# TOLERANCE OF HY 320 AND HARD RED SPRING WHEAT TO SOIL INCORPORATED HERBICIDES

S.D. Lyimo and F.A. Holm
Department of Crop Science and Plant Ecology
University of Saskatchewan

Abstract: Field experiments were conducted at Kernen and Goodale farms near Saskatoon in 1985 and 1986 to compare the tolerance of HY 320 and Katepwa spring wheats to triallate and trifluralin herbicides. HY 320 and Katepwa were seeded at each site in both years at 90 and 67 kg/ha respectively. 1985 experiments were conducted at one seeding depth. In 1986, three seeding depths were examined at each site. Each herbicide was applied after seeding at 1x and 2x the maximum recommended rate. A tank-mixture of the two products was also tested at 1x and 2x rates. Incorporation to a depth of approximately 5 cm was accomplished using two passes of a diamond harrow. Treatments were replicated four times. In 1985, significant differences in yield and plant stand were measured for Katepwa at Goodale and Kernen, respectively. There were no significant differences in HY 320 yield or plant stand and it outyielded Katepwa at both sites. Significant differences in yield resulted from the herbicide treatments in both varieties and sites in 1986. Highest yields were recorded in the untreated checks and the lowest in the 2x tank-mix treatments. As in 1985, HY 320 outyielded Katepwa at both sites. In 1986, shallow seeding resulted in reduced yields of both Katepwa and HY 320. The tolerance of HY 320 to these products appears to be similar to that of Katepwa.

## Introduction

The coleoptilar node of grass seedlings is, in most cases, the most important site of absorption on the underground shoot, for soil applied herbicides. The coleoptilar node of barley and rice seedlings remain within about 1.2 cm of the seed, so that the location of their coleoptilar nodes below the soil surface is dependent on the depth to which the seed is planted. The coleoptilar nodes of corn and sorghum seedlings are also located just below the soil surface while that of wheat is about intermediate between corn and barley. The primary region of absorption of soil-applied herbicides in barley, wheat and wild oats is located 10 to 15 mm above their coleoptilar nodes.

Emergence of most grasses is largely dependent on elongation of the coleoptile and the first internode. The first internode of wheat does not elongate as the seedling develops, and the coleoptile node remains closely associated with the caryopsis. Semidwarf wheats have shortened internodes resulting in reduced plant height, and they also have shorter coleoptile growths which prevent their emergence from as deep in the soil as the taller cultivars.

Trifluralin and triallate are selective, pre-emergent, soil incorporated herbicides that inhibit growth of germinating seedlings. They are used extensively in wild oats control in Western Canada (Billet and Ashford, 1978).

Trifluralin is classed as a mitotic inhibitor or mitotic "poison" which does not directly inhibit seed germination (WSSA Herbicide Handbook, 1983; Parka and Soper, 1977). 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 coleoptile node.

It was concluded by Banting (1967) that the primary site of triallate action is the stem apex and developing tissue above the coleoptile node. The major phytotoxic effect of triallate is on cell elongation or expansion of the shoots (Banting 1970; Billet and Ashford 1978).

The occurence of certain varieties of specific crops resistant to particular herbicides provides a source of improvement of weed control effectiveness (Hodgson et. al. 1964). Such information can be of value in screening programs for new herbicides. Discovery of susceptible varieties can also provide a means of other improvements such as hybrid seed production and variety roguing (Wiebe 1960 cited by Hodgson et. al. 1964).

Both trifluralin and triallate and a tank-mixture of the two are used extensively in Saskatchewan for control of wild oats (Avena fatua) and green foxtail (Setaria viridis) in wheat and barley. 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 these treatments is to seed the crop at a uniform depth of 5 - 7.5 cm and then apply and incorporate the herbicides using two passes of spring or diamond harrows. Placement of the seed into the treated soil will result in stand reductions

and delayed maturity.

Since semi-dwarf wheats 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. Therefore, experiments were established to determine whether or not these soil incorporated treatments are safe to use on semi-dwarf wheat.

The main objectives of the experiments were:

1) To evaluate the performance of HY 320 and Katepwa at different rates of Trifluralin and Triallate and a tank-mix of the products under different field conditions.
2) To determine varietal differences in tolerance to these herbicides.
3) To examine the effects of seeding depths on the varietal tolerance to the herbicides.

## Materials and Method

The experiments were carried out at Goodale and Kernen farms near Saskatoon, in 1985 and 1986 growing seasons using HY 320 and Katepwa wheat varieties. HY 320 is a high-yielding, semi-dwarf red spring wheat licensed in 1985. Katepwa is a hard, red spring wheat, taller than HY320, licensed in 1981. It is similar to Neepawa but has better stem and leaf rust resistance and is easier to thresh. 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%.

