Small Grain Cultivar Response to Trifluralin Granules

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INTRODUCTION

In North Dakota, 0.39 to 0.45 kg ha^{-1} of spring-applied preplant incorporated (PPI) trifluralin granules are labeled for use in hard red spring (HRS) wheat (*Triticum aestivum* L.), durum wheat (*Triticum durum*), and 0.56 kg ha^{-1} in barley (*Hordeum vulgare*) to control selected annual grass and broadleaf weeds (Zollinger et al., 1999). Potential for small grain injury and seed yield loss exists with trifluralin. In North and South Dakota trials, some cultivars of HRS wheat have been injured by spring-applied trifluralin granules (Gaffney et al., 1992; Thilmony, 1993).

OBJECTIVE

The objective of this study was to quantify any response with spring-applied PPI trifluralin granules in selected HRS wheat, durum wheat, and barley cultivars.

MATERIALS AND METHODS

Field trials were conducted in North Dakota in 1997-98. Trifluralin granules were applied with a Gandy air-flow applicator at 0.45 kg ha^{-1} (labeled rate) and 0.90 kg ha^{-1} (2X labeled rate). Recommended equipment and procedures were used to incorporate the herbicide. The first incorporation was performed immediately after granule application. At Feekes growth stage 1, crop stand was measured and injury was visually evaluated. Appropriate postemergence herbicides were used to exclude weed competition. Plots were machine harvested. The experimental design was a randomized complete block with a split-plot arrangement and four replications. Trifluralin treatments represented whole plots and cultivars subplots. Additional trial details are listed in Tables 1 and 2.

Table 1. Trial location details.

	Carrington		Casselton	Prosper
Year	1997	1998	1997	1998
Soil	Heimdahl-Emrick loam		Perella-Bearden silty clay loam	
Herbicide:				
application date	14-May	28-Apr	15-May	24-Apr
second incorporation date	21-May	6-May	20-May	29-Apr
Planting:				
date	21-May	13-May	21-May	30-Apr
rate (PLS ha^{-1})	506250	486000	526500	
depth (cm)	3.8		3.8	
row spacing (cm)	17.8		30	
Total rainfall (cm):				
1 wk before herb. application	1.17	0.33	1.57	0.00
3 wk after herb. application	1.37	2.95	6.45	10.00
Harvest date	19-Aug	11-Aug	16-Aug	12-Aug
Plot size - harvest (m)	1.6x3.6		1.2x3.0	1.2x3.1

Table 2. Level of significance for source of variation [1] = trifluralin x cultivar.

Crop	Plant Injury	Plant Stand	Grain yield
Carrington, 1997			
HRS	*	NS	NS
Durum	NS	NS	NS
Barley	*	NS	NS
Casselton, 1997			
Durum	*	*	
Carrington, 1998			
HRS	*	NS	NS
Durum	*	NS	NS
Barley	NS	NS	NS
Prosper, 1998			
HRS			*
Durum	*	*	*
Barley			NS
Casselton, 1997 and Prosper, 1998			
HRS	*	*	
Barley	*	*	

[1]NS = nonsignificant; * = significant (p=0.05).

RESULTS AND DISCUSSION

Casselton, 1997 and Prosper, 1998

HRS wheat cultivar injury across environments ranged from 23 to 34% with trifluralin at 0.45 kg ha^{-1} and 63 to 80% with trifluralin at 0.90 kg ha^{-1} (Figure 5). Also, high stand loss occurred, averaging 48% reduction across cultivars at the labeled rate of trifluralin and 78% reduction at the 2X rate compared to untreated stands (Figures 6 and 7). Differences in injury and stand occurred among HRS wheat cultivars but response was not consistent to identify susceptible cultivars.

At both environments, significant rainfall occurred during the three weeks following application (Table 1), resulting in herbicide activation and increased crop injury.

HRS wheat cultivar yield at Prosper with the labeled trifluralin rate was similar to yield of the untreated checks (Figure 8), thus confirming the ability of small grain to compensate for early-season injury and stand reduction. Trifluralin at 0.90 kg ha^{-1} reduced yield of 2375, Gunner, Kulm, and Reeder 22 to 32% compared to untreated checks.

Durum cultivar injury ranged from 8 to 33% with trifluralin at 0.45 kg ha^{-1} and 13 to 78% with trifluralin at 0.90 kg ha^{-1} at Casselton in 1997 and Prosper in 1998 (Table 3). Also, substantial stand loss occurred with trifluralin at the labeled and 2X rates. Yield at Prosper across cultivars with the labeled rate was not reduced compared to yield of the untreated checks. Differences in response occurred among cultivars but were not consistent to identify susceptible cultivars.

Barley cultivar injury averaged across environments ranged from 18 to 23% with trifluralin at 0.45 kg ha^{-1} and 36 to 59% with trifluralin at 0.90 kg ha^{-1} (Figure 9). Also, substantial stand loss occurred - a 25% reduction across cultivars at the labeled rate of trifluralin and a 52% reduction at the 2X rate compared to untreated stands (Figure 10). Stand loss with Stander occurred with trifluralin at the 2X rate.

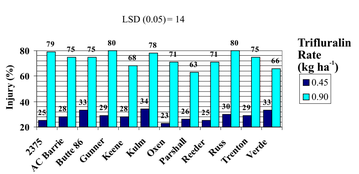

Figure 5. HRS wheat cultivar visual injury with trifluralin granules, Casselton, 1997 and Prosper, 1998.

