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Influence of Cultivars Under Different Tillage and Weed Management in Wheat

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ABSTRACT

Zero tillage had more grassy weeds, whereas conventional tillage had more of sedge and broad-leaved weeds. Zero tillage significantly reduced the weed density and total weed dry weight as compared to conventional tillage. Wheat cv. HUW 234 had more light interception, minimum weed density and total weeds dry weight accumulation than HP 1761, HUW 468, HP 1731 and NW 1012. The maximum grain and straw yields were obtained with HUW 234 under zero tillage and hand weeding.

INTRODUCTION

In the recent past due to inherent problems associated with use of herbicides, non-chemical approaches are gaining importance in the management of weeds in wheat which include crop rotation, date of sowing, zero till technology, selection of competitive crops/cultivars, closer row spacing, higher seed rates, bi-directional planting and methods of fertilizer application, etc. Herbicides have provided very effective control of weeds; however, with the continuous use of herbicides, weeds like *Phalaris minor* have developed resistance against isoproturon (Malik and Singh, 1993). Evidences suggest that delayed wheat sowing after mid November in Indo-Gangetic plains results in grain yield loss of 1% ha^{-1} day^{-1} (Hobbs, 1997) and use of zero till ferti-seed drill is being advocated for timely sowing of wheat after rice harvest (Sen *et al.*, 2002). Adoption of zero till system, principally due to herbicide resistance in *P. minor* is likely to be valuable for the sustainability of this intensively cropped agro-ecosystem (Chahal *et al.*, 2003). Aslam *et al.* (1993) recorded 41% more wheat yield under zero tillage as compared to conventional and it was mainly due to timely sowing (almost 24 days earlier), which was not possible in conventional planting method. Besides this, it provides saving of labour and time (Singh, 2000).

Crop species and cultivars are known to differ in their competitiveness with weeds. Good competitive cultivars should have the characteristics of rapid germination and initial quick growing habits with more tillering capacity, leaf area and crop height (Lamerle *et al.*, 1995, 1996). This offers opportunities to select and breed for competitive cultivars that call be adopted by the farmers as a part of sustainable agriculture at little or no additional cost. Keeping the above facts in view, the present experiment was conducted to evaluate the competitive ability of wheat cultivars under different tillage and weed management treatments.

MATERIALS AND METHODS

Field experiment was conducted in winter seasons of 1999-2000 and 2000-01 at the Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The treament consisted of five cultivars (HUW 234, HUW 468, HP 1731, HP 1761 and NW 1012) under two tillage systems, zero till drill and conventional tillage (one deep ploughing followed by two harrowings with disc) and two weed management (hand weeding 30 and 60 DAS and weedy check). The experiment was laid out in split plot design keeping tillage and weed management in main plots, cultivars in sub-plots and replicated thrice. Zero tilled plots were sown on December 20 and conventional tilled were sown on January 4 during both the seasons with the recommended

