weeds than the three year rotation utilizing fall tillage (treatment 3) due to depletion of residual chemical control (Command + Atrazine) applied to treatment 4 the previous fall. At this site, fall tillage and spring-applied Roundup controlled downy brome and volunteer cereals in post-harvest stubble more effectively than did a single residual herbicide on stubble in the fall.

Downy brome populations were not different between plow (treatment 6) and chisel (treatments 1 and 2), but were greater compared to the other crop rotations since they were in winter wheat production at the

Table 1a. Influence of cropping system on weed populations, January 27, 1995 - Shaw Site.

Tmt. No.	Treatment*	Downy Brome	Vol. Cereal	Russian Thistle	Kochia	Prickly Lettuce	Other Weeds
		---------- plants/ m^2 ----------					
	Chisel						
1	W-F Conv Fallow	7	0	0	0	0	0
2	W-F Chem Fallow	4	0	0	0	0	0
3	F-W-B Conv Fallow	10	27	0	0	0	0
4	F-W-B Chem Fallow	1	1	0	0	0	0
5	C-W-F Conv Fallow	3	0	0	0	0	0
7	SW No-Till	19	36	0	0	0	0
	Plow						
6	W-F Conv Fallow	3	0	0	0	0	0
	(LSD 0.05)	8	9	NS	NS	NS	NS

* The first crop indicated on the treatment list was present at the time of weed counts.
F = fallow, W = winter wheat, SW = spring wheat, C = canola, B = barley.

Table 1b. Influence of cropping system on weed populations, April 25, 1995 - Shaw Site.

Tmt. No.	Treatment*	Downy Brome	Vol. Cereal	Russian Thistle	Kochia	Prickly Lettuce	Other Weeds
		---------- plants/ m^2 ----------					
	Chisel						
1	W-F Conv Fallow	37	0	0	0	1	0
2	W-F Chem Fallow	42	0	1	0	1	0
3	F-W-B Conv Fallow	0	1	0	0	2	0
4	F-W-B Chem Fallow	19	37	13	10	47	0
5	C-W-F Conv Fallow	--	--	--	--	--	--
7	SW No-Till	0	0	17	9	4	3
	Plow						
6	W-F Conv Fallow	30	0	2	0	1	1
	(LSD 0.05)	16	6	8	4	10	2

* The first crop indicated on the treatment list was present at the time of weed counts.
W = winter wheat, SW = spring wheat, F = fallow, B = barley, C = Canola.

time of weed counts (Table 1b). No downy brome was present in spring seeded wheat at the time of April weed counts (treatment 7).

The crop rotations in 1995 were in a different phase at the Gilliland and Shaw sites. At both the January (Tables 1c), and April (Table 1d) weed sampling dates the three year wheat-barley rotation utilizing sweep tillage for fall weed management in stubble (treatment 3) resulted in less downy brome in the subsequent wheat crop than did the three year wheat-barley rotation utilizing chemical weed management on stubble in the fall (treatment 4). Downy brome levels in January were extremely high in winter wheat following a fall seed canola crop (treatment 5, Table 1c), which necessitated removal of the winter wheat crop and reseeding with spring wheat in February. This heavy downy brome infestation after fall canola production constitutes a major constraint to re-cropping winter wheat after a fall seeded canola crop. Moldboard plowed wheat-fallow plots (treatment 6) had more downy brome than did chiseled wheat-fallow plots (treatments 1 and 2) because moldboard plowing had not been completed and chiseling had been performed at the time of April weed counts (Table 1d). Changes in downy brome, and other weed problems, will be further elucidated from evaluations made in coming years.

Surface residue cover has been adequate to meet conservation compliance regulations on all conservation tillage treatments. Surface residue counts reflected the crop rotation phase present when the residue measurements were taken. Percent residue cover in newly seeded winter wheat was higher in wheat-fallow rotations utilizing chisel compared to moldboard plowing. Fall seeded canola provided high amounts of green cover going into winter (Table 2).

Wheat yields in 1995 from the chisel based wheat-fallow rotation at the Shaw site were slightly lower than the conventional crop rotation practice. These crop yields reflect the lower yields that can occur when changing tillage regimes (Tables 3a). Fall canola yields were also disappointingly low at the Shaw site in 1995. Wheat yields at the Gilliland site in 1995 were typical for that site (Table 3b).

Table 1c. Influence of cropping system on weed populations, January 27, 1995 - Gilliland Site.

