Indian Journal of Agronomy **58** (2): 215–219 (June 2013)

Research Paper

Weed management studies in wheat (*Triticum aestivum*) with herbicides under different establishment methods

DIVAKAR DEV[1], VIVEK[2], SHEESH PAL SINGH[3] AND RAVINDRA KUMAR[4]

Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh 250 110

Received : May 2012; Revised accepted : May 2013

ABSTRACT

A field experiment was conducted at Meerut during *rabi* season 2005–2006 and 2006–2007, in a spilt plot design with four replications to find out the effect of weed management and tillage methods on wheat [*Triticum aestivum* (L.) emend. Fiori & Paol]. The tillage methods as main-plots treatment comprised of zero tillage, reduced tillage and conventional tillage, whereas weed control practices as sub-plot comprised of five treatments *viz.* sulfosulforon 25 g/ha, isoproturon 750 g + 2,4-D 250 g/ha, metribuzin 250 g/ha applied at 30 days after sowing, weed free and weedy cheek. The highest yield attributes and yield were noticed under conventional tillage followed by zero tillage. Minimum weed density and dry matter accumulation was found under zero tillage. Zero tillage was most economical. Among the methods of weed control, sulfosulfuron 25 g/ha gave excellent control of weeds and increased the yield attributes and yield, gross returns, net returns and B: C ratio. Thus zero tillage in combination with application of sulfosulfuron 25g/ha was found effective to manage weeds and increase wheat grain yield.

Key words : Tillage methods, Wheat, Weed management practices

Wheat is the important cereal among the food grain crops in the world. In India, wheat is grown mostly in rice–wheat system. Poor crop stand, late planting, poor physical conditions due to puddling are the some of important constraints for wheat in this system. Under such conditions sowing of wheat is often delayed due to long duration of rice cultivars and infestation of weeds deprives the crop of plant nutrients and drains the farmer's economy. Delayed sowing beyond November reduces wheat grain yield at 1%/ha/day (Hobbs, 1994). To overcome above constraints zero tillage sowing of wheat is emerging as an important technology. Under such circumstances, the adoption of proper establishment methods and weed management practices can raise wheat productivity/ sustainability and can make it cost effective.

With the introduction of high yielding dwarf varieties having heavy demand of inputs, the problem of weed infestation has increased manifold as it created favourable conditions for invasion as well as luxuriant growth of weeds particularly of *Phalaris minor* and *Avena* spp. throughout wheat growing area in our country (Gill *et al.*, 1984). In wheat, yield losses due to weeds may range from 10–82% depending upon the density and species of weed, duration of infestation and competing ability of crop plants under different agro–ecological conditions (Rao, 1994). Conventional methods of weed control being weather dependent, laborious, time consuming and costly due to high cost of labour and mechanical means being less efficient in controlling weeds compare to use of herbicides. Under such conditions it is important to find out the economic feasibility of wheat cultivation with herbicides under different establishment methods.

MATERIALS AND METHODS

A field experiment was conducted at Sardar Vallabh Bhai Patel University of Agriculture & Technology, Modipuram, Meerut during *rabi* 2005–06 and 2006–07. The soil of experimental field represented sandy loam series–inceptisols, medium in organic carbon, low in available nitrogen, medium in available phosphorus and available potassium, normal in soluble salts (EC) with a pH of 7.6. Experiment was conducted in split–plot design having fifteen treatments with four replications. The tillage methods as main plot treatments comprised of zero tillage, reduced tillage and conventional tillage, whereas weed management practices comprised of five treatments *viz.*,

