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Effect of wheat establishment methods and weed management practices on weed dynamics and productivity of wheat grown in succession to rice

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ABSTRACT

A field experiment was conducted for two consecutive wheat seasons of 2005-06 and 2006-07 at crop research centre, GBPUA&T, Pantnagar on sandy loam soil to find out the effect of establishment methods and weed management practices on weed dynamics and productivity of wheat grown after harvesting of rice. Wheat was infested with *Phalaris minor, Melilotus indica, Medicago denticulata, Chenopodium album* and *Rumex acetosella* in weedy check at 60 days after sowing (DAS). Zero till sown wheat had significantly lesser infestation of all weeds except *Rumex acetosella* than other wheat establishment methods. Hand weeding twice at 35 and 55 DAS was most effective to minimize the weed density and their dry weight under all the wheat establishment methods. Zero till sown crop led to recorded significantly higher grain yield than other establishment methods, however, hand weeding twice was most effective in increasing the grain yield.

Key Words: Establishment methods, Cropping system, Weed dynamics

Rice-wheat is one of the most predominant cropping systems occupying 10.5 m ha area, specially in North India. Sowing of wheat in this tract is generally delayed due to cultivation of long and medium duration rice varieties and time required in field preparation of wheat. The conventional method of wheat sowing by giving repeated tillage further delays sowing by 10 to 15 days, affecting the yield adversely. The reduction in grain yield due to delay in wheat sowing has been recorded as 37.5 kg/ha/day (Pal *et al.* 1996). It has been observed that zero tillage technique not only ameliorates the problem of delayed sowing but also reduces the incidence of most problematic weed like *Phalaris minor* in wheat, which is also a serious factor in rice-wheat cropping system. Effective weed control enhances grain yield of wheat by 40.6% (Dixit and Bhan 1997). Keeping these points in view, present investigation was made to evaluate the impact of establishment methods and weed management practices on weeds as well as wheat crop.

MATERIALS AND MATHODS

A field experiment was conducted on wheat cv. *PBW 343* grown after rice during *rabi* seasons of 2005-06 and 2006-07 at Crop Research Centre, GBPUA&T, Pantnagar (Uttarakhand). The soil of the experimental field was sandy loam in texture, normal in reaction (pH 7.8) medium in organic carbon (0.68%) and low in available nitrogen (262 kg/ha), medium in available phosphorus (37.6 kg/ha) and available potassium (260 kg/ha) contents. Twelve treatments consisted with three methods of wheat establishment *viz.,* zero tillage (without tillage), reduced tillage (3 harrowings) and conventional tillage (6 harrowings) as main plot treatments and four weed management practices, *viz.,* hand weeding at 35 and 55 DAS, isoproturon 1.0 kg/ha, clodinafop-propargyl at 60 g *fb* metsulfuron methyl (MSM) 4 g/ha and weedy check as sub plot treatments were tested in split plot design with three replications. Sowing of wheat was done on November 19 and November 22 under zero tillage and on November 25 and 29 under reduced as well as conventional tillage in both the consecutive years. The wheat was sown with seed rate of 100 kg/ha at a row spacing of 20 cm apart. The herbicides were applied as spray with the help of Maruti Foot Sprayer fitted with flat fan nozzle. Isoproturon and clodinafop-propargyl were applied 30 days after sowing, however, metsulfuron methyl was applied one week after first spray.

RESULTS AND DISCUSSION

Effect on weeds

The major weed flora recorded in wheat field under weedy check plot were little seed canary grass (*Phalaris minor*) 56.0%, yellow sweet clover (*Melilotus indica*) 12.4%, black medick (*Medicago denticulata*) 8.2%, common lambsquarters (*Chenopodium album*) 7.5% and red sorrel (*Rumex acetosella*) 6.3%. Other minor weeds were swinecress (*Coronopus didymus*), wild pea (*Lathyrus aphaca*), fumitory (*Fumaria parviflora*), common vetch (*Vicia sativa*), prostrate knot weed (*Polygonum plebejum*) and purple nut sedge (*Cyperus rotundus*) constituting 9.6 per cent of the total weed population.

