THE EFFECT OF SEEDING DEPTH AND SOIL INCORPORATED HERBICIDES ON SPRING WHEAT

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INTRODUCTION

Triallate and trifluralin are selective, pre-emergent, soil incorporated herbicides which inhibit growth of germinating seedlings. Triallate is used extensively in Western Canada for the control of wild oats (Avena fatua). Trifluralin is widely used in wheat and a number of other crops (Billet and Ashford, 1978). Fortress is a granular formulation of triallate and trifluralin combined in the ratio 10:4.

The primary region of absorption of triallate in barley, wheat and wild oats is located 10 to 15 mm above their coleoptilar nodes. It was concluded by Banting (1967) that the primary site of triallate action is the stem apex and developing tissue above the coleoptilar node. The major phytotoxic effect of triallate is on cell elongation or expansion of the shoots (Banting 1970; Billet and Ashford 1978). Trifluralin is classed as a mitotic inhibitor or mitotic "poison" which does not directly inhibit seed germination (Parka and Soper, 1977; WSSA Herbicide Handbook, 1983).

It can inhibit coleoptile elongation to the extent that the coleoptile fails to emerge above the soil surface (Rahman and Ashford, 1970). According to Billet and Ashford (1970) trifluralin causes its greatest phytotoxic effect in the meristematic tissue at the region of the coleoptilar node.

The basis of selectivity is dependent on placement of the crop seed below the treated layer of soil and followed by shallow incorporation of the herbicides. The standard recommendation for triallate and trifluralin is to seed the crop at a uniform depth of 5-7.5 cm and then apply and incorporate the herbicides to a depth of 5 cm using two passes of spring or diamond harrows. Fortress is normally applied in fall but in this study it was applied and incorporated after seeding in spring.

Emergence of most grasses including wheat is largely dependent on the elongation of the coleoptile and the first internode. The first internode of wheat, however, does not elongate as the seedling develops. Consequently, the coleoptilar node remains closely associated with the caryopsis. Since semi-dwarf wheats like HY320 have shorter coleoptiles and thus must be seeded at a shallower depth than standard height wheats, there is a potential for greater crop injury from the use of these soil incorporated treatments. Experiments were therefore conducted to determine whether or not these soil incorporated treatments are safe to use on semi-dwarf wheats like HY320. The main objectives of the experiments were:

1) To examine the effects of seeding depths on the varietal tolerance to the herbicides

2) To evaluate the performance of HY320 and Katepwa at different rates of triallate and trifluralin under different field conditions

3) To determine varietal differences in tolerance to the herbicides

MATERIALS AND METHODS

A growth chamber experiment was set up to measure emergence, plant shoot dry weight and coleoptile length for HY320 and Katepwa at 5 different seeding depths. The results for coleoptile length are shown in Fig. 1.

The field experiments were carried out at Goodale and Kernen farms near Saskatoon. in the 1985-87 crop seasons using HY320 and Katepwa wheat varieties. In 1985-86 crop seasons the soils at Goodale had a loam texture with organic matter of 3.4% and the Kernen site had clay textured soils with organic matter of 4.1%. In 1987 the Kernen site had a clay textured soil with 3.5% organic matter, and the moisture content (0-15 cm depth) was 20.06% at seeding.