[4]**Corresponding author Email:** kumarrk2000@yahoo.com
[1]Marketing Field Representative, National Fertilizer Limited, Betul, M.P.; [2]Associate Professor, [3]Subject Matter Specialist, Krishi Vigyan Kendra, Hastinapur; [4]Associate Professor, Department of Finger Printing, College of Biotechnology, SV Patel University, Meerut, Uttar Pradesh

sulfosulforon 25 g/ha, isoproturon 750 g + 2,4–D 250 g/ha, metribuzin 250 g/ha each applied at 30 days after sowing, weed free and weedy cheek. In zero tillage no field preparation was done, whereas in reduced tillage three operation *viz.* one harrowing by disk harrow, one cultivator followed by leveling and in case of conventional tillage five operation namely, two harrowing by disk harrow, two cultivator and finally leveling were done for field preparation. Zero tillage plots were directly sown with the help of Pant–zero–till–drill at row spacing of 20 cm. In case of reduced and conventional tillage, sowing was done by conventional seed drill at the row–to–row spacing of 20 cm. The crop was sown on November 20, during both the years using wheat 'PBW 343' at the seed rate of 100 kg/ha. The crop was fertilized uniformly with 150kg N/ha through urea, 75 kg P_2O_5/ha through Diammonium phosphate and 50 kg K_2o/ha through muriate of potash. Post emergence herbicide *viz.*, sulfosulfuron 25g/ha, isoproturon 750 g + 2,4–D 250 g/ha and metribuzin 250 g/ha were applied at 30 days after sowing using 800 liters of water/ha, with manually operated knapsack sprayer.

Weed density was recorded by using a quadrate of 50 cm × 50 cm (0.25cm^2) size from center of the plot. The total numbers of weeds falling within quadrate were counted species wise in each plot. All the weeds inside the quadrate were cut close to the ground level in each plot and collected for dry matter accumulation. The samples were first dried in sun and then kept in oven at 70^o C $\pm$ 2 ^{o}C. The dried samples were weighed and expressed in grams/m^2. Weed control efficiency was calculated at 60 DAS in relation to total weed dry matter and expressed in per cent. Net returns for each treatment combination was calculated by deducting the cost of cultivation from the respective gross returns. Benefit: cost ratio was calculated by dividing net returns (₹/ha)/with cost of cultivation (₹/ha). Pooled data of two years are presented in the tables.

RESULTS AND DISCUSSION

Effect on weeds

Tillage practices had marked effect on weed density, weed dry matter accumulation and weed control efficiency. The major weed species present in the experimented field were *Phalaris minor, Avena ludoviaciana, Cyprus rotundus, Chenopodium album* and other weeds. The effect of different tillage practices on the density of *Phalaris minor* was non significant during both the years. Density of weeds in conventional tillage was higher than zero tillage (Table 1). In case of dry matter accumulation, similar trends were found as density. It might be due to the fact that *Phalaris minor* seeds, which were in deeper soil layer comes to upper soil layer due to conventional and reduced tillage and get germinated in conducive environ-

Table 1. Density and dry matter accumulation of different weeds at 60 days after sowing as influenced by various tillage methods and weed management practices in wheat. (Pooled data of two years)