Wheat sown with conventional tillage led to record significantly higher density of *Phalaris minor, Melilotus indica, Medicago denticulata* and *Chenopodium album* as compared to zero till sown crop during both the years. Weed density in conventional till sown wheat was at par with reduced till sown crop with respect to density of *Phalaris minor* during first year, however, differences between them were significant during second year. This was due to the fact that intensive tillage operation in conventional tillage treatment brought out the weed seeds from sub surface to favourable moist upper soil layer for good germination. Contrary to this, weed seeds remained in sub surface under zero till sown crop due to puddling carried out during paddy transplanting and failed to germinate because of unfavorable condition (Sinha and Singh 2005). The density of *Rumex acetosella* was almost constant in all establishment methods. The density of other minor weeds was significantly higher under zero till sowing as compared to other tillage and sowing methods due to presence of some perennial weeds. All weed management practices tested in wheat significantly reduced the density and dry weight of all the weeds over weedy check during both the years. Hand weeding twice at 35 and 55 DAS proved most effective in arresting weed growth as compared to other treatments. Among herbicidal treatments, application of clodinafop-propargyl *fb* metsulfuron methyl was significantly superior to the application of isoproturon alone (Table 1) mainly due to broad spectrum control of weeds. Similarly, superiority of clodinafop-propargyl over isoproturon in controlling the grasses especially resistant bio-types of *Phalaris minor* has been also reported by Chopra and Chopra (2005).

Effect on crops

Both zero and reduced till sown crops were better for dry matter accumulation and number of spikes/m^2 and spike length than conventional till sown crop, but differences among them were non-significant. The number of grains/spike was significantly higher under conventional tillage as compared to zero and reduced tillage. Zero tillage being at par with reduced tillage recorded higher 1000-grain weight than conventional tillage during second year. All weed management practices had significantly higher crop dry matter accumulation, number of spikes/m^2, number of grains/spike and 1000-grain weight than weedy check. Weed-crop competition index was minimum in zero till sown crop, which was comparable to reduced till sown crop, but former was significantly lower than conventional till sown crop during both the years. Weedy check had significantly higher weed-crop competition index under all tillage and methods of sowing than all those treatments receiving various weed control measures.

Zero till sown crop being compared to reduced till sown crop led to register significantly higher grain yield than conventionally till sown crop. The grain yields under zero tillage were on an average 4.81, 7.80 and 3.22, 8.88% higher than that of reduced and conventional tillage during both the consecutive years, respectively. Highest grain yield was observed in hand weeding twice at 35 and 55 DAS in both the years. All weed management practices produced significantly higher grain yield than weedy check (Table 2). Hand weeding twice at 35 and 55 DAS being at par with clodinafop-propargyl fb metsulfuron methyl produced significantly higher grain yield than isoproturon and weedy check. These results indicated that increase in yield attributes and grain yield was higher in those treatments which had lower weed density and total weed dry weight. This was because of minimum crop weed competition under these treatments which enabled the crop to make maximum use of natural and applied inputs for the development of yield attributes and consequently grain yield.

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Table 1. Weed density and total weed dry weight at 60 DAS as affected by establishment methods and weed management practices in wheat

