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IMPACT OF MECHANICAL MEASURES AND APPLICATION OF COMMON HERBICIDES ON WHEAT (*TRITICUM ESTIVUM* L.) PERFORMANCE AND THEIR RELATED WEEDS UNDER *ALFISOLS*

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ABSTRACT
A field experiment was conducted during *rabi* season of the year 2005-2006 at Agriculture Research Farm T.D.P.G. College, Jaunpur. The treatments comprises 2, 4-D @ 0.40 kg *a.i.* / ha, 2, 4-D @ 0.50 kg *a.i.* /ha, isoproturon@ 0.75 kg *a.i.* /ha, isoproturon @1.00 kg *a.i.*/ha, one hand weeding at 28 DAS, two hand weeding 28 & 42 DAS. Results indicated that two hand weeding at 28 & 42 DAS were eradicate significantly (not more than weed free) weed density, number of weed (species wise) and dry weight of weed at different DAS and also improved yield attributes *viz.*, number of spikes m^{-2}, length of spike (cm), number of grains per spike and yield *viz*., grain yield, straw yield, biological yield and harvest index. However, weed density and weed dry weight were decreased significantly with increasing number of two hand weeding (28 & 42 DAS). A part from this two hand weeding at 28 & 42 DAS also proved its superiority over other methods in respect of weed control followed by isoproturon @ 0.75 kg *a.i./*ha as post-emergence weeding

KEY WORDS: biological yield, Herbicides, yield, yield attributes, weed,

INTRODUCTION

India is second largest wheat producing country in the world after china, with in area of 29.64 mha., production 92.46 mt. and productivity of 31.2 q/ha (USDA, 2013). In U.P. having first rank in production (30.29 mt) and area (9.73 mha), while in productivity Haryana having first rank with 50.3 q/ha and followed by Punjab (48.98 q/ha), Rajasthan and U.P. (31.13 q/ha). Among the technological advances weed management is a prime one because weeds have been recognized as a major pest/constraint for limiting wheat production in most part of growing area. The introduction of high yielding dwarf varieties, which required comparatively large amount of moisture and fertilizer created favorable conduction for invasion as well as luxuriant growth of weeds throughout wheat growing area in county. This is probably due to fact that the dwarf wheat varieties with short stature and erect leaf orientation, allowing more light penetration through the canopy, are less competitive against weed species than the traditional cultivars' (Gill and Mehra, 1981). Various weed control measures have been recommended for weed control in wheat crop through various research papers. Initially the application of 2, 4-D for control of different dominant weeds in wheat crop. However the introduction of dwarf wheat many dominant weeds appeared in irrigated wheat field 2, 4-D proved ineffective in many cases, particularly against grassy weeds. Grain yield of wheat reduced by 72.28 per cent due to infestation of grassy and broad leaf weeds, total density and weed dry weight of 12.36 m^{-2} and 1867.33 kg/ha, respectively at 60 days after sowing (Singh *et at.*, 2005). Post emergence of herbicide Metsulfuron and 2, 4-D @ 6 gm and 500 gm/ha at 30-35 DAS effectively weed killing efficiency 38.1% and weed control efficiency 78.3% and their dry matter accumulation reduce 67.4% and weed index 23.5% and increase the grain yield of wheat 37.8% compared to farmer practices (Singh *et al.*, 2013). Reduction in grain yield of wheat due to infestation of weeds to a tune of 46.48 per cent has been reported by Malik *et al*. (2005). Lowest weed dry weight and significantly higher grain yield in isoproturon treated plots when compared to mesosulfuron + indosulfuron at 9.0+1.8 g/ha and weedy check plots (Singh *et al*., 2003). Application of isoproturon at 1000 g *a.i.*/ ha reduced both grassy and broad –leaf weeds as compared to weedy check, and ultimately increase the grain yield by 21.28 per cent as compared to weedy check (Punia *et al.*, 2005). The greatest reduction in grain yield competition was 63 per cent. Application 2,4-D at 0.5 kg/ha resulted more than 85 per cent control of non grassy weeds and significantly higher grain yield as compared to clodiafop at 60 g *a.i.* /ha and weedy check. Therefore, the present study was carried out to investigate impact of mechanical measures and common herbicides on wheat yield and their related weeds vis-à-vis sustainability of wheat.