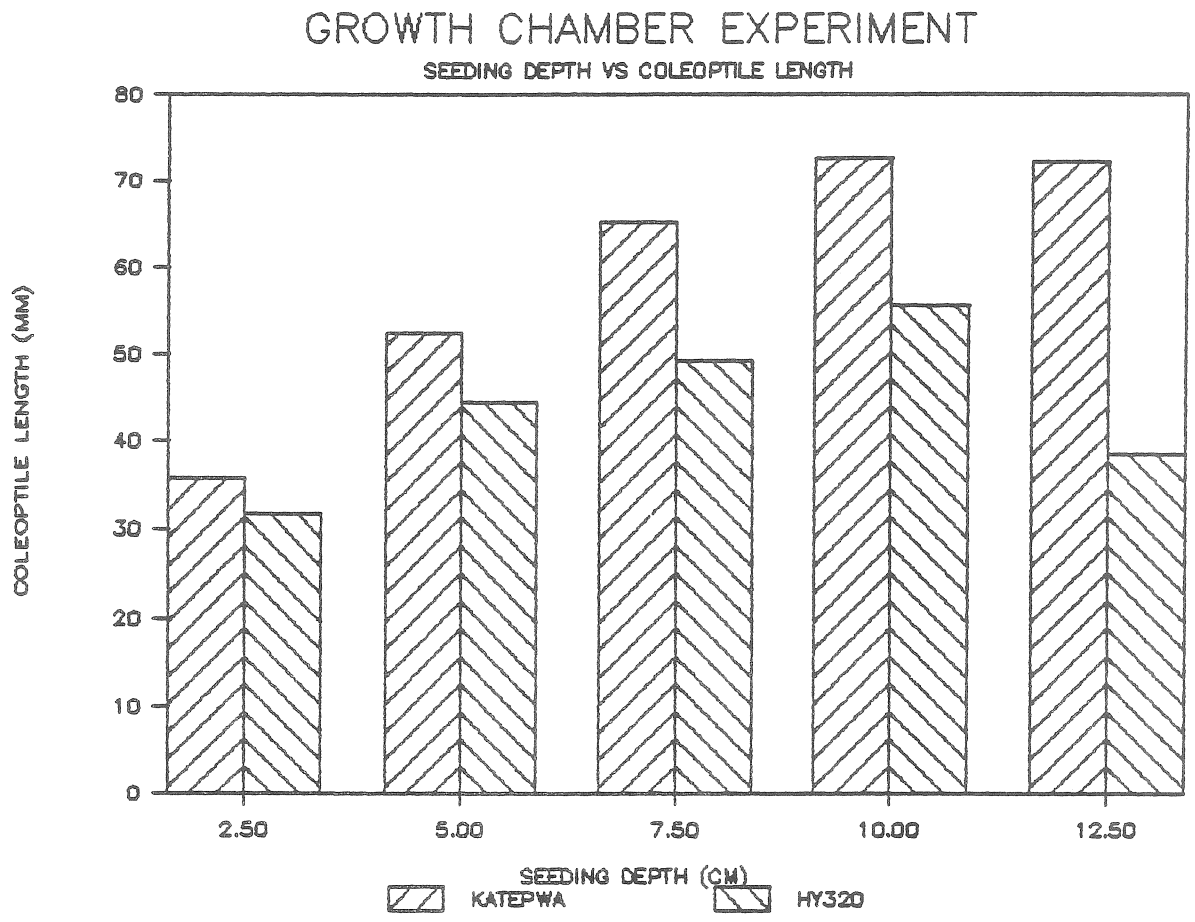
In 1985, only one seeding depth was examined. The experiments were laid out in a randomized complete block design replicated four times. Plot size at each site was 2.5 x 5.0 m^2. The 1986-87 experiments were laid out in a split plot design replicated four times. Three seeding depths formed main plots and 7 or 9 herbicides rates were the subplots. Seeding rates were 90 and 67 kg/ha for HY320 and Katepwa respectively in all three years. Monoammonium phosphate (11-51-0) was applied with the seed according to soil testing lab. recommendations.

In all three years, triallate and trifluralin were applied after seeding at single and double the recommended rates. A tank-mixture of the products was also tested at the single and double rates. The granular formulation, fortress, was included in the treatments in 1987 and tested at single and double rates also. The herbicides were incorporated to a depth of 5 cm by making two passes with a diamond harrow at right angles. Stinkweed, Russian thistle, wild mustard and lamb's-quarters were problem weeds at Goodale in 1986. They were controlled by MCPA amine at 0.63 kg/ha. There was no weeds problem at Kernen site in 1985-86 crop seasons. In 1987 broadleaf weeds were controlled at Kernen site by spraying MCPA-amine at the rate of 0.85 kg/ha. There was no grass weeds problem at the site.

