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Influence of Different Tillage and Herbicide Management on Weed Dynamics and Wheat Productivity under Rice-Wheat Cropping System

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ABSTRACT

A field experiment was conducted during rabi 2004-05 and 2005-06 to ascertain the relationship among the seed-bed preparation, nutrient and weed management of wheat (*Triticum aestivum* L.) under six tillage conditions. Furrow irrigated raised bed planting system (FIRBS) recorded yield attributes as well as grain and straw yield significantly higher over the other tillage management. Conventional line sowing (CLS) also recorded significantly higher yield and yield attributes as compared to other tillage practices. The herbicide application significantly increased the grain and biomass yield due to reduction in weed density and weed dry weight. The highest yield and yield attributes was obtained with the application of Sulfosulfuron @ 33.3 g/ha followed by Metribuzin @ 250 g/ha in present investigation. Net return was found maximum under FIRBS with herbicide application of Sulphosulfuron. The maximum benefit: cost ratio of 3.32 obtained during second year in strip till drill plots.

***Keywords* :** Tillage, Planting system, Sulfosulfuron, weed dynamics, grain yield

INTRODUCTION

Rice-wheat is the most commonly employed cropping system in around 14 million hectares of land extending across the Indo-Gangetic Plain (IGP) and the rice-wheat sequence in India is estimated to occupy about 10.47 mha. Wheat (*Triticum aestivum* L.) is a predominant *rabi* crop of North- Western Plain Zone and Central Zone of India which occupies about 28.52 mha area and the production 94.45 m tonnes during 2011-12. The rice-wheat cropping system will also remain a pivot in future planning for food-sufficiency at the national level. Wheat production technology has systematically changed with the adoption of high yielding dwarf varieties. The agronomic packages like seed-bed preparation, fertilizer doses and weed management were markedly different for tall varieties from the presently grown dwarf ones. The introduction of dwarf, input responsive, high yielding mexican wheat varieties over an extensive area under the intensive cropping system in north-west India has changed the micro-climate in wheat crop ecosystem in favour of establishment of certain obnoxious grassy weeds like *Phalaris minor* Retz. (Canary grass) and *Avena ludoviciana* Dur. (wild oat). In addition to grassy weeds, broad leaf weeds like *Cirsium arvence, Convolvulus arvensis, Chenopodium album, Melilotus* spp. do also exist in wheat fields (Rathi *et al.,* 2008). It is thus clear that, the introduction of dwarf wheat varieties has increased the problem of weed competition.

The magnitude of crop-weed competition is greatly dependent on the supply of nutrients, type of seed-bed preparation and availability of the moisture. These factors, which are indispensable for maximization of wheat production, are also salubrious for the rank growth of weeds. Besides considerable reduction in grain yield, weeds deplete substantially the soil of its fertility to un-checked weed growth (Singh *et al.,* 2005). The nutrients drain by un-interrupted weed growth assumes added significance in the context of increasing cost of fertilizers. Thus a challenging target in wheat production has to be achieved with

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proper management of all inputs particularly fertilizers and pesticides. Gill and Brar (1975) observed reduction in grain yield of wheat to the extent of 19.5 q/ha due to infestation of *Phalaris minor* Retz. alone. It is thus obvious that for tapping the maximum yield potential of meticulously tailored dwarf wheat varieties and for judicious use of fertilizers, aggressive weed growth has to be checked in time.

The weeds in wheat fields can be checked either by physical methods including agronomic manipulations or by use of herbicides. With the rapid progress of industrialization and urbanization coupled with higher standards of literacy and living in a developing country like India, not only labour costs are ascending up, more and more people shun the drudgery of many agricultural operations including hand weeding. Thus chemical weed control offers, in such a situation, the most effective measures of weed management. In modern agriculture, the use of herbicides otherwise also has become an integral part of the crop production. With the availability of better farm machines and high potency herbicides together with economic pressure to reduce the production costs, there is need to develop alternate tillage practices for reducing the tillage operation for wheat sowing in conjunction with the use of herbicide for effective control of weeds.