Tmt. No.	Treatment*	Downy Brome	Vol. Cereal	Russian Thistle	Kochia	Other Weeds
		---------- plants/ m^2 ----------				
	Chisel					
1	F-W Conv Fallow	28	52	0	0	0
2	F-W Chem Fallow	16	7	0	0	0
3	W-F-B Conv Fallow	31	0	0	0	0
4	W-F-B Chem Fallow	76	0	0	0	0
5	SW-F-C Conv Fallow**	135	0	0	0	0
	Plow					
6	F-W Conv Fallow	3	16	0	0	0
	(LSD 0.05)	48	15	ns	ns	ns

* The first crop indicated on the treatment list was present at the time of weed counts.
** Counts made prior to planting spring wheat.
F = fallow, W = winter wheat, SW = spring wheat, C = canola, B = barley.

Table 1d. Influence of cropping system on weed populations, April 27, 1995 - Gilliland Site.

Tmt. No.	Treatment*	Downy Brome	Vol. Cereal	Russian Thistle	Kochia	Other Weeds
		---------- plants/ m^2 ----------				
	Chisel					
1	F-W Conv Fallow	0	0	4	0	0
2	F-W Chem Fallow	1	0	20	0	0
3	W-F-B Conv Fallow	65	0	1	0	0
4	W-F-B Chem Fallow	137	0	2	0	0
5	SW-F-C Conv Fallow	0	0	44	1	99
	Plow					
6	F-W Conv Fallow	90	285	47	0	32
	(LSD 0.05)	31	30	20	ns	14

* The first crop indicated on the treatment list was present at the time of weed counts.
F = fallow, W = winter wheat, SW = spring wheat, C = canola, B = barley.

New production practices, fertilizer needs, tillage requirements, and pest management operations were required to establish and maintain these crop rotations, which emphasizes the need for more agronomic information before successful development of alternative crop rotation systems can occur. Specifically needed are acceptable protocols for fertilization, and tillage methods, and methods to establish winter wheat following canola, canola following winter wheat, or recropping of spring barley following winter wheat. Recommendations for these alternative cropping practices will be partly developed from this study.

REFERENCES

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Lyon, D, J., and D. D. Baltensperger. 1995. Cropping systems control winter annual grass weeds in winter wheat. J. Prod. Agric., 8 (4): 535-539.

Table 2. Influence of cropping system on ground cover, Gilliland and Shaw Sites.

Treatment*	Gilliland Site, Dec. 1, 1993 Residue	Green Cover	Clods >2"	Shaw Site, Dec 1, 1994 Residue	Green Cover	Clods >2"
	---------- % cover ----------					
Chisel						
W-F Conv Fallow	5	21	1	19	27	2
W-F Chem Fallow	9	16	1	20	29	0
F-W-B Conv Fallow	75	0	3	18	0	7
F-W-B Chem Fallow	89	0	0	30	0	0
C-W-F Conv Fallow	1	89	0	4	82	0
No-Till						
SW-SW	--	--	--	31	0	1
Plow						
W-F Conv Fallow	1	5	10	8	33	1

* The first crop indicated on the treatment list was present at the time of weed counts. W = winter wheat, SW = spring wheat, F = fallow, B = barley, C = Canola.

Table 3a. Crop yield summaries from Shaw site for 1995.

Treatment	Description	Yield	Notes
1	Winter Wheat (chiseled)- Conventional Fallow (swept stubble)	'Madsen' 77.7 bu/A	Seeded 9/19/94, Hoe-drill
2	Winter Wheat (chiseled)- Chemical Fallow (standing stubble)	'Madsen' 78.5 bu/A	Seeded 9/19/94, Hoe-drill
5	Fall Canola-W Wheat-Conventional Fallow (swept stubble)	'Arabella' 1380 lb/A	Seeded 8/29/94, JD HZ drill, 8 #/A
6	Winter Wheat (plowed)- Conventional Fallow	'Madsen' 90.0 bu/A	Seeded 9/19/94, Hoe-drill
7	Continuous Spring Wheat (no-till)	'936R' HRS 46.4 bu/A	Seeded 3/7/95, Great Plains drill

Table 3b. Crop yield summaries from Gilliland site for 1995.

Treatment	Description	Yield	Notes
3	Winter Wheat (chiseled)- Spring Barley- Conventional Fallow (swept stubble)	'Stephens' 57 bu/A	Seeded 10/13/94, Double Disk, 82#/A
4	Winter Wheat (chiseled)- Spring Barley- Chemical Fallow (standing stubble)	'Stephens' 60 bu/A	Seeded 10/13/94, Double Disk, 82#/A
5 *	Spring Wheat (chiseled)- Conventional Fallow-Fall Canola	'Wakanz' 40 bu/A	Seeded 3/6/95, Double Disk, 80#/A

* This treatment was originally seeded with 'Stephens' winter wheat in canola stubble on 10/28/94, but was tilled out with disking due to heavy downy brome, and reseeded with 'Wakanz' spring wheat on 2/21/95.