1985 experiments were laid out in a randomized complete block design replicated four times. Plot size at each site was

2.5 x 5.0 $m^2$. Seeding at Goodale and Kernen was done on the 10th May and 23 May, 1985 respectively. HY 320 and Katepwa were seeded at each site at 90 and 67 kg/ha respectively at a depth of 5 cm. 60 lbs/acre of monoammonium phosphate (11-51-0) was applied with the seed at each site.

The 1986 experiments were laid out in a split-plot design, replicated four times, with three seeding depths forming main plots and seven herbicide rates forming the subplots. Plot size was 2.5 x 4.5 $m^2$. Seeding dates were 14 May and 26 May, 1986 at Goodale and Kernen respectively. Seeding rates were the same as in 1985, and 40 lbs/acre of 11-51-0 was applied with the seed.

In both years, Trifluralin and Triallate were applied after seeding at single and double the recommended rates. A tank-mixture of the two products was also tested at the single and double rates. Incorporation of the herbicides to a depth of 5 cm was accomplished using two passes of a diamond harrow at right angles. Stinkweed, Russian thistle, Wild mustard and Lambs quarters were problem weeds at Goodale in 1986. They were sprayed on the 10/6 using MCPA amine at 1.25 L/ha. No broadleaf spraying was done at Kernen in both years. Plants/m row and grain yield are reported for 1985; and plants/$m^2$, spikes/$m^2$ and grain yield are reported for 1986.

## Results and Discussion

The plants/m row results obtained at Goodale in 1985 for both varieties showed no significant differences (p=0,05). The untreated plots however, had the highest number of plants/m row and the lowest

was from the double triallate rate (Table 1).

Table I

Tolerance of HY 320 and Katepwa to Soil Incorporated Herbicides at Goodale, 1985

| No. | Treatment | Yield (Kg/ha) HY 320 | Yield (Kg/ha) Katepwa | Plant Stand (Plants/m of row) HY 320 | Plant Stand (Plants/m of row) Katepwa |
|---|---|---|---|---|---|
| 1. | Triallate, 1.4 kg/ha | 5171 | 4097 D | 21.25 | 20.00 |
| 2. | Triallate, 2.8 kg/ha | 4771 | 4546 BCD | 19.13 | 18.88 |
| 3. | Trifluralin, 0.82 kg/ha | 4876 | 5149 AC | 22.38 | 19.13 |
| 4. | Trifluralin, 1.64 kg/ha | 4824 | 4527 CD | 23.38 | 21.13 |
| 5. | Triallate and Trifluralin, 1.4 + 0.82 kg/ha | 4561 | 5304 AB | 21.63 | 19.00 |
| 6. | Triallate and Trifluralin, 2.8 + 1.64 kg/ha | 4944 | 5330 A | 22.38 | 19.13 |
| 7. | Untreated | 4885 | 4981 AC | 24.25 | 22.50 |
| | | N.S. | | N.S. | N.S. |
| | C.V. | 6.7% | 10.7% | 12.2% | 13.6% |

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

Yields for Katepwa were significantly different (p=0,05), with the single triallate rate giving significantly less yields than the other treatments, except the double rates of triallate and trifluralin. The double tank-mix rate yielded highest. No significant differences in yield were obtained from HY 320. The overall yields were however slightly more than for Katepwa. Highest yields were from the single rate of Triallate.

At Kernen, (Table 2), the HY 320 didn't show any significant differences in plants/m row.

Table II

Tolerance of HY 320 and Katepwa to Soil Incorporated Herbicides at Kernen, 1985

| No. | Treatment | Yield (Kg/ha) HY 320 | Yield (Kg/ha) Katepwa | Plant Stand (Plants/m of row) HY 320 | Plant Stand (Plants/m of row) Katepwa |
|---|---|---|---|---|---|
| 1. | Triallate, 1.4 kg/ha | 6147 | 4134 | 22.50 | 20.63 B |
| 2. | Triallate, 2.8 kg/ha | 5914 | 4214 | 24.38 | 18.75 B |
| 3. | Trifluralin, 0.82 kg/ha | 5737 | 4271 | 25.25 | 20.50 B |
| 4. | Trifluralin, 1.62 kg/ha | 5985 | 4309 | 23.50 | 19.63 B |
| 5. | Triallate and Trifluralin, 1.4 + 0.82 kg/ha | 5845 | 4294 | 23.25 | 17.38 B |
| 6. | Triallate and Trifluralin, 2.8 + 1.64 kg/ha | 6137 | 4080 | 22.25 | 19.50 B |
| 7. | Untreated | 5952 | 4123 | 23.88 | 24.75 A |
| | | N.S. | N.S. | N.S. | |
| | C.V. | 7.0% | 3.0% | 13.3% | 11.7% |