MATERIALS AND METHODS

The soil of the experimental field was sandy loam (67.50 % coarse sand, 16.80% silt and 13.70% clay) in texture having moderate fertility and a pH of 7.0 at the Research Farm of the Janta Vedic (P.G.) College, Baraut, District–Baghpat (U.P.) at winter rabi 2004-05 and 2005-06. The soils was low in available N (162.07 kg/ha) and medium in available P (17.87 kg/ha) and rich in K (217.21 kg/ha). The experimental layout accommodated 18 treatments combinations imposed to wheat crop, comprising six tillage practices (Strip till-drill (STD), Zero tillage (ZT), Surface seeding (SS), Reduced tillage (RT), Conventional line sowing (CLS) and Furrow irrigated raised bed planting system (FIRBS) in main plots and three weed control measures (Metribuzin (Sencor) @ 250 g/ha, Sulfosulfuron (Leader) @ 33.3 g/ha, Weedy check) in sub plots with four replicates. The wheat variety 'PBW-373' was sown at a distance of 20 cm between lines under all the conventional and zero tillage with a seed rate of 100 kg/ha. Rice variety Pusa-1121 was transplanted on 5th July 2005 and 26 June 2006 for residual effect of herbicide and tillage management. Conventional plots were prepared for sowing wheat after giving pre sowing irrigation and sowing was accomplished on Dec, 8 and 5 of 2004-05 and 2005-06, respectively, whereas, sowing in zero tilled plots was taken directly after harvesting Rice

Table 1: Weed flora of experimental field during wheat crop season

Botanical name	Family name	English name	Hindi name
Grassy weeds			
Phararis minor Retz.	Gramineae	Little seed canary grass	Gullidanda
Avena ludoviciana L.	Gramineae	Wild oat	Jangli Jai
Polypogon monspeliensis (L.) Desf.	Gramineae	Rabit foot grass	-
Cynodon dactylon (L.) Pers.	Gramineae	Bermuda grass	Doob
Paspalum conjugatum Bergius	Gramineae	Sour grass	-
Non grassy weeds			
Chenopodium album L.	Chenopodiaceae	Lambsquarters	Bathua
Anagallis arvensis L.	Primulaceae	Scarlet pimpernel	Krishan neel
Fumaria parviflora L.	Fumariaceae	Fumitory	Gajri
Lathyrus aphaca L.	Leguminaceae	Wild pea	Matari
Medicago denticulate Wild	Leguminaceae	Yellow trefoil	Chandansi
Melilotus indica (L.) All.	Leguminaceae	Yellow sweet clover	Pillisenji
Rumex acetosella L.	Polygonaceae	Red Sorrel	Khattapalak
Vicia sativa L.	Leguminaceae	Common vetch	Akra
Coronopus didymus L.	Crucifereae	Swin cress	Jangli baboon
Eclipta alba L.	Compositae	Yerba-de-tago	Bhangra
Ageratum conyzoides L.	Compositae	Troic ageratum	Mahakua
Sedges			
Cyperus rotundus L.	Cyperaceae	Purple nutsedge	Motha

variety Pusa-1121 on same dates on residual moisture. Full dose of P and K was applied basel under all tillage methods, whereas, N was applied in splits at basal, crown root initiation (CRI) and earing stage of the wheat crop. Herbicides was applied at 30-35 days after sowing as a post, emergence. The amount of each herbicides per plot was measured and diluted to desired concentration. Data on weed flora, weed density and weed dry matter, various yield attributes, grain and straw yields of wheat and economic return were calculated as per the standard procedures.

to tilled ones. The total weed density and weed dry weight were also higher under untilled conditions. During both the years, *Phalaris minor* was the dominant weeds in weedy checks which contributed 23% to the total weeds. *Phalaris minor* was also reported to be a dominant weed at different places under to rice-wheat system.

The differences in the weed density as well as weed dry weight due to tillage proved to be significant. The crop grown under FIRBS and conventional sowing option recorded lower weed density and weed dry weight before application of

Table 2: Weed density, weed dry matter and weed control efficiency of wheat crop as influenced by tillage and weed management

	Weed density (No./m²) at at 60 DAS		Weed dry matter at 120 DAS		Weed control efficiency (%)	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Tillage management						
Strip till-drill (STD)	482.50	467.30	203.17	198.10	61.38	61.38
	16.92	16.61	11.98	11.83		
Zero tillage (ZT)	512.30	524.43	219.57	213.63	61.46	61.44
	16.94	16.97	13.12	13.07		
Surface seeding (SS)	594.90	569.87	241.10	238.93	61.11	61.09
	18.50	18.04	12.43	12.27		
Reduced tillage (RT)	530.10	505.03	248.83	247.17	61.95	62.09
	17.51	17.06	13.09	13.00		
Conv. line sowing (CLS)	370.77	346.27	204.57	199.40	62.12	62.16
	14.69	14.17	11.82	11.66		
FIRBS	278.37	261.40	188.33	180.07	62.33	62.17
	12.76	12.35	11.29	11.08		
SEm ±	0.52	0.41	0.133	0.175	1.30	1.25
LSD 0.05	1.63	1.30	0.420	0.565	NS	NS
Herbicide						
Metribuzin @ 250 g/ha	45.28	42.62	43.88	43.15	92.30	92.25
	6.71	6.52	6.64	6.59		
Sulfosulfuron @ 33.3 g/ha	37.52	34.37	40.62	39.50	92.88	92.91
	6.13	5.86	6.39	6.30		
Weedy check	1301.67	1260.17	568.28	556.00	0.00	0.00
	35.82	35.21	23.82	23.56		
SEm±	0.37	0.29	0.231	0.203	1.33	1.29
LSD 0.05	1.07	0.87	0.674	0.595	3.90	3.74