Plants/m row and grain yields are reported for 1985; and plants/m^2, test weight (kg/hl) and grain yields are reported for 1986-87 crop seasons. 1987 data from Goodale site is not reported due to severe drought conditions and wheat stem sawfly infestation.

RESULTS AND DISCUSSION

The average coleoptile length of HY320 and Katepwa varieties grown at five seeding depths in the greenhouse are represented in Fig. 1. Katepwa coleoptile length was greater than HY320 at every seeding depth.



The plants/m of row results obtained at Goodale in 1985 for both varieties showed no significant differences (P = 0.05), Table 1.

Table 1. Tolerance of HY320 and Katepwa to triallate and trifluralin at Goodale, 1985

No.	treatment	Plants/m of row HY320	Plants/m of row Katepwa	Yield (kg/ha) HY320	Yield (kg/ha) Katepwa*
1.	Triallate, 1.4 kg/ha	21	20	5171	4097D
2.	Triallate, 2.8 kg/ha	19	19	4771	4546BCD
3.	Trifluralin, 0.82 kg/ha	22	19	4876	5149AC
4.	Trifluralin, 1.64 kg/ha	23	21	4824	4527CD
5.	Triallate and trifluralin, 1.4 + 0.82 kg/ha	22	19	4561	5304AB
6.	Triallate and trifluralin, 2.8 + 1.64 kg/ha	22	19	4944	5330A
7.	Check	24	23	4885	4981AC
		N.S.	N.S.	N.S.	
C.V.		12.2%	13.6%	6.7%	10.7%

*Figures followed by the same letters are not significantly different at 5% probability (DMRT).

Significantly reduced yields resulted from the single triallate rate in Katepwa variety. No significant differences in yield were obtained in HY320.

At Kernen (Table II) the HY320 plant stand was not significantly affected by the herbicides treatments.

Table II. Tolerance of HY320 and Katepwa to triallate and trifluralin herbicides at Kernen, 1985

No.	treatment	Plants/m of row HY320	Plants/m of row Katepwa[1]	Yield (kg/ha) HY320	Yield (kg/ha) Katepwa
1.	Triallate, 1.4 kg/ha	23	21B	6147	4134
2.	Triallate, 2.8 kg/ha	24	19B	5914	4214
3.	Trifluralin, 0.82 kg/ha	25	21B	5737	4271
4.	Trifluralin, 1.62 kg/ha	24	20B	5985	4309
5.	Triallate and trifluralin, 1.4 + 0.82 kg/ha	23	17B	5845	4294
6.	Triallate and trifluralin, 2.8 + 1.64 kg/ha	22	20B	6137	4080
7.	Untreated	24	25A	5952	4123
		N.S.		N.S.	N.S.
C.V.		13.3%	11.7%	7.0%	3.0%

[1]Figures followed by the same letters are not significantly different at 5% probability (DMRT).

The untreated Katepwa plots had significantly higher plant population than all other treatments, but there were no differences among chemical treatments. Both varieties showed no significant differences in yields.

The 1986 results at Goodale indicated that plant stand was affected only by seeding depth, (Table III). The shallow seeding depths had lowest number of plants/m^2 in both varieties. Highest test weights were obtained from the shallow seeding depths.

Table III. Effects of seeding depths, triallate and trifluralin herbicides rates on HY320 and Katepwa at Goodale - 1986