Treatment	Density of different weeds (No. per m^2)					Dry matter accumulation (g/m^2)				
	Phalaris minor	*Avena ludoviciana*	*Cyprus rotundus*	*Chenopodium album*	other weeds	*Phalaris minor*	*Avena ludoviciana*	*Cyprus rotundus*	*Chenopodium album*	other weeds
Tillage methods										
Zero Tillage	1.81(3.75)	1.93(4.32)	1.63(3.00)	1.63(3.05)	1.51(2.52)	1.65(2.26)	1.55(2.30)	1.46(2.07)	1.46(2.10)	1.47(2.18)
Reduced Tillage	2.03(5.02)	1.82(3.75)	1.75(3.47)	1.82(3.77)	1.71(3.25)	1.72(2.48)	1.64(2.62)	1.54(2.31)	1.54(2.29)	1.58(2.52)
Conventional Tillage	1.98(4.57)	1.77(3.52)	1.65(3.12)	1.71(3.35)	1.62(2.90)	1.69(2.40)	1.58(2.39)	1.48(2.17)	1.49(2.16)	1.53(2.35)
SEm±	0.08	0.07	0.09	0.06	0.07	0.03	0.02	0.05	0.04	0.06
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed management practices										
Weed Free	0.71(0.00)	0.71(0.00)	0.71(0.00)	0.71(0.00)	0.71(0.00)	071(0.00)	071(0.00)	071(0.00)	071(0.00)	071(0.00)
Weedy check	3.76(13.87)	3.59(12.58)	3.24(10.12)	3.34(10.91)	3.05(9.20)	2.62(6.44)	2.64(6.51)	2.55(6.08)	2.60(6.32)	2.69(6.94)
Sulfosulfuron25g/ha	1.59(2.20)	1.47(1.79)	1.30(1.37)	1.36(1.53)	1.30(1.33)	1.47(1.69)	1.45(1.65)	1.35(1.47)	1.33(1.39)	1.35(1.43)
Isoproturon750g+2,4-D 250 g/ha	1.74(2.78)	1.59(2.20)	1.50(2.03)	1.53(2.08)	1.44(1.75)	1.51(1.83)	1.55(1.92)	1.40(1.59)	1.38(1.51)	1.43(1.61)
Metribuzin 250 g/ha	1.91(3.37)	1.75(2.74)	1.63(2.45)	1.65(2.41)	1.57(2.16)	1.55(1.93)	1.60(2.12)	1.47(1.77)	1.47(1.70)	1.48(1.78)
SEm±	0.11	0.09	0.13	0.09	0.12	0.03	0.03	0.08	0.07	0.09
CD (P=0.05)	0.34	0.27	0.38	0.34	0.36	0.10	0.10	0.26	0.22	0.26

ment. Similar findings were also reported by Bisen *et al.* (2006). The higher dry matter accumulation of weeds was under reduced tillage and almost similar to conventional and zero tillage (Table 1). It may be due to lower density of crop plants and more competition of weed plants and crop. The dominance of *Phalaris minor* in the field suppressed the others weeds. Density of *Chenopodium album*, and others weed did not varied significantly, maximum weed density and dry weight was found under reduced tillage followed by conventional and zero tillage. These results are similar to the findings of Jain *et al.* (2006).

Weed control efficiency was higher in zero tillage followed by conventional and reduced tillage at 60 days after sowing during both the years (Table 3). It may be due to higher soil compaction, lower germination of weeds, and Vigorous growth of crop and suppression effect of crop plants on weeds. Sinha and Singh (2005) also reported less weed density and dry matter accumulation under zero tillage as compared to conventional tillage.

Weed control measures had significant effect on weed population and its dry matter accumulation. The sulfosulfuron treatment was effective to control the weeds viz. *Phalaris minor*, *Avena ludoviaciana*, *Cyprus rotundus Chenopodium album* and other weeds. In general weed density reduced after execution of weed control measures as the crop comes in advance stage. Application of sulfosulfuron @ 25g/ha, resulted significantly lower weed density and dry matter accumulation of weeds (Table 1). It was effective than isoproturon 750 g + 2, 4–D 250 g/ha and metribuzin 250 g/ha to control weeds.

Yield and its attributes

Grain and straw yields was significantly higher in conventional tillage over reduced tillage and being at par with zero tillage during both the years. The grain yield under conventional plot was higher over zero and reduced tillage during both the years. Whereas, straw yield in conventional tillage was higher over zero and reduced tillage during both the years. Higher grain and straw is the result of higher yield attributes associated with conventional tillage (Table 3). Zero tillage also resulted into considerably better yield contributing characters thereby yielding higher over reduced tillage. These results are in conformity with the finding of Singh and Kumar (2005) and Bisen *et al.* (2006).