Table 1. Effect of tillage, weed management and cultivars on weed density (No. m^{-2}) and total dry weight of weeds (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 wt. (g)	
	1999-2000	2000-01	1999-2000	2000-01	1999-2000	2000-01	1999-2000	2000-01	1999-2000	2000-01	1999-2000	2000-01	1999-2000	2000-01	1999-2000	2000-01
Tillage																
Zero	3.24	3.41	3.00	3.22	2.35	2.55	2.41	2.52	1.88	1.91	1.62	1.84	3.13	3.20	5.74	6.03
	(17)	(18)	(14)	(16)	(8)	(9)	(8)	(9)	(4)	(4)	(3)	(4)	(15)	(16)	(50)	(56)
Conventional	4.03	4.29	2.71	2.93	3.07	2.98	3.21	3.38	2.77	2.70	2.21	2.73	2.89	2.91	6.72	7.03
	(26)	(31)	(11)	(13)	(15)	(14)	(16)	(18)	(11)	(10)	(7)	(11)	(13)	(13)	(71)	(78)
LSD (P=0.05)	0.34	0.31	0.32	0.39	0.34	0.39	0.42	0.44	0.54	0.45	0.34	0.42	0.39	0.32	0.74	0.55
Weed management																
Hand weeding	1.89	2.14	1.75	1.89	1.72	1.98	1.57	1.72	1.80	1.74	1.58	1.52	2.08	2.14	1.52	1.61
(30 & 60 DAS)	(5)	(6)	(4)	(5)	(4)	(5)	(2)	(4)	(4)	(4)	(2)	(3)	(4)	(6)	(2)	(2)
Weedy check	5.38	5.56	3.96	4.26	3.70	3.55	4.05	4.18	2.85	2.87	2.25	3.05	3.94	3.97	10.94	11.45
	(31)	(43)	(21)	(25)	(19)	(18)	(22)	(23)	(12)	(12)	(7)	(12)	(22)	(22)	(120)	(132)
LSD (P=0.05)	0.34	0.31	0.32	0.39	0.34	0.39	0.42	0.44	0.54	0.45	0.34	0.42	0.39	0.32	0.74	0.55
Cultivars																
HUW 234	3.48	3.69	2.67	2.91	2.47	2.55	2.54	2.69	2.06	2.12	1.72	2.06	2.76	2.85	5.94	6.13
	(20)	(22)	(10)	(13)	(9)	(10)	(10)	(11)	(6)	(6)	(4)	(6)	(11)	(12)	(53)	(58)
HUW 468	3.64	3.84	2.85	3.08	2.70	2.77	2.88	3.02	2.31	2.32	1.90	2.32	3.04	3.05	6.22	6.52
	(22)	(24)	(12)	(15)	(11)	(12)	(13)	(14)	(8)	(7)	(4)	(8)	(14)	(14)	(61)	(66)
HP 1731	3.67	3.88	2.90	3.11	2.76	2.82	2.94	3.09	2.38	2.34	1.95	2.33	3.06	3.08	6.32	6.59
	(22)	(25)	(13)	(15)	(12)	(12)	(13)	(15)	(8)	(8)	(5)	(8)	(14)	(15)	(62)	(69)
HP 1761	3.56	3.80	2.79	2.99	2.59	2.68	2.67	2.78	2.22	2.19	1.85	2.19	2.92	2.97	6.12	6.35
	(21)	(24)	(12)	(14)	(10)	(11)	(10)	(12)	(7)	(7)	(4)	(7)	(13)	(13)	(57)	(62)
NW 1012	3.84	4.03	3.07	3.29	3.00	3.02	3.02	3.41	2.65	2.55	2.17	2.54	3.26	334	6.57	7.05
	(24)	(27)	(15)	(17)	(14)	(14)	(14)	(19)	(10)	(9)	(6)	(9)	(17)	(18)	(69)	(78)
LSD (P=0.05)	0.12	0.13	0.16	0.15	0.21	0.17	0,18	0.17	0.23	0.17	0.17	0.17	0.18	0.17	0.22	0.25

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

Table 2. Effect of tillage, weed management and cultivars on crop dry matter accumulation, light interception, spikes, grain and straw yields at harvest in wheat