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

The Katepwa showed significant differences with the untreated plots being significantly higher than all other treatments which were not significantly different from one another. Both varieties showed no significant differences in yields. The HY 320, however, very much outyielded the Katepwa. Highest yields in HY 320 were obtained from the single Triallate rate whereas in Katepwa they were obtained from the double Trifluralin rate. Lowest yields in HY 320 were obtained from the single Trifluralin rate and they were very high compared to the highest yields obtained from the Katepwa.

The 1986 results at Goodale indicated that only plants/$m^2$ had significant differences from the seeding depths, (Table III).

Table III

Tolerance of HY 320 and Katepwa to Soil Incorporated Herbicides at Goodale Farm - 1986

| | Plants/$m^2$ | | Spikes/$m^2$ | | Yield (kg/ha) | |
|---|---|---|---|---|---|---|
| Seeding Depth[(a)] | HY320 | Katepwa | HY320 | Katepwa | HY320 | Katepwa |
| 1 | 56 | 74 | 350 | 503 | 3655 | 4227 |
| 2 | 68 | 104 | 341 | 538 | 4685 | 4217 |
| 3 | 95 | 76 | 320 | 500 | 5295 | 4064 |
| LSD 0.05 | 15.14 | 11.42 | N.S. | N.S. | N.S. | N.S. |
| C.V.(a) | 11.99% | 7.76% | 9.79% | 10.46% | 18.85% | 12.22% |
| Herbicide Treatment[(b)] | | | | | | |
| A1 | 80 | 94 | 363 | 556 | 4692 | 4416 |
| A2 | 78 | 83 | 335 | 503 | 4522 | 4112 |
| T1 | 74 | 91 | 353 | 547 | 4631 | 4219 |
| T2 | 59 | 72 | 310 | 462 | 4429 | 3976 |
| M1 | 64 | 78 | 298 | 499 | 4410 | 4021 |
| M2 | 53 | 64 | 317 | 507 | 4342 | 3930 |
| CK | 103 | 111 | 382 | 521 | 4790 | 4508 |
| LSD 0.05 | 9.96 | 9.8 | 42.98 | N.S. | 284.79 | 235.18 |
| C.V. (b) | 16.72% | 14.17% | 15.62% | 16.88% | 7.67% | 6.91% |

(a) HY320 1 = 4.4 cm  Katepwa 1 = 4.6 cm
2 = 4.9 cm  2 = 5.7 cm
3 = 6.1 cm  3 = 6.3 cm

(b) 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

The shallow seeding depths in both varieties had lowest number of plants/$m^2$. Katepwa had more spikes/$m^2$ than HY320 but lower overall yields. Significant differences in plants/$m^2$ and yields were obtained

from the herbicide treatments in both varieties, spikes/$m^2$ were affected only in the HY 320. The untreated plots had significantly higher plants/$m^2$ and yields than the double rates of tank-mix plots. In both varieties low plants/$m^2$ and grain yields were obtained from the double rate of the tank-mix, single rate tank-mix and double rates of trifluralin.

Significant differences in plants/$m^2$ and grain yield were obtained from the seeding depths in both varieties at Kernen (Table IV).

Table IV

Tolerance of HY320 and Katepwa to Soil Incorporated Herbicides at Kernen Farm - 1986

| | Plants/$m^2$ | | Spikes/$m^2$ | | Yield (kg/ha) | |
|---|---|---|---|---|---|---|
| Seeding Depth[a] | HY320 | Katepwa | HY320 | Katepwa | HY320 | Katepwa |
| 1 | 56 | 61 | 343 | 476 | 3628 | 3410 |
| 2 | 139 | 116 | 435 | 487 | 5140 | 4551 |
| 3 | 140 | 104 | 557 | 482 | 5128 | 5138 |
| LSD 0.05 | 11.87 | 8.89 | 79.5 | N.S. | 534.30 | 470.15 |
| C.V.(a) | 6.13% | 5.53% | 10.32% | 10.19% | 6.67% | 6.22% |
| Herbicide Treatment[b] | | | | | | |
| A1 | 110 | 94 | 444 | 487 | 4775 | 4492 |
| A2 | 115 | 95 | 479 | 506 | 4749 | 4232 |
| T1 | 111 | 92 | 445 | 493 | 4691 | 4505 |
| T2 | 112 | 89 | 408 | 462 | 4422 | 4209 |
| M1 | 112 | 95 | 457 | 462 | 4593 | 4447 |
| M2 | 102 | 90 | 417 | 486 | 4294 | 4079 |
| CK | 120 | 100 | 465 | 476 | 4898 | 4600 |
| LSD 0.05 | N.S. | N.S. | N.S. | N.S. | 252.57 | 329.59 |
| C.V.(b) | 12.5% | 14.14% | 15.92% | 19.63% | 6.68% | 9.24% |