* Values in bold letters are transformed

RESULTS AND DISCUSSION

Weed flora, weed density and weed dry weight

Weed flora of the experimental field consisted of sixteen weed sp. (5 grassy), (non-grassy and sedge) (Table 1). The *P. minor, M indica* and *Coronopus didymus* were dominant weeds in the experimental fields. These weeds species were predominant under untilled plots in comparison

herbicide also observed that the furrow irrigated raised tilled bed planting system (FIRBS) of wheat cultivation proved reasonably good for the control of *Phararis minor.* Lower weed density under zero tillage before application of herbicide could be due to poor weed emergence because of improper aeration and light enrichment in the deeper soil, compaction of the soil inhibiting the germination of the weeds, and poor contact of weed seeds with moisture in case of seeds remaining on the surface. Due to' poor weed density upto 30 days, these tillage options recorded lower weed dry weight. It was also found that optimally tilled plots had more weeds/unit area than zero tillage plots, but grain yield and net returns were higher under optimally tilled plots as compared to zero-tillage. FIRBS recorded lower weed density followed by conventional line sowing than any other tillage options at all the stages of crop growth. Weed dry matter was significantly reduced by FIRBS and conventional line sowing at all the stages of crop growth (Table 2). Jat and Singh (2003) and Sharma *et al.* (2004) reported that FIRBS provided reasonably good control of *Phararis minor.* Mishra *et al.* (2005) reported that the problem of *Phalaris minor* was comparatively less as the weed seeds lying on the top of the raised beds failed to germinate as the top of bed dried out quickly.

leaves and lowest in fruits and grams. Yadav *et al.* (2001) reported that sulfosulfuron herbicide had controlled the weeds like *Bromus* spp., *Apera spicaventi* and *Poa trivialis, Convolvulus arvensis, Poa annua, Rumex* spp., *Spergula arvensis, Lolium temulentum* etc. which are of grassy nature (Table 1).

The weed control efficiency of both the herbicides was higher under FIRBS, conventional line sowing and reduced tillage in comparison to strip-till-drill, zero tillage and surface seeding that resulted in greater reduction in weed density as well as weed dry weight. This might be due to favourable condition available for plant growth under tilled plots with healthy grown plants having fast metabolic activity leading to fast translocation of herbicides to their site of action inside the plant body.

Yield performance

Data recorded on yield attributes, viz. number of effective tillers, spike length, number of grains/ spike, 1000 seed weight as well as grain and straw yield of wheat crop (Table 3 and Table 4) exhibited significant differences under different tillage management and herbicide applied to wheat crop. The grain yield per unit area is a product of main yield contributing characters viz., number of effective shoots per unit area, grain weight per spike and 1000-grain weight. Significantly more number of grains/earheads, seed yield per plant and higher test weight were recorded under FRBS

Table 3 : Yield attributes of wheat crop as influenced by tillage management and herbicide use under rice-wheat cropping system

Treatments	Effective tillers/plant		Grains/ear heads		Grain Wt./spike		1000 seds Wt.(g)		Length of (cm)	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Tillage management										
Strip till-drill (STD)	302.00	313.00	33.80	33.94	2.42	2.52	38.18	38.22	9.37	9.47
Zero tillage (ZT)	286.67	326.33	32.14	32.35	2.51	2.57	38.67	38.88	8.80	8.85
Surface seeding (SS)	230.00	233.67	32.73	32.92	1.99	2.13	38.89	38.99	8.47	8.52
Reduced tillage (RT)	323.33	328.00	32.73	32.96	2.19	2.28	39.06	39.12	9.07	9.19
Conv. line sowing (CLS)	314.67	319.67	35.93	36.19	2.51	2.61	39.16	39.31	9.92	10.07
FIRBS	321.67	327.00	38.79	38.91	2.58	2.68	39.63	39.68	10.41	10.55
SEm ±	4.08	3.85	.45	0.76	0.023	0.025	0.49	0.42	0.099	0.106
LSD 0.05	12.87	12.13	1.43	2.39	0.074	0.079	NS	NS	0.279	0.330
Herbicide										
Metribuzin @ 250 g/ha	297.83	319.50	34.95	35.10	2.37	2.45	39.99	40.12	9.35	9.47
Sulfosulfuron @ 33.3 g/ha	314.67	321.00	37.02	37.24	2.48	2.59	41.48	41.59	10.20	10.31
Weedy check	276.67	283.33	31.10	31.30	2.26	2.36	35.33	35.39	8.47	8.54
SEm±	4.97	5.76	0.57	.67	0.044	0.046	0.72	0.59	0.172	0.144
LSD 0.05	14.53	16.82	1.66	1.96	0.127	0.133	2.09	1.74	0.052	0.423