Treatments	Weed density/m²												Total weed dry weight (g/m²) at 60 DAS	
	Phalaris minor		*Melilotus indica*		*Chenopodium album*		*Rumex acetosella*		*Medicago denticulata*		others			
	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
Wheat establishment methods														
Zero Tillage	1.7 (17.7)	1.9 (21.3)	0.5 (1.3)	0.6 (2.3)	0.5 (2.00)	0.5 (1.3)	0.8 (5.7)	0.6 (5.7)	0.6 (2.3)	0.6 (3.0)	2.2 (14.2)	3.0 (20.7)	2.4 (17.7)	2.3 (20.8)
Reduced Tillage	2.8 (47.7)	2.4 (55.3)	0.9 (6.7)	0.9 (7.8)	0.8 (5.00)	0.8 (5.0)	0.4 (2.0)	0.6 (3.0)	1.1 (5.3)	0.9 (6.3)	1.3 (6.0)	1.5 (9.3)	2.6 (28.6)	2.6 (26.7)
Conventional Tillage	3.1 (58.3)	3.1 (65.3)	1.2 (13.3)	1.4 (16.0)	0.8 (6.67)	0.8 (7.0)	0.6 (2.3)	0.7 (4.0)	1.2 (9.0)	1.7 (8.0)	1.2 (5.7)	1.5 (7.3)	2.7 (34.2)	3.0 (38.3)
LSD (P=0.05)	0.8	0.7	0.5	0.5	0.1	0.1	NS	NS	0.5	0.4	0.6	0.7	0.3	0.2
Weed management practices in wheat														
HW 35 and 55 DAS	0.5 (1.8)	0.9 (3.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.3 (1.8)	0.8 (4.4)	0.7 (1.0)	0.1 (2.2)
Isoproturon 1.0 kg/ha	3.0 (24.9)	2.5 (32.9)	0.4 (1.3)	0.5 (2.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.2 (0.4)	0.2 (0.4)	1.9 (9.3)	1.9 (12.0)	2.8 (15.3)	2.7 (15.8)
Clodinafop 60 g/ha *fb* MSM 4 g/ha	1.7 (8.9)	1.6 (13.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.0 (3.1)	0.4 (1.3)	1.2 (5.8)	2.3 (11.1)	2.5 (10.9)	2.4 (10.6)
Weedy	4.8 (129.3)	4.8 (139.6)	3.0 (27.1)	3.3 (32.7)	2.8 (18.24)	2.7 (17.8)	2.3 (13.3)	2.7 (16.9)	2.5 (18.7)	3.0 (21.3)	2.9 (17.6)	3.1 (22.2)	4.3 (80.2)	4.4 (85.7)
LSD (P=0.05)	0.7	1.4	0.5	0.4	0.8	0.1	0.5	0.4	0.8	0.6	0.8	0.7	0.2	0.2

* Original values given in parenthesis

Table 2. Crop dry matter accumulation, yield contributing characters, weed crop competition index and grain yield as affected by establishment methods and weed management practices in wheat

Treatments	Crop dry matter (g/m²) at 120 DAS		Spikes (no./m²)		Spike length (cm)		Grains/spike (no./m²)		1000-grain weight (g)		Weed crop competition index (WI)		Grain yield (kg/ha)	
	05-06	06-07	05-06	06-07	05-06	06-07	05-06	06-07	05-06	06-07	05-06	06-07	05-06	06-07
Wheat establishment methods														
Zero Tillage	361.5	371.1	155.0	154.6	8.6	8.5	40.2	39.2	40.0	41.0	9.7	12.5	4272	4232
Reduced Tillage	348.8	363.8	150.4	152.1	8.4	8.3	41.2	42.6	37.1	37.2	15.9	16.8	4076	4100
Conventional Tillage	321.3	342.1	142.6	141.3	8.4	7.7.	46.0	47.0	36.4	34.3	19.2	21.2	3963	3887
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	4.2	2.5	NS	4.1	1.8	1.2	228	258
Weed management practices in wheat														
HW 35 and 55 DAS	371.6	402.4	162.4	171.1	8. 7	8.4	46.5	46.3	39.7	40.2	0.0	0.0	4830	4900
Isoproturon 1.0 kg/ha	347.0	350.5	154.4	154.5	8.5	8.3	42.1	42.2	37.2	37.5	5.1	8.5	4580	4482
Clodinafop 60 g/ha *fb* MSM 4 g/ha	360.4	389.0	158.9	157.2	8.6	8.4	43.4	45.0	38.5	38.7	3.4	3.6	4663	4721
Weedy	296.4	293.9	121.6	114.4	8.1	7.6	37.4	38.3	34.5	33.7	51.2	55.1	2342	2189
LSD (P= 0.05)	40.1	43.7	20.6	31.1	NS	NS	2.5	3.7	2.1	3.13	1.3	1.8	221	255

WI - Weed index