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Studies on the Effect of Herbicides Under Different Tillage Practices in Wheat

A. K. Sinha[1] and R. P. Singh
Department of Agronomy
Institute of Agricultural Sciences
Banaras Hindu University, Varanasi-221 005 (U. P.), India

ABSTRACT

The dominant weed flora under weedy check recorded at 60 DAS were *Cyperus rotundus, Phalaris minor, Rumex denticulata, Chenopodium album, Melilotus* spp. and *Anagallis arvensis*. Zero tillage was dominated by sedge, whereas reduced and conventional by broad-leaved weeds, specially *Rumex denticulata* which suppressed all other weeds at late stages of crop growth. Isoproturon at 1 kg ha^{-1} (30 DAS) fb 2, 4-D 0.5 kg ha^{-1} (40 DAS) was more effective to minimize weed density and their dry weight under all the tillage treatments than glyphosate at 0.5 l fb isoproturon at 1.0 kg ha^{-1}, sulfosulfuron at 25 g ha^{-1} and isoproturon at 1.0 kg ha^{-1}. The minimum weed control efficacy was observed in alone application of sulfosulfuron and isoproturon. On an average, isoproturon fb 2, 4-D increased the grain yield by 42.3, 38.0 and 39.1% over weedy check in zero, reduced and conventional tillage, respectively.

INTRODUCTION

In intensive cropping system, management of time and space are important factors for getting optimum yield. But in rice-wheat cropping system, sowing of wheat is often delayed due to long duration rice cultivars. Allowing weeds to grow even for a short period deprives the crop of the valuable plant nutrients and this is a drain of farmer's economy. Delayed sowing beyond November reduces wheat grain yield at 1% ha^{-1} day^{-1} (Hobbs, 1994). Zero tillage seems to be more advantageous than conventional treatments to overcome the late seeding problem as well as minimising rising production cost and reducing weed density. Information on feasibility of Zero tillage in eastern Uttar Pradesh is limiting. Therefore, the present study was made to investigate impact of tillage on weeds and performance of herbicides in wheat.

MATERIALS AND METHODS

Field experiment was conducted during winter seasons of 1999-2000 and 2000-01 at the Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Experiment was laid out in split plot design with three replications. Treatments consisted of three tillage (zero tillage, reduced tillage and conventional tillage) in main plot and six weed control treatments (isoproturon 1.0 kg ha^{-1}, sulfosulfuron 25 g ha^{-1}, isoproturon 1.0 kg ha^{-1} fb 2, 4-D 0.5 kg ha^{-1}, glyphosate 0.5 l ha^{-1} fb isoproturon 1.0 kg ha^{-1}, hand weeding 30 and 60 DAS and weedy check) were assigned in sub-plots. Glyphosate was applied as pre-sown (10 DBS), whereas isoproturon and sulfosulfuron were applied 30 DAS and 2, 4-D at 40 DAS with the help of knapsack sprayer fitted with flat fan nozzle. Wheat cultivar HUW 234 was sown at row spacing of 20 cm. Zero tilled plots were sown by Zero tilled ferti-seed drill on December 20, reduced tillage by Chinese rotovator was on December 27 and conventional tillage (One deep ploughing fb two disc harrowings) on January 4 during both the years with the recommended package of practices. The soil of experimental field was sandy clay loam in texture having 0.5% organic matter, low in nitrogen (184.0 kg ha^{-1}), phosphorus (40.0 kg ha^{-1}) and medium in available potassium (221.3 kg ha^{-1}) with pH 7.4. In zero tillage, sowing was done by zero till seed-cum-fertilizer drill, reduced tillage was by Chinese rotovator + zero till seed-cum ferti-drill

[1]Present Address : R. M. D. College of Agriculture and Research Station, Ajirna, Ambikapur, Surguja-497 001 (C. G.), India.