A significant reduction was recorded due to application of both herbicide in weed density and weed dry matter at all the stages in comparison to weedy check. Metribuzin controlled grasses and broad-leaf weeds including deep rooted weeds, whereas the sulfosulfuron was slightly more effective in controlling the grassy weed. Rao and Bhardwaj (1986) reported that metribuzin was readily taken up by the plant roots through diffusion and translocated upward apoplectically. Its accumulation was highest in roots, stems and as compared to other tillage management practices., whereas more number of effective tillers under residue tillage, which was significantly on par with FRBS than other tillage management.

The grain yield was significantly influenced by tillage management (Table 4). Among tillage options, FIRBS and conventional line sowing recorded consistently higher grain and biomass yield than reduced tillage, zero tillage and surface seeding. Grain yield reduction by zero tillage, surface seeding and reduced tillage was mainly due to lower crop emergence and growth, and reduced ear fertility and also higher weed infestation, which could not be controlled even with herbicide application. Jat and Singh (2003) confirmed that deeply tilled plots produced maximum grain yield followed by conventional and zero tillage and increased the yield in the same fashion, where herbicide was applied. The herbicide application significantly increased the grain and biomass yield due to reduction in weed density and weed dry weight (Table 4 and 2). That's why there would be less crop weed competition for space, light, moisture and nutrient etc which resulted in better crop establishment, reduced tiller mortality and ultimately increase in the grain and biomass yield. According to Chauhan *et al.* (2003) the application of metribuzin was found to decrease the weed population and weed biomass significantly when compared with weedy check and resulted higher grain yield. Similar was the result with application of sulfosulfuron in another experiment during same year. In wheat crop, 10-50 per cent loss in grain yield due to weeds was quite usual Chauhan *et al.* 1998), Pradhan *et al.* (2000), Rathi *et al.* (2008), Mishra and Singh (2009) reported that weedy conditions in wheat resulted in 35-50 per cent reduction in grain yield.

Table 4 : Yield of wheat crop as influenced by tillage management and herbicide use under rice-wheat cropping system

Treatments	Grain yield (q/ha)		Straw yield (q/ha)		Biological yield (q/ha)	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Tillage management						
Strip till-drill (STD)	30.43	31.28	42.18	42.98	72.61	74.26
Zero tillage (ZT)	28.89	29.59	39.89	40.43	68.78	70.02
Surface seeding (SS)	29.54	29.93	40.73	40.94	70.26	70.87
Reduced tillage (RT)	29.55	30.42	41.55	41.67	71.11	72.09
Conv. line sowing (CLS)	32.45	33.31	45.39	46.25	77.84	79.56
FIRBS	36.67	37.43	48.94	49.91	85.62	87.34
SEm ±	0.59	0.62	0.74	0.81	1.41	1.43
LSD 0.05	1.89	1.96	2.38	2.54	4.47	4.50
Herbicide						
Metribuzin @ 250 g/ha	36.20	36.74	48.96	49.39	85.16	86.12
Sulfosulfuron @ 33.3 g/ha	39.54	40.43	53.21	54.00	92.75	94.43
Weedy check	18.03	18.81	27.17	27.71	45.20	46.52
SEm±	0.56	0.59	0.76	0.82	1.33	1.40
LSD 0.05	1.65	1.73	2.25	2.39	3.89	4.09

Economics

In the present study net return was found to be maximum under FIRBS with herbicide application of Sulphosulfuron, due to relatively higher gross return. FIRBS with herbicide Metribuzin also to observed second highest net return, zero tillage with weedy check during both the years recorded least net return due to least gross return (Table 5). The maximum benefit: cost ratio of 3.23 in 2004-05 and 3.32 in 2005-06 was obtained from sowing of wheat with strip till drill, respectively. Among the herbicide application, highest B:C ratio during first and second year, respectively, was obtained with application of Sulphosulfuron, mainly due to the relatively higher net return. During the first year conventional line sowing with weedy check and reduced tillage with weedy check recorded lowest B:C ratio whereas due to lowest cost of field preparation and very low net return, zero tillage and surface seeding, respectively recorded similar trend in B.C ratio.