Seeding depth (cm)		Plants/m^2		Test wt. (kg/hl)		Yield (kg/ha)	
HY320	Katepwa	HY320	Katepwa	HY320	Katepwa	HY320	Katepwa
4.4	4.6	56	64	75.0	80.3	3655	4227
4.9	5.7	68	104	74.4	80.0	4685	4217
6.1	6.3	95	76	74.4	79.7	5295	4064
LSD(0.05)		15.1	11.4	N.S.	N.S.	N.S.	N.S.
C.V.(a)		12.0%	7.8%	0.2%	0.2%	18.9%	12.2%
Herbicide Treatment (*)							
A1		80	94	74.36	80.24	4692	4416
A2		78	83	73.64	79.88	4522	4112
T1		74	91	75.00	80.12	4631	4219
T2		59	72	74.72	79.96	4429	3976
M1		64	78	74.68	79.88	4410	4021
M2		53	64	74.32	79.72	4342	3930
CK		103	111	75.36	80.28	4790	4508
LSD(0.05)		10.0	9.8	N.S.	N.S.	284.8	235.2
C.V. (b)		16.7%	14.2%	0.6%	0.3%	7.7%	6.9%

(*) A1 - triallate, 1.4 kg/ha
A2 - triallate, 2.8 kg/ha
T1 - trifluralin, 0.82 kg/ha
T2 - trifluralin, 1.64 kg/ha
M1 - triallate & trifluralin, 1.4 + 0.82 kg/ha
M2 - triallate & trifluralin, 2.8 + 1.64 kg/ha
CK - untreated

HY320 had lowest yields from the shallow seeding depths whereas Katepwa had the highest from the shallow seeding depths. Drought conditions at heading (35.7% of normal) could have contributed to the non-significant yields obtained from the seeding depths particularly from the Katepwa variety.

Significant differences in plants/m^2 and yields were obtained in both varieties from the herbicides treatments. Katepwa variety had reduced overall yields compared to HY320. Low plants/m^2 and grain yields were obtained in both varieties from the double rate of the tank-mix, single rate tank-mix and double rates of trifluralin. Test weights were not significantly affected by the herbicide treatments.

The data obtained at Kernen (Table IV) showed significant differences in plants/m^2 and grain yields due to seeding depth in both varieties.

Table IV. Effects of seeding depths and triallate and trifluralin herbicides rates on HY320 and Katepwa, at Kernen - 1986

Seeding depth (cm)		Plants/m^2		Test wt. (kg/hl)		Yield, kg/ha	
HY320	Katepwa	HY320	Katepwa	HY320	Katepwa	HY320	Katepwa
3.9	4.3	56	61	69.1	75.0	3628	3410
6.0	5.9	139	116	70.3	76.7	5140	4551
6.8	6.3	140	104	67.2	76.9	5128	5138
LSD (0.05)		11.9	8.9	2.0	N.S.	5343	4702
C.V. (a)		6.1%	5.5%	1.7%	0.7%	6.7%	6.2%
Herbicide Treatments (*)							
	A1	110	94	68.7	75.9	4775	4492
	A2	115	95	68.0	75.2	4749	4232
	T1	111	92	70.5	76.8	4691	4505
	T2	112	89	68.5	76.60	4422	4209
	M1	112	95	69.7	76.48	4593	4447
	M2	102	90	68.2	75.9	4294	4079
	CK	120	100	68.11	76.4	4898	4600
	LSD(0.05)	N.S.	N.S.	N.S.	N.S.	252.6	329.6
	C.V.(b)	12.5%	14.1%	3.4%	0.6%	6.7%	9.2%

(*) A1 - Triallate, 1.4 kg/ha
A2 - Triallate, 2.8 kg/ha
T1 - trifluralin, 0.82 kg/ha
T2 - Trifluralin, 1.64 kg/ha
M1 - triallate & trifluralin, 1.4 + 0.83 kg/ha
M2 - Triallate + trifluralin, 2.8 + 1.64 kg/ha
CK - untreated

Lowest plants/m^2 and grain yields were obtained from the shallow seeding depths in both varieties. Only HY320 showed significant effects on test weights from the seeding depths.

Plants/m^2 and test weights didn't show significant differences from the herbicides treatments. Both varieties showed significant differences in grain yields. HY320 outyielded Katepwa. Lowest plant population and grain yields were also obtained from the double rates of tank-mix products, double rates of trifluralin and single rate of tank-mix products.

