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Effect of crop establishment and weed management practices on growth and yield of wheat

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ABSTRACT

A field experiment was conducted during the winter season of 2012-13 and 2013-14 at ICAR-DWR, Jabalpur, Madhya Pradesh, to study the effect of crop establishment and weed management practices on growth and yield of wheat. Maximum reduction in density and biomass of *Phalaris minor* and *Avena ludoviciana* was recorded under zero-tillage with residue while in *Medicago denticulata* under conventional tillage practices. Zero tillage with residue retention recorded higher grain and straw yield as well as net return and B:C ratio. Among the different herbicides ready mix application of sulfosulfuron + metsulfuron (32 g/ha) significantly reduced weed density and dry biomass accumulation, and which was followed by application of mesosulfuron +iodosulfuron and mertibuzin over weedy check due to enhanced of growth, yield and benefit cost ratio of wheat. As compared to weedy, the higher yield attribute character and yield of wheat was produced with the herbicidal treatments. The maximum yield, net return and B:C was achieved with the post-emergence application of sulfosulfuron + metsulfuron.

INTRODUCTION

Introduction of high yielding dwarf genotypes, improved fertilizer and irrigation facilities coupled with scientific research have led India to the prestigious position in the world in wheat production (92.29 million tonns in 2015-16). There are many factors affect the yield of wheat but weed infestation is one of the most serious causes of low yield of irrigated wheat due to severe competition between weeds and crop plants for moisture, nutrient, light and space. The studies of Brar and Walia (2008) revealed that severe competition of grassy weeds like *Phalaris minor* caused 30-80% reduction in grain yield of wheat. The most common methods used by farmers for weed management are tillage system, crop rotation and herbicide application (Ball 1992). Tillage plays an important role in controlling weeds and managing crop residues. Herbicides are more effective in controlling the weeds besides reducing the total energy requirement for wheat cultivation. Systematic comparison of weed infestation, and wheat yield in conventional tillage, zero tillage without residue, zero tillage with residue and zero tillage with residue burning are not yet well understood. We hypothesized that modifications and innovations of agricultural technologies, such as land preparation operations, establishment methods, and weed control methods, have different effects on weed flora composition and wheat productivity. Therefore, a study was conducted at the DWR, research farm to evaluate the effect of different wheat establishment methods and weed control treatments on weed emergence, weed growth, and wheat yield.

MATERIALS AND METHODS

A field experiment was conducted on Vertisol (medium to deep depth and black in colour) clayey in texture soil of ICAR-Directorate of Weed Research, Jabalpur, MP (23º132 N and 79º592 E with an altitude of 388 m above the mean sea level) during 2012-13 and 2013-14 to evaluate the performance of different tillage and weed management practices on growth and yield of wheat. The soil was medium in organic carbon (0.79%), available nitrogen (312 kg/ha), phosphorus (18 kg/ha), potassium (291 kg/ ha) and having pH 7.2. The experiment was conducted in split-plot design having 4 tillage practices *viz*. conventional tillage , zero tillage without residue, zero tillage with residue and zero

tillage with residue burning were taken in main plots, while weed management treatment in sub plots. The conventional tillage was performed by cultivator and planking. In zero tillage, T-type slit/furrows were opened at a spacing of 20 cm for wheat with the help of happy seeder and sowing of seed and fertilizers was done in furrows. Four weed management treatments, *viz*. ready mixed combination of herbicides, *viz.* mesosulfuron + iodosulfuron (12+2.4 g/ha), sulfosulfuron + metsulfuron (32 g/ha), metribuzin (200 g/ha) and weedy check were included in the experiment. The treatment was replicated three. The variety of wheat was '*GW 273*'. Recommended dose of fertilizers (120 kg N + 60 kg P_2O_5 + 40 kg K_2O) were applied in wheat. Half dose of nitrogen and full dose of phosphorus and potash were applied at the time of seeding. The remaining nitrogen was top dressed in two equal splits, at the time of first and second irrigation. Herbicides were sprayed by knapsack sprayer fitted with flat-fan nozzle using a spray volume of 500 L/ha at 30 days after sowing (DAS). Weedy check plots remained infested with native population of weeds till harvest. Observation on weed density and dry matter accumulation were recorded from 4 random quadrate of 0.5 × 0.5 m in each plot at 20 days after herbicide application. Total number of weeds falling within each quadrate were counted and cut at ground level for measuring weed dry weight data. The sample were first dried in sun and after then kept in oven at 65°C. The dried samples were weighted and expressed in g/m^2.Data on weeds were subjected to square-roots transformation $\sqrt{(x+0.5)}$ to normalize their distribution. Leaf area index (LAI) is defined as the area of leaves per unit area of soil surface. LAI was quantified with the Accu PAR model LAI-2200 C, Inc. instrument, which calculates LAI based on the above and below-canopy PAR measurements. For root volume studies, the soil saturated with water before uprooting the wheat plant from experimental plots to avoid losses of root tissues. After uprooting the plant with soil it was kept overnight in large buckets and shacked gently to remove soil and other foreign material. Once, the soil is removed from roots it was washed again with fresh water. The root volume measurement was made using water displacement. To determine the yield of wheat, an area of 10 m^2 each sub plot was harvested by manually after physiological maturity, tied into bundles, sun dried and weight of bundle was recorded with the help of digital balance in kg. The biomass of each sub plot was threshed, cleaned and grain yield was recorded in kg/plot. The Grain yield recorded in kg/plot was finally converted into grain yield kg/ha. The statistical analysis of data was done using SAS Windows Version 9.3.