Table 1. Effect of tillage and herbicides on weed density (No. m^{-2}) and total weeds dry weight (g m^{-2}) at 60th day in wheat

Treatment	*P. minor*		*C. rotundus*		*C. album*		*R. denticulata*		*A. arvensis*		*Melilotus* spp.		Other weeds		Total dry weight	
	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001
Tillage																
Zero	2.71	3.05	3.22	3.28	2.31	2.38	2.50	2.69	1.99	2.09	2.23	2.36	3.40	3.68	4.90	5.13
	(8)	(10)	(11)	(12)	(5)	(5)	(6)	(7)	(3)	(4)	(4)	(5)	(12)	(15)	(30)	(32)
Reduced	2.90	3.29	2.89	2.82	2.64	2.69	2.92	3.10	2.21	2.34	2.49	2.64	3.05	3.33	5.21	5.44
	(10)	(12)	(9)	(9)	(7)	(7)	(9)	(10)	(4)	(5)	(6)	(7)	(11)	(13)	(34)	(38)
Conventional	3.11	3.51	2.80	2.79	2.94	2.94	3.13	3.52	2.41	2.62	2.65	2.94	2.74	3.07	5.53	5.75
	(12)	(14)	(8)	(9)	(9)	(9)	(11)	(13)	(6)	(7)	(7)	(9)	(8)	(11)	(39)	(44)
LSD (P=0.05)	0.37	0.31	0.56	0.55	0.30	0.34	0.41	0.47	0.40	0.32	0.32	0.32	0.47	0.45	0.36	0.43
Herbicide																
Isoproturon	2.41	2.86	2.39	2.35	2.99	2.86	3.45	3.89	2.51	2.70	3.04	3.25	3.38	3.84	5.35	5.74
(1.0 kg ha^{-1})	(5)	(8)	(6)	(5)	(9)	(8)	(12)	(15)	(6)	(7)	(9)	(10)	(11)	(14)	(28)	(32)
Sulfosulfuron	2.25	2.64	2.57	2.51	2.86	2.70	3.23	3.65	2.46	2.59	2.83	3.12	3.15	3.69	5.21	5.49
(25 g ha^{-1})	(5)	(7)	(7)	(6)	(8)	(7)	(10)	(13)	(6)	(6)	(8)	(9)	(10)	(13)	(26)	(29)
Isoproturon+2,4-D	2.27	2.68	2.23	2.20	1.88	2.06	1.83	2.01	1.64	1.72	1.72	1.86	2.06	2.14	3.18	3.22
(1.0+0.5 kg ha^{-1})	(5)	(7)	(5)	(5)	(3)	(4)	(3)	(4)	(2)	(3)	(3)	(3)	(4)	(4)	(9)	(10)
Glyphosate+	2.33	2.71	2.26	2.32	2.04	2.15	1.96	2.12	1.68	1.78	1.96	2.12	2.30	2.40	3.34	3.49
Isoproturon	(5)	(7)	(5)	(5)	(4)	(4)	(3)	(4)	(2)	(2)	(3)	(4)	(4)	(5)	(10)	(11)
(0.5 l+1.0 kg ha^{-1})																
Hand weeding	2.08	2.49	2.08	2.02	1.75	1.92	1.72	1.98	1.49	1.59	1.57	1.72	1.83	1.94	3.00	3.09
(30 & 60 DAS)	(4)	(6)	(4)	(4)	(3)	(3)	(3)	(4)	(2)	(2)	(2)	(3)	(3)	(3)	(8)	(9)
Weedy check	6.07	6.31	4.52	5.43	4.28	4.31	4.91	4.98	3.44	3.75	3.61	3.80	5.70	6.15	11.21	11.59
	(37)	(40)	(20)	(30)	(18)	(18)	(23)	(25)	(12)	(14)	(13)	(14)	(32)	(38)	(126)	(135)
LSD (P=0.05)	0.27	0.24	0.40	0.39	0.28	0.26	0.24	0.29	0.22	0.19	0.23	0.21	0.30	0.28	0.24	0.29

Data transformed to $\sqrt{X+0.5}$. Figures in parentheses indicate original values.