Straw and grain yields were affected significantly by various weed management practices. The higher grain yield was observed under weed free treatment. This was 38.4 and 52.6% higher over weedy check. However, sulfosulforon 25 g /ha was second most effective treatment just after weed free treatment. This may be as a result of yield contributing characters, lesser number of weeds and better nutrient availability to crop as reported by Bisen *et al.* (2008). Higher straw and grain yields under weed free and sulfosulfuron 25 g /ha treatment may be due to efficient control of weeds, reduced crop–weed competition for nutrient, water, space and light and resulted in better growth, yield attributes and finally yield. Whereas, in weedy plot the vigorously growing weeds competed with the crop plant for nutrient, moisture, space and sunlight throughout growing period and finally suppressed the crop growth.

Among the yield attributes viz., spike length, number of spikelets per spike, number of grains per spike and 1000 grain weight, the spike length under conventional tillage was significantly higher than reduced tillage and was found at par with zero tillage during both the years. Apart from conventional tillage, zero tillage treatment was found

Table 2. Yield attributes as influenced by tillage and weed management practices. (Pooled data of two years)

Treatment	Yield attributes			
	Spike length (cm.)	No. of grains/spike	No. of spikelets/spike	1,000–grain wt. (g)
Tillage Methods				
Zero Tillage	8.8	37.7	13.9	43.1
Reduced Tillage	8.1	34.4	13.3	41.7
Conventional Tillage	9.0	40.3	14.3	44.1
SEm±	0.07	0.79	0.23	0.17
CD (P=0.05)	0.28	2.74	0.81	0.61
Weed management practices				
Weed Free	9.1	41.4	15.1	44.6
Weedy check	8.0	32.5	11.9	40.4
Sulfosulfuron 25 g/ha	8.8	39.4	14.3	43.8
Isoproturon 750 g/ha + 2,4-D 250 g/ha	8.7	37.7	13.9	43.3
Metribuzin 250 g/ha	8.5	36.2	13.4	42.6
SEm±	0.13	1.05	0.43	0.30
CD (P=0.05)	0.38	3.03	1.24	0.87

Table 3. Weed control efficiency, straw yield, grain yield and economics as influenced by various tillage methods and weed management practices in wheat. (Pooled data of two years)

Treatment	Weed control efficiency at 60 days	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index (%)	Cost of cultivation (× 10^3 ₹/ha)	Net returns (× 10^3 ₹/ha)	B: C ratio
Tillage Methods							
Zero Tillage	66.34	5.31	4.39	45.27	18.6	31.7	1.71
Reduced Tillage	62.63	5.01	4.18	45.04	21.9	23.8	1.08
Conventional Tillage	64.58	5.46	4.56	45.48	23.3	28.6	1.22
SEm±	–	0.09	0.09	0.02			
CD (P=0.05)	–	0.32	0.31	NS			
Weed management practices							
Weed Free	100.00	5.75	4.85	45.76	24.1	30.3	1.25
Weedy check	0.00	4.29	3.36	43.90	20.5	19.2	0.94
Sulfosulfuron 25 g/ha	76.71	5.53	4.63	45.57	21.1	31.5	1.49
Isoproturon 750 g + 2,4–D 250 g/ha	74.10	5.44	4.53	45.45	20.8	30.3	1.45
Metribuzin @ 250 g/ha	71.79	5.30	4.39	45.32	21.0	28.1	1.33
SEm±	–	0.09	0.09	0.07			
CD (P=0.05)	–	0.26	0.25	0.22			

next best performer (Table 2), which showed its superiority over reduced tillage for most of the yield attributes. Superiority of conventional tillage might be due to better plant growth. Such parameters were not favourable in reduced tillage, which were hurdle for initial growth and reflected by lower crop growth and development. Such effect of tillage practices on yield attributes had been reported by Rawat and Varma, (2006).