RESULTS AND DISCUSSION

Weeds

The dominant weed species identified in the experiment field of wheat ware *P. minor, A. ludoviciana* and *M. denticulata*. The higher density and biomass of *P. minor* and *A. ludoviciana* were observed under convention tillage in wheat while *M. denticulate* was higher in Zero-tillage with residue because of soil disturbance by tillage practices may have brought the deep buried weed seeds near to soil surface, where, provide favorable environment *i.e.* light, oxygen and moisture for facilitated the germination and emergences of weed seeds (**Table 1**). Choker *et al.* (2009) observed that density of *P. minor* was higher under conventional tillage. But, infestation of broad- leaved weed *Rumex dentatus* and *M. denticulata* was maximum under zero-tillage condition. The significantly lower density and biomass of all weeds under zero- tillage with residue of rice in wheat was owing to deeper buried of weeds seeds. Beside, statistical analysis revealed significantly difference between weed management practices. Application of ready mixture of sulfosulfuron + metsulfuron was recorded more effective in controlling grasses and broad leave weeds followed by mesosulfuron + iodosulfuron as compare to metribuzin while highly infestation of weeds was found under weedy check over rest of the treatments. Similar result was also recorded by Yadav and Dixit (2014). The total weed density and dry matter accumulation of weeds varied significantly under different tillage practices in wheat. Minimum weed density and dry matter were recorded form zero-tillage with residue plots, which was statistically at par with zero-tillage with residue burning. As compared to conventional tillage, the significantly lower weed density and dry weight was recorded from zero tillage practices. In case of zero tillage with rice residue, the lower weed emergence and growth was observed; and it may be due to rice residue on the soil surface that reduce light transmittance and release allelopathic compounds. Similar results were found as by Yenish (1995) and Chhokar *et al.* (2007). The lower density and dry weight of weed in zero-tillage was due to lesser emergence owing to higher soil strength. Soil strength was higher up to zero-tillage, moisture remain higher than conventional tillage. In conventional tillage the upper layer soil layers dry very fast leading to lesser moisture and ultimately lesser weed emergence before first irrigation. Chhokar *et al*. (2007) also reported the similar observation.

Statistical analysis revealed significantly difference between weed management practices. As compared to other herbicides, application of sulfosulfuron + metsulfuron significantly reduced the density and dry weight of weed, which was closely followed by mesosulfuron + iodosulfuron and metribuzin. However, the post-emergence application of sulfosulfuron + metsulfuron, mesosulfuron+ iodosulfuron and metribuzin curtailed the density and dry weight of both the grassy and broad leaved weeds, although an inflated control of weeds were observed with the application of ready mix herbicide formulation. Good performance of sulfosulfuron + metsulfuron-methyl in the present study is also supported by the results of Zand *et al.* (2007). The maximum weed control efficiency was recorded in sulfosulfuron + metsulfuron over rest of the treatments. Similar result was also recorded by Yadav and Dixit (2014).

The growth parameters, *viz*. plant height, number of tiller, dry matter accumulation and leaf area index differed significantly due to tillage practices (**Table 2**). The tallest plant with the maximum number of tiller/m^2 were observed with zero-tillage with residue retention practices and it was closely followed by zero–tillage with residue burning. Similar trend was also found in case of all other growth parameters i.e dry matter accumulation and leaf area index. Rice residue retained under zero-tillage improved plant growth due to nitrogen mineralization, increased moisture availability, reduced weeds competition and increased photosynthesis rate (Kumar *et al.* 2016). Root volume did not differ significantly with various tillage practices.