Table 5 : Economics of wheat cultivation under different tillage treatment and herbicide application

Treatments	Net return (Rs/ha)		B:C ratio	
	2004-05	2005-06	2004-05	2005-06
STDM	35690	36268	3.19	3.24
STDS	38068	39168	3.23	3.32
STDW	9842	11194	0.98	1.12
ZTM	30969	31351	2.90	2.94
ZTS	34545	36127	3.06	3.20
ZTW	13655	14135	1.44	1.49
SSM	29720	29866	2.39	2.41
SSS	34446	35060	2.65	2.69
SSW	12250	12800	1.09	1.14
RTM	28770	29632	2.10	2.16
RTS	33454	34274	2.34	2.40
RTW	10868	11846	0.87	0.95
CLSM	34152	35132	2.29	2.36
CLSS	36778	37528	2.37	2.42
CLSW	9552	10928	0.70	0.80
FIRBSM	38570	39350	2.54	2.59
FIRBSS	42110	43554	2.67	2.76
FIRBSW	13706	14330	0.98	1.02

CONCLUSION

Furrow irrigated raised bed planting system (FIRBS) recorded yield attributes as well as grain and straw yield significantly higher over the other tillage management. Conventional line sowing (CLS) also recorded significantly higher yield and yield attributes as compared to other tillage practices. The herbicide application significantly increased the grain and biomass yield due to reduction in weed density and weed dry weight. The highest yield and yield attributes was obtained with the application of Sulfosulfuron @ 33.3 g/ha followed by Metribuzin @ 250 g/ha in present investigation. Net return was found to be maximum under FIRBS with herbicide application of Sulphosulfuron, due to relatively higher gross return. FIRBS with herbicide Metribuzin also to observed second highest net return and least net return was recorded under zero tillage with weedy check. The maximum benefit: cost ratio of 3.23 in 2004-05 and 3.32 in 2005-06 was obtained from sowing of wheat with strip till drill, respectively.

REFERENCES

Chauhan DS, Sharma RK and Chhokar RS. 2003. Comparative performance of tillage options in wheat (*Triticum aestivum*) productivity and weed management. *India J. Agric. Sci.* **73**(7): 402-406.

Chauhan DS, Sharma RK, Verma OS, Nagarajan S, Singh G and Tyagi BS. 1998. Integrated weed management in wheat through tillage options and new molecules under rice-wheat system. Wheat research need beyond 2000 AD. Proceedings of an International Conference 12-14 Aug. 1997, Karnal, India. 263-273.

Gill HS and Barar LS. 1975. Importance of herbicides in the Agriculture of Punjab and Haryana. *Pesticides* **9**(4): 20-24.

Jat LN and Singh SM. 2003. Varietal suitability, productivity and profitability of wheat (*Triticum species*) intercrops and relay cropping under furrow-irrigated raised bed system. *India J. Agric. Sci.* **73**(4): 187-190.

Mishra JS and Singh VP. 2009. Weed dynamics and productivity of soybean (*Glycine max*) – based cropping systems as influenced by tillage and weed management. Indian Journals of Agronomy **54**(1): 29-35.

Mishra JS, Singh VP and Yaduraju NT. 2005. Effect of tillage and weed control methods on weeds and wheat (*Triticum aestivum*) in vertisols. *Indian J. Weed Sci.* **37**(1-2): 96-97.

Pradhan AC, Nayak M and Sarkar PK. 2000. Effect of weed management on wheat (*Triticum aestivum* L.) under different tillage system after kharif rice. *Journal of Crop and Weed* **1**(2): 52-59.

Rao MV and Bhardwaj RBL. 1986. Weed Menace in wheat field. *Indian Farming* **29**(4): 16-18.

Rathi AS, Kumar V, Singh VP and Singh DK. 2008. Integrated weed management in irrigated wheat. *Progressive Agriculture* **8**(1): 74-76.

Sharma AK, Sharma RK and Babu KS. 2004. Effect of planting options and irrigated schedules on development of powdery mildew and yield of wheat in the North Western Plains of India. *Crop Protection* **23**(3): 249-253.

Singh A, Brar SS, Virk HK and Kaur Amarpreet. 2005. Studied on the interactive effect of crop establishment methods in rice-wheat cropping system. *Haryana J. Agron.* **21**(1): 10-12.

Yadav SK, Singh RG, Singh VP, Singh G. 2001. Weed management studies in ziro tillage wheat in rice-wheat cropping system. *Indian J. Weed Sci.* 33(3/4): 95-99.

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