Yield attributes were affected significantly by weed control measures. Weed free treatment had significantly higher spike length, number of grains/spike, number of spikelets/spike and 1000 grains weight over rest the treatments. The second next best performer was sulfosulfuron 25g/ha over rest of the treatments (Table 2). The higher number of attributes may be result of good crop growth parameter, better nutrient availability and absence of weeds. Among the herbicides sulfosulfuron 25 g/ha had good capacity to control the grassy and non–grassy weeds. However, poor yield attributing character in metribuzin 250 g/ha may be the result of phytotoxic effect and presence of weeds as described by Banga *et al*. (2003).

Economics

Economics reveals that high cost of cultivation was found in conventional tillage, followed by reduced and zero tillage. Gross return was also higher in conventional tillage followed by zero and reduced tillage (Table 3). Net returns and B:C ratio was higher in zero tillage followed by conventional and reduced tillage. This may be due to lower cost of cultivation incurred in zero tillage. In case of weed management practices higher cost of cultivation, gross returns, net returns and B: C ratio were found under sulfosulfuron 25 g/ha treated plots followed by isoproturon 750 g + 2,4–D 250 g/ha and Metribuzin 250 g/ha treated plots (Table 3). This may be due to excellent arresting capacity of grassy and non–grassy weeds by sulfosulfuron.

Among the methods of weed control, sulfosulfuron 25 g /ha gave excellent control of weeds population and increased the yield attributes and yield, gross returns, net returns and B:C ratio. Zero tillage in combination with application of sulfosulfuron 25 g/ha was found effective to manage weeds and increase wheat grain yield.

REFERENCES

Banga, R.S., Malik, R.K., Yadav, A and R.S. Malik 2003. Compatibility of Clodinafop with Metsulfuron and 2,4–D against wild oat in wheat. In: *Proceedings of Biennial Conference, Indian Society of Weed Science,* Pantnagar. pp.17.

Bisen, P.K., and Singh, Raghavendra 2008. Effect of tillage and weed control practices on weed growth and yield of wheat in rice–wheat system. *Indian Journal of Agricultural Sciences* **78**(4): 347–50.

Bisen, P.K., Singh, R. K. and Singh R.P. 2006. Relative composition of weeds and wheat yield as influenced by different weed control and tillage practices. *Indian Journal of Weed* Science **38**(1&2): 9–11.

Gill, H.S., Ajmer Singh and Walia, U.S. 1984. Tolerance of weed cultivars to metoxuron. *Indian Journal of Weed Science* **16**: 176–81.

Hobbs, P.R. 1994. Rice–Wheat system in South Asia. In: *Proceedings of Symposium on "Sustainability of Rice–Wheat System in India"* held at Karnal, May 7–8. Pp. 61–76.

Jain, N., Kewat, M.L., Mishra, J.S. and Jain, V. 2006. Effect of tillage and herbicides on weeds and wheat in transplanted rice–wheat system. *Indian Journal of Weed science* **38**(1&2): 16–19.

Rao, V.S. 1994. Principles of weed science, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi, p. 540.

Rawat, S.N. and Varma, M. R. 2006. Effect of different tillage systems on grain yield of wheat crop. *International Journal of Agricultural Science* **2**(1): 151–53.

Singh, R. and Kumar, S. 2005. Effect of tillage options on wheat productivity. In: *Proceedings of the Project Workshop on Accelerating the Adoption of Resource Conservation Technologies in Rice–Wheat Systems of the Indo–Gangetic Plains*, June 1–2, 2005, Directorate of Extension Education, CCS Haryana Agricultural University, Hisar 125 004 (Haryana), India. pp. 224–28.

Sinha, R.K. and. Singh, A.K. 2005. Wheat establishment methods under late sown condition in rice–wheat cropping system. In: *Proceedings of the Project Workshop on Accelerating the Adoption of Resource Conservation Technologies in Rice–Wheat Systems of the Indo–Gangetic Plains*, June 1–2, 2005, Directorate of Extension Education, CCS Haryana Agricultural University, Hisar 125 004 (Haryana), India. pp. 265–66.