Treatment	Dry matter accumulation ($g\ m^{-2}$)		Light interception (%)		Spikes 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	1999-2000	2000-01
Tillage										
Zero	941.9	908.4	93.82	93.46	253.6	236.4	2805	2567	4168	3707
Conventional	866.7	863.9	89.56	89.22	229.1	213.6	2491	2335	3751	3399
LSD (P=0.05)	51.4	41.5	3.12	3.60	22.8	21.6	221	54	375	236
Weed management										
Hand weeding (30 & 60 DAS)	977.2	941.7	95.73	94.65	264.1	242.9	3328	3038	4974	4405
Weedy check	831.4	830.6	87.66	88.04	218.7	207.7	1968	1864	2945	2702
LSD (P=0.05)	51.4	41.5	3.10	3.60	22.7	21.6	221	54	375	236
Cultivars										
HUW 234	945.2	919.9	94.82	94.14	258.2	242.2	2888	2669	4333	3871
HUW 468	909.8	892.4	91.63	91.36	241.5	224.5	2655	2454	3946	3551
HP 1731	896.6	878.1	91.16	90.93	237.1	221.2	2606	2440	3910	3506
HP 1761	921.4	901.7	92.24	91.84	247.2	232.7	2743	2507	4115	3672
NW 1012	848.7	838.7	86.62	86.43	223.2	204.3	2347	2184	3496	3166
LSD (P=0.05)	26.55	29.4	2.12	1.95	12.6	13.4	163	157	244	227

package of practices. The soil of the experimental field was sandy clay loam in texture having 0.46% organic matter, low in N (184.0 kg ha^{-1}), P_2O_5 (40.0 kg ha^{-1}) and medium in available K_2O (221.3 kg ha^{-1}) with pH 7.4. In zero tillage, sowing was done by zero till seed-cum-fertilizer drill and in conventional by manual at the spacing of 20 cm. The seed rate was 100 kg ha^{-1}.

Weed samples were collected with the help of quadrate (0.25 m^2) randomly placed at two places in each plot and counted species-wise. Number of weeds and total weeds dry weight were subjected to ($\sqrt{x}+0.5$) transformation prior to statistical analysis. Light interception was measured at the bottom of the wheat crop at 60th and 90th day stage of crop growth. Luxmeter (Luxomet 300 XD) was used to measure the light intensity, between 10-11 a. m. (clear day) and per cent light interception was calculated by using the following formula (Pearce *et al.*, 1961).

$$\% \text{ Light interception} = \frac{\text{Light at top of canopy} - \text{Light at base of canopy}}{\text{Light at top of canopy}} \times 100$$

RESULTS AND DISCUSSION

Effect on Weeds

The maximum relative composition of weeds in zero tillage was of *Cyperus rotundus* L. (23.7%), followed by *Phalaris minor* Retz. (19.3%), *Rumex denticulata* L. (11.6%), *Chenopodium album* L. (8.9%), *Melilotus* spp. (6.6%) and *Anagallis arvensis* L. (5.4%), whereas in conventional tillage, maximum relative composition of weeds was of *P. minor* Retz. (24.0%) followed by *R. denticulata* L. (16.0%), *C. album* L. (12.6%), *C. rotundus* L. (12.5%), *A. arvensis* L. (9.4%) and *Melilotus* spp. (8.9%). Conventional tillage had more density of weeds as compared to zero tillage (Table 1). This was perhaps due to intensive tillage operation, which brought the weed seeds from sub-surface to favourable moist upper soil layer for good germination. In zero tillage. weed seeds remained in sub-surface due to puddling carried out during paddy transplanting and failed to germinate because of unfavourable condition. These results are in conformity with the findings of Singh (2000).

HUW 234 recorded less weed density and dry weight as compared to other cultivars (Table 1) which was owing to more height, more tillers, more number of leaves, more leaf area and higher crop growth and minimum availability of light to weeds (Table 2). These findings are in agreement with the observations made by Lamerle *et al.* (1996).

Effect on Crop

Zero tilled crop had better growth as compared to conventional tillage. Advance sowing, better soil moisture for good germination brought good establishment of the crop leading to higher yield of wheat under zero tillage (Table 2). The hand weeded crop had significantly more number of tillers and dry matter accumulation than weedy check during both the years.

Light interception (%) is the total result of plant canopy. Wheat cv. HUW 234 exhibited significant superiority over other cultivars when judged in terms of light interception (%) which ultimately resulted in lower total weeds dry weight and higher dry matter accumulation by crop. The difference in yield (grain + straw) of cultivars may be ascribed to variation in yield attributing characters and more light interception by crop (Table 2).

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