1987 data from Kernen (Table V) showed that there were significant effects obtained in emergence and test weights from the seeding depths in both varieties. Yields were not significantly reduced in HY320 from the seeding depths.

Table V. Effect of seeding depth on emergence, test wt. and yields at Kernen, 1987.

	Plants/m^2		Test. wt. (kg/hl)		Yield (kg/ha)	
Seeding depth (cm)	HT320	Katepwa	HY320	Katepwa	HY320	Katepwa
2.5	93.3B	89.6C	76.1B	75.7B	2511	1795B
5.0	106.0A	115.8B	77.9A	77.1A	2606	2215A
7.5	112.3A	135.0A	77.9A	76.6A	2567	2125A
C.V.	5.7%	3.2%	0.7%	0.6%	5.2%	7.0%

Within a column, figures followed by the same letters are not significantly different at 5% probability (DMRT).

The herbicides treatments significantly affected emergence and test weight in both varieties and grain yield in Katepwa (Table VI).

Table VI. Effect of herbicide rates on emergence, test weight and yield at Kernen, 1987.

	Plants/m^2		Test wt. (kg/hl)		Yield (kg/ha)	
Herbicide rate (a)	HY320	Katepwa	HY320	Katepwa	HY320	Katepwa
A1	107.3BC	116.9AB	77.7A	76.7A	2642	2103AB
A2	103.6BC	111.3B	77.6A	76.4AB	2612	2049AB
T1	105.4BC	112.4B	77.1AB	77.1A	2594	2029ABC
T2	99.7C	107.0B	77.2AB	75.7B	2517	1928BC
M1	99.6C	117.3AB	77.2AB	76.7A	2475	2115AB
M2	88.8D	105.8B	76.8B	75.7B	2453	1862C
F1	111.3AB	109.5B	77.7A	76.6A	2660	2067AB
F2	98.5CD	114.4AB	77.2AB	76.3AB	2479	2082AB
CK	121.8A	126.8A	77.6A	77.0A	2621	2169A
					N.S.	
C.V.	11.7%	12.0%	0.8%	1.3%	9.9%	10.1%

Within a column, figures followed by the same letters are not significantly different at 5% probability (DMRT).

a)
A1 - triallate, 1.7 kg/ha
A2 - triallate, 3.4 kg/ha
T1 - trifluralin, 0.68 kg/ha
T2 - trifluralin, 1.36 kg/ha
M1 - triallate & trifluralin, 1.7 + 0.68 kg/ha
M2 - triallate & trifluralin, 3.4 + 1.36 kg/ha
F1 - fortress, 2.38 kg/ha
F2 - fortress, 4.76 kg/ha
CK - untreated

SUMMARY

1. In 1985 experiments there were variable responses in plant stand and grain yields from the herbicides treatments. The variable responses could have been due to serious lack of moisture (22% of normal precipitation) in the month of June.

2. The 1986-87 results indicate that the shallow seeding depths resulted in significantly lower plant populations in both varieties at the two sites.

3. Shallow seeding resulted in significantly lower test weights of HY320 in 1986 and both varieties in 1987 at Kernen.

4. Both varieties had lowest grain yields in 1986-87 from the shallow seeding depths with the exception of Katepwa at Goodale in 1986.

5. Goodale site had serious moisture stress in June (35.7% of normal precipitation) 1986. The stress affected heading and filling of both varieties especially the deep seeded Katepwa treatments which were more advanced than those of HY320.

6. Significant differences in test weights were obtained only in 1987 from the herbicide rates in both varieties.

7. Plant populations were significantly reduced in both varieties from the herbicides rates at Goodale in 1986 and at Kernen in 1987. A similar trend was observed in both varieties and sites in 1986-87, whereby the highest plant population and yields were obtained from the checks and the lowest from the double rate of tank-mix products.

8. HY320 outyielded Katepwa at both sites in all 3 years.

9. No varietal differences were established in plant stand, quality or grain yields from the seeding depths or applied rates of herbicides.

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