MATERIALS & METHODS

The experiment was conducted during rabi season of the year 2005-2006 at the Agriculture Research Farm (pili Kothi), of Agronomy Department, T.D.P.G. College, Jaunpur (U.P.) India. The field study was planned and layout in randomized block design. Wheat was sown in first fortnight of December and was harvested in the second fortnight of March. Soil of the experimental site

has been classified as sandy loam and field was drained and leveled. Soil samples were collected at random from different parts of experimental field (16 places) with the help of a soil auger to a depth of 0-22.5 cm prior to the fertilizer application. The collected soil samples were mixed together and a composite sample was drawn and analyzed. The poor in organic carbon, available nitrogen, available phosphorus and medium in available potash along with slightly alkaline reaction. During crop season, the maximum temperature varied from 23.08 ^{0}C to 38.97 ^{0}C. The maximum rainfall of 12.3 mm was recorded in the month of March and total rainfall received during the crop period was 17.70 mm. The sunshine hours ranges from October 2.6 to 9.9 hours. Relative humidity was the maximum 93.71% in the month of December respectively. Wheat variety UP 2338 was sowing in furrows opened by Kudal at the spacing of 22.5 cm apart using 100 kg seed ha^{-1}. Application of fertilizers dose 120:60:40 kg NPK ha^{-1}. Application of 2, 4-D and isoproturan were done as post-emergence at 32 days after sowing respectively. Weed population was studied with the help of a quadrate (50cm x 50cm) placed in second row in the different corners of the plot in different observations. The populations counts were taken at different stages of crop growth *i.e.*at 30, 60, 90 DAS and at harvest sampled plants were dried in sun and subsequently into oven at 70^{0}C till constant weight were obtained and total dry matter accumulation of whole plant was recorded. The data recorded on different observations were tabulated and analyzed statistically by using the analysis of variance (ANOVA) techniques as suggested by Gomez and Gomez (1984).

RESULTS & DISCUSSION

Weed Dynamics

The observations on total weed count per unit area recorded at different stages of crop growth are presented in Table 1. Total weed density increased up to 90 days stage of crop growth their after decreased at 120 days stage in weedy check. There was significant reduction in total weed density under various weed control measures when compared to weedy check at all stages of crop growth, except both rate of isoproturon at 0.75 and 1.00 Kg/ha and one hand weeding at 28, 90 days stage and isoproturon at 0.75 Kg/ha at 120 days stage of crop growth. Among the weed control measures maximum weed population was recorded by isoproturon at 0.75 Kg/ha treated plot, and minimum two hands weeding at 28 and 42 DAS treated plots. Two hand weeding at 28 and 42 DAS was statistically on par as compared to both rate of isoproturon at 0.75 &1.00 Kg/ha, one hand weeding at 28 & 42 DAS and weedy check but remain at par with 2, 4-D at 0.4 Kg /ha and 2,4-D at 0.5 Kg/ha treated plots at 30 days stage of crop growth.

TABLE 1: Population of total weeds (number m^{-2}) as affected by different treatment

Treatment	Rate (kg *a.i.*/ha)	Days after sowing			
		30	60	90	120
2,4-D	0.4	6.56 (42.00)	8.25 (67.00)	11.14 (123.0)	7.72 (58.64)
2,4-D	0.5	6.24 (73.98)	7.46 (54.680)	10.47 (108.6)	7.26 (51.68)
Isoproturon	0.75	7.55 (55.98)	9.97 (98.32)	12.79 (162.6)	9.38 (87.00)
Isoproturon	1.00	7.07 (48.96)	9.54 (90.00)	12.30 (150.3)	8.35 (68.72)
One hand weeding at 28DAS	-	7.26 (51.66)	9.51 (89.36)	12.22 (184.3)	8.39 (69.32)
Two hand weeding at 28 & 42 DAS	-	5.69 (31.34)	7.14 (50.04)	9.56 (90.32)	6.61 (42.68)
Weed -free	--	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Weedy	-	10.52 (109.68)	11.63 (134.36)	14.01 (195.3)	10.20 (103.00)
SEm+-	-	0.45	0.50	0.67	0.49
C.D.at 5%	-	I.37	1.51	2.04	1.50

Maximum and minimum weed population were recorded by isoproturon at 0.75 Kg/ha and two hand weeding at 28 & 42 DAS treated plot respectively, among various applied weed control measures, two hands weeding at 28 & 42 DAS treated plots was statistically at par compared to both rate of 2, 4-D where on par with both rate of isoproturon treated plots and one hand weeding at 28 DAS, at 60 days stage of crop growth.

Application of various weed control measures, two hand weeding at 28 & 42 DAS recorded lower total weed density significantly when compared to isoproturon at 0.75 & 1.00 Kg/ha, one hand weeding at 28 DAS and weedy check but it remain statistically similar with 2, 4-D at 0.4 Kg/ha and 0.5 Kg /ha treated plots at 90 days stage of crop growth. At 120 days stage minimum total weed density two hand weeding at 28 & 42 DAS treated plot followed by 2,4-D at 0.5 Kg/ha treated plot. Two hands weeding at 28 & 42 DAS was statistically on par compared to both rate of isoproturon at 0.75 &1.00 Kg/ha, one hand weeding at 28 DAS and weedy check but remain at par with 2, 4-D at 0.4 Kg/ha treated plot.

The observations on total weed dry weight per unit area recorded at different stages of crop growth are presented in Table 2. Total weed dry weight increased at successive stages of crop growth up to 90 days stage and there after decreased at 120 days stages of crop growth. Maximum and minimum dry weight of total weed was noticed