Table 2. Effect of tillage and herbicides on crop dry matter accumulation, spikes, grain and straw yields at harvest in wheat

Treatment	Dry matter accumulation ($g\ m^{-2}$)		Spikes ($No.\ m^{-2}$)		Grain yield ($kg\ ha^{-1}$)		Straw yield ($kg\ ha^{-1}$)	
	1999-2000	2000-01	1999-2000	2000-01	1999-2000	2000-01	1999-2000	2000-01
Tillage								
Zero	916.6	863.3	255	247	2954	2735	4277	3911
Reduced	875.7	827.7	245	236	2783	2608	4088	3718
Conventional	833.0	795.3	231	222	2609	2506	3753	3585
LSD (P=0.05)	45.4	42	14	14	180	138	279	202
Herbicide								
Isoproturon ($1.0\ kg\ ha^{-1}$)	820.9	767.4	231	221	2599	2436	3819	3502
Sulfosulfuron ($25\ g\ ha^{-1}$)	851.5	797.2	239	228	2716	2543	3925	3644
Isoproturon+2,4-D ($1.0+0.5\ kg\ ha^{-1}$)	958.0	914.6	265	258	3172	2977	4560	4255
Glyphosate+Isoproturon ($0.5\ l\ a.i.+1.0\ kg\ ha^{-1}$)	929.0	884.6	254	249	3077	2869	4436	4101
Hand weeding (30 & 60 DAS)	987.0	943.5	276	267	3289	3094	4714	4399
Weedy check	704	664.9	197	186	1839	1778	2862	2738
LSD (P=0.05)	37.4	35.2	11	11	123	123	182	179

for sowing and conventional by manual. The seed rate was 100 kg ha^{-1}.

RESULTS AND DISCUSSION

Effect on Weeds

The major weeds in zero tilled plots were *Cyperus rotundus* (21.7%) followed by *Phalaris minor* Retz. (20.6%), *Rumex denticulata* L. (13.3%), *Melilotus* spp. (9.5%) and *Anagallis arvensis* L. (7.0%), whereas in reduced tillage major weeds were *P. minor* (17.7%) followed by *R. denticulata* (16.9%), *C. rotundus* (15.0%), *C. album* (11.5%), *Melilotus* spp. (10.3%) and *A. arvensis* (9.6%). In case of conventional tillage, mean relative density of weeds was of *P. minor* (19.4%) followed by *R. denticulata* (18.5%), *C. album* (13.5%) *C. rotundus* (12.0%), *Melilotus* spp. (11.9%) and *A. arvensis* (9.7%). Zero tillage had less density of broad-leaved and grassy weeds and also total weeds dry weight than reduced and conventional tillage (Table 1).

Isoproturon fb 2, 4-D proved most effective in arresting weed growth as compared to other herbicidal treatments. This combination was at par with hand weeding and glyphosate+isoproturon. Both of these sequential applications of herbicides were significantly superior to alone application of sulfosulfuron and isoproturon (Table 1). This was perhaps due to broad-spectrum control of weeds by these treatments. The isoproturon applied alone had minimum weed control efficiency. Among herbicides, isoproturon fb 2, 4-D proved to be most effective which was followed by glyphosate fb isoproturon and sulfosulfuron under all the tillage treatments. The poor efficacy of herbicides under conventional tillage was owing to extended period of weed emergence as it provided better environment for emergence of weeds in different flushes. This reasoning finds support from the observation of Buhler *et al.* (1990).

Effect on Crop

Zero tillage was on par with reduced tillage and significantly superior to conventional tillage in crop dry matter accumulation, number of spikes, grain and straw yields. Contrary to this, conventional tillage with comparatively poor crop dry matter accumulation was comparable to reduced tillage (Table 2).

All the herbicidal treatments had significantly more crop dry matter accumulation, spikes, grain and straw yields as compared to weedy check (Table 2). Isoproturon fb 2, 4-D and glyphosate fb isoproturon were significantly superior to alone application of sulfosulfuron and isoproturon in these respects. These results indicated that increase in yield contributing characters and yield was more in the treatments, which had low weed density and total weed dry weight (Table 1). This is owing to fact that minimum crop-weed competition with these treatments enabled the crop to make maximum use of inputs for the formation and development of yield attributes and consequently grain yield.

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