The data showed that of growth parameter, *viz.* plant height, number of tiller/m^2, leaf area index and dry matter accumulation significantly varied with different weed management practices. The lowest values of all plant growth parameter were observed with unweeded situation, whereas, plots receiving post emergence herbicides, *viz*. sulfosulfuron + metsulfuron, mesosulfuron + iodosulfuron and metribuzin recorded higher crop growth rate. These

Table 1. Effect of crop establishment and weed management practices on weed density and dry biomass accumulation and weed control efficiency in wheat (pooled data of two years)

Treatment	Weed density (no./m^2)				Weed dry weight (g/m^2)				Weed control efficiency (%)
	P. minor	*A. ludoviciana*	*M. denticulata*	Total	*P. minor*	*A. ludoviciana*	*M. denticulata*	Total	
Tillage practices									
Conventional tillage	8.91(79)	6.49(42)	4.11(16)	12.14(147)	2.74(7.0)	1.89(3.1)	2.88(7.8)	4.33(18)	-
Zero-tillage without residue	8.35(69)	5.48(29)	3.55(12)	11.46(131)	1.80(2.7)	1.75(2.6)	2.59(6.2)	3.57(12)	-
Zero-tillage with residue	7.47(55)	6.85(46)	3.31(10)	10.94(119)	1.71(2.4)	2.07(3.8)	2.36(5.1)	3.52(12)	-
Zero-tillage with residue burning	8.48(71)	5.91(34)	3.50(12)	11.32(128)	1.72(2.5)	1.79(2.7)	2.60(6.3)	3.49(12)	-
LSD (p=0.05)	0.30	0.90	0.16	0.14	0.21	0.09	0.15	0.09	-
Weed management practices									
Mesosulfuron+iodosulfuron (12+2.4 g/ha)	6.94(48)	4.93(24)	2.49(6)	7.18(79)	1.48(1.7)	1.47(1.7)	1.92(3.2)	2.68(6.7)	79.0
Sulfosulfuron+metsulfuron (32 g/ha)	5.87(34)	4.21(17)	2.57(6)	6.92(62)	1.45(1.6)	1.44(1.6)	1.87(3.0)	2.59(6.2)	83.6
Metribuzin (200 g/ha)	7.41(54)	5.02(25)	3.02(9)	8.86(93)	1.93(3.2)	1.61(2.1)	2.30(4.8)	3.42(11.2)	75.3
Weedy check	15.0(224)	10.6(111)	6.39(40)	19.9(377)	3.13(9.3)	2.98(8.4)	4.34(18.3)	6.11(36.9)	0.0
LSD (p=0.05)	0.05	0.04	0.06	0.04	0.16	0.03	0.03	0.04	-

Original figures in parentheses were subjected to square-root transformation $\sqrt{x+0.5}$ before statistical analysis

Table 2. Effect of crop establishment and weed management practices on weed and growth stage of wheat (pooled data of two years)

Treatment	Plant population at 15 DAS	Plant height at harvest (cm)	No. of tillers/m^2 at harvest	Plant dry weight at 60 DAS (g/m^2)	Leaf area index at 60 DAS	Root volume at 60 DAS (cc/plant)
Tillage practices						
Conventional tillage	181	93.9	323	34.6	2.62	13.2
Zero-tillage without residue	188	94.4	329	30.9	2.52	12.0
Zero-tillage with residue	164	97.1	407	38.6	3.03	14.0
Zero-tillage with residue burning	154	95.3	376	36.7	2.85	13.7
LSD (p=0.05)	NS	1.45	61.7	2.60	0.24	NS
Weed management practices						
Mesosulfuron + idosulfuron (12+2.4 g/ha)	177	93.3	372	33.5	2.47	12.0
Sulfosulfuron + metsulfuron (32 g/ha)	197	95.4	416	38.1	2.79	13.3
Metribuzin (200 g/ha)	155	95.2	377	36.1	2.71	13.3
Weedy check	181	96.9	269	33.1	3.06	14.2
LSD (p=0.05)	NS	2.07	43.2	1.71	0.27	NS

Table 3. Effect of crop establishment and weed management practices on yield attribute and yield of wheat (pooled data of two years)