Figure 6. Small grain stands untreated (left), and with trifluralin granules at 0.45 kg ha^{-1} (middle) and 0.90 kg ha^{-1} (right) at Casselton, 1997.

Table 3. Durum wheat cultivar response to trifluralin granules, Casselton, 1997 and Prosper, 1998.

Cultivar	Visual injury 0.45	Visual injury 0.90	Stand 0	Stand 0.45	Stand 0.90	Grain yield 0	Grain yield 0.45	Grain yield 0.90
	%		Trifluralin granule rate (kg ha^{-1}) x1000 ha^{-1}			kg ha^{-1}		
Casselton, 1997								
Belizer	18	57	2555	1372	932			
Ben	15	55	2394	1399	767			
Maier	10	15	2582	1103	1318			
Renville	8	13	2179	1439	686			
LSD (0.05)	13		511					
Prosper, 1998								
Belizer	28	63	1291	968	538	34.4	34.7	30.2
Ben	30	65	1614	968	430	35.0	36.9	35.1
Maier	33	78	1614	968	323	31.7	32.9	28.5
Mountrail	25	65	1399	1076	430	38.1	43.8	35.9
Munich	23	60	1721	1184	430	36.0	36.9	29.6
Renville	23	63	1506	1291	430	32.7	34.3	36.2
LSD (0.05)	15		420			7.9		

RESULTS AND DISCUSSION

Carrington, 1997 and 1998

HRS wheat visual injury averaged across cultivars was low (≤10%) in 1997 (Figure 1), but was substantial in 1998, averaging 21% with trifluralin at 0.45 kg ha^{-1} and 53% at 0.90 kg ha^{-1} (Figure 2). At the 2X labeled rate during both years of the trial and at the labeled rate in 1998, differences in injury occurred among cultivars. All HRS wheat cultivars had significant injury at the labeled rate in 1998.

In 1998, durum cultivar injury ranged from 8 to 18% at the labeled trifluralin rate and ranged from 21 to 63% at the 2X rate (Figure 3). At the labeled rate, Ben, Belzer, and Renville had 15% or greater injury compared to the untreated checks..

Barley injury in 1998 averaged 9% with trifluralin at 0.45 kg ha^{-1} and 26% at 0.90 kg ha^{-1} (data not shown). In 1997, barley cultivar injury was similar at the labeled rate but Stander had 10% injury compared to 1% with Foster and Robust at the 2X rate (Figure 4).

In 1997, minimal rainfall after granule application (Table 1) may have slowed herbicide release resulting in little injury during crop germination and emergence. A similar response was found with 11 HRS wheat cultivars in an arid environment at Minot, ND (Thilmony, 1993). In contrast, significant rainfall occurred during the three weeks following trifluralin application in 1998, resulting in herbicide activation and increased crop injury.

No trifluralin by cultivar response was measured for grain yield with each of the three crop species.

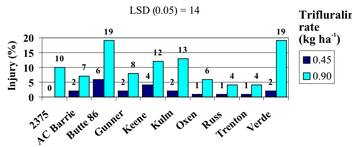

Figure 1. HRS wheat cultivar visual injury with trifluralin granules, Carrington, 1997.

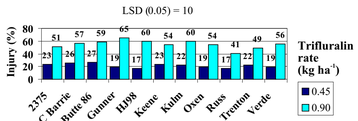

Figure 2. HRS wheat cultivar visual injury with trifluralin granules, Carrington, 1998.

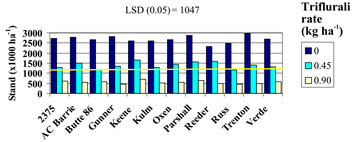

Figure 7. HRS wheat cultivar stand with trifluralin granules, Casselton, 1997 and Prosper, 1998.

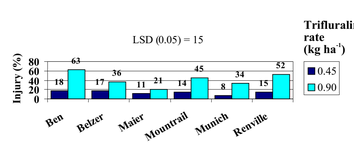

Figure 3. Durum wheat cultivar visual injury with trifluralin granules, Carrington, 1998.

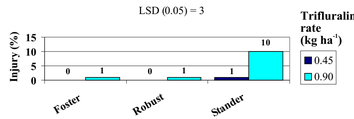

Figure 4. Barley cultivar visual injury with trifluralin granules, Carrington, 1997.

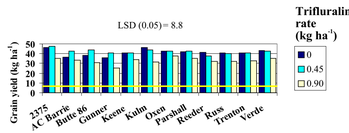

Figure 8. HRS wheat grain yield with trifluralin granules, Prosper, 1998.

SUMMARY

- Trifluralin injured small grain especially with adequate topsoil moisture during crop emergence.
- Grain yield generally was not reduced.
- Differences in small grain cultivar response with trifluralin were generally minimal and inconsistent, especially with trifluralin at 0.45 kg ha^{-1}.

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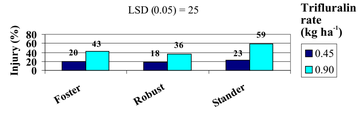

Figure 9. Barley cultivar visual injury with trifluralin granules, Casselton, 1997 and Prosper, 1998.

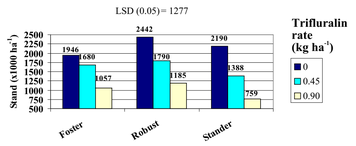

Figure 10. Barley cultivar stand with trifluralin granules, Casselton, 1997 and Prosper, 1998.