Table IV (cont'd)

(a) HY320 1 = 3.9 cm  Katepwa 1 = 4.3 cm
2 = 6.0 cm  2 = 5.9 cm
3 = 6.8 cm  3 = 6.3 cm

(b) 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

Lowest plants/$m^2$ and grain yields were obtained in both varieties from the shallow depths of seeding, and with variable responses in the intermediate and deepest depths of seeding. There were significant differences in grain yields from the herbicide treatments in HY 320 and Katepwa. Plants/$m^2$ and spikes/$m^2$ didn't show significant differences. Grain yields from the untreated plots were significantly higher than from the double rates of tank-mix treatments. The same tendency of low plants/$m^2$ and grain yields from the double rates of tank-mix products, double rates of trifluralin and single rate of tank-mix products was observed in both varieties.

## Summary

1) In 1985 there were variable responses in plant stand and grain yield from the herbicide treatments.
2) Significant differences were only obtained in grain yields and plant stand in Katepwa at Goodale and Kernen respectively.
3) Other factors like moisture shortage in the months of June and

August (22% and 55% precipitation respectively based on 1951-80 averages) could have influenced the responses obtained.

4) The HY 320 outyielded Katepwa at both sites.
5) 1986 experiments showed signigicant differences in plants/$m^2$ from the seeding depths in both varieties at the two sites. Shallow seeding depths had the lowest plants/$m^2$.
6) The non-significant responses in spikes/$m^2$ and yield to seeding depths at Goodale could have been caused by lack of enough moisture in the months of June and August. The site had 35.7% and 38.0% precipitation (based on averages for 1951-80) in the two months respectively, compared to Kernen which had 89.3% and 72% of moisture in the same months.
7) Large numbers of secondary tillers which developed at Goodale in July due to very heavy rains (246.9% based on averages for 1951-80) could have also masked any initial effects on the spikes and yields.
8) Significant differences in yields (p=0,05) were obtained from the herbicides treatments in both varieties at the two sites. A similar trend was observed in both varieties and sites whereby highest plants/$m^2$ and yields were obtained from the untreated plots and lowest from the double rate of tank-mix products.
9) HY 320 outyielded Katepwa at both sites in 1986 too.
10) No varietal differences in tolerance to the applied herbicides were obtained in the 1986 experiments.

## References


1) Anderson, W.P. 1983. Weed Science: Principles. Second Edition. pp:243-247; 258-267; 479-482; 577-589.

2) Banting, J.D. 1967. Factors affecting the activity of diallate and triallate. Weed Res. 7:302-315

3) Banting, J.D. 1970. Effect of diallate and triallate on Wild oat and wheat cells. Weed Sci. 18:80-84.

4) Billet, D; and R. Ashford. 1978. Differences in the phytotoxic response of wild oats (Avena fatua) to triallate and trifluralin Weed Sci. 26:273-276.

5) Chemical Weed Control in Cereal, Oilseed, Pulse and Forage Crops 1987. Saskatchewan Agriculture, Soils and Crops Branch, Crop Protection Section. pp. 13-15; 65-67.

6) Herbicide Handbook of the Weed Science Society of America. Fifth Edition, 1983. pp: 464-467; 470-476.

7) Hodgson, J.M.; F.P. Thrasher; and R.F. Elsick. 1964. Effects of eight herbicides on yields of barley and wheat varieties. Crop Sci. 4:307-310.

8) Nelson, C.J.; and K.L. Larson. 1984. Physiological Basis of Crop Growth and Development. pp:108-111.

9) Parka, S.J.; and O.F. Soper. 1977. The physiology and mode of action of the dinitroaniline herbicides. Weed Sci. 25:79-87.

10) Rahman, A.; and R. Ashford. 1970. Selective action of trifluralin for control of green foxtail in wheat. Weed Sci. 18:754-759.