Treatment	Spike length (cm)	No. of grains/ spike	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)	Net returns (x10^3 `/ha)	B:C ratio
Tillage practices								
Conventional tillage	10.61	53.5	39.3	3.23	4.30	42.97	31.96	1.15
Zero-tillage without residue	10.51	52.5	39.4	3.13	3.80	45.19	29.99	1.36
Zero-tillage with residue	11.07	60.8	42.6	3.86	4.80	44.38	36.18	1.86
Zero-tillage with residue burning	11.07	55.1	40.8	3.43	4.32	44.27	35.84	1.74
LSD (p=0.05)	0.30	2.80	2.35	0.21	0.55	-	-	-
Weed management practices								
Mesosulfuron + iodosulfuron (12+2.4 g/ha)	10.47	53.7	39.7	3.47	4.02	46.33	35.26	1.65
Sulfosulfuron + metsulfuron (32 g/ha)	11.10	56.8	41.9	3.90	4.93	44.12	36.79	1.88
Metribuzin (200 g/ha)	10.60	51.5	39.8	3.54	4.89	42.01	35.97	1.73
Weedy check	11.08	59.9	40.7	2.75	3.40	44.69	24.81	1.02
LSD (p=0.05)	0.51	1.90	1.70	0.26	0.53	-	-	-

parameters attained the superior value under ready mix herbicide of sulfosulfuron + metsulfuron and which was at par with mesosulfuron + iodosulfuron controlling weeds at higher level.

Yield attributes and yield

The grain yield of wheat crop was varied significantly due to different tillage and weed management practices (**Table 3**). The significantly higher spike length, grains/spike and test weight was recorded in zero-tillage with residue retention practice and which was at par with zero-tillage with residue burning. Among the different tillage practices, the maximum grain and straw yield were recorded under zero-tillage with residue retention practice, and the minimal one was observed in case of zero-tillage without residue. Increase in grain and straw yield may be attributed mainly to grains/spike, spike length and test weight which highly favored under zero-tillage with residue retention practice. However, the harvest index was not differed significant with various tillage practices. Similar results were reported by Mitra *et al*. (2014 and Kumar *et al*. (2016).

The yield attributing traits, *viz*. length of spike, grain/spike and test weight; grain and straw yields and harvest index were differed significantly due to various weed management practices. These attributes attained the poorest value under weedy check plot and improved due to application of sulfosulfuron + metsulfuron, mesosulfuron + iodosulfuron and metribuzin. The yield attribute character and yield of wheat was improved, remarkably, under the post-emergence application of sulfosulfuron + metsulfuron *fb* mesosulfuron + iodosulfuron and metribuzin.

Economics

Among the different tillage practices, the maximum net returns (` 36180 /ha) and benefit:cost (1.86) was found with zero-tillage with residue retention practice. Whereas, among various weed management practices application of sulfosulfuron + metsulfuron at 30 DAS gave the maximum net returns (` 36790 /ha) and benefit:cost ratio (1.88).

Thus, it can be inferred that zero-tillage with previous rice residue retention and application sulfosulfuron+metsulfuron at 30 DAS was the most productive and profitable in wheat.

REFERENCES

Annonymus 2016. Department of agriculture cooperation and farmers welfare New Delhi.

Brar AS and Walia US. 2008. Effect of rice residue management techniques and herbicides on nutrient uptake by *Phalaris minor*. .*Indian Journal of Weed Science* **40**(3&4): 121–127.

Chhokar RS, Sharma RK, Jat GR, Pundir AK, Gathala M K. 2007. Effect of tillage and herbicides on weeds and productivity of wheat under rice-wheat growing system. *Crop Protection* **26**: 1689–1696.

Chhokar RS, Sharma RK, Sharma RK and Singh, M. 2009. Influence of straw management on *Phalaris minor* control. *Indian Journal of Weed Science* **41**: 150–156

Kumar A, Jat ML, Kumar A, Tomar J, Kumar S and Kushwaha SR. 2016. Riceresidue management in wheat under different tillage practices and nitrogen doses. *Annals of Agricultural Research* **37**(1): 49–55.

Mitra B, Mookherjee S and Das S. 2014. Performances of wheat *(Triticum aestivum)* under various tillage and nitrogen management in sub-Himalayan plains of West Bengal. *Journal of Wheat Research* **6**(2): 150–153.

Yadav NS and Dixit A. 2014.Bioefficacy of some herbicides and their mixture against complex weed flora in wheat. *Indian Journal of Weed Science* **46**(2): 180–183.

Yenish JP, Fry TA, Durgan BR, Wyse DL. 1996. Tillage effects on seed distribution and common milkweed (*Asclepias syriaca*) establishment. *Weed Science* **44**: 815–820.

Zand E, Baghestani MA, Soufizadeh S, Eskandari A, Pour Azar R, Veysi M, Mousavi K, Barjasteh A. 2007. Evaluation of some newly registered herbicides for weed control in wheat (*Triticum aestivum* L.) in Iran. *Crop Protection* **26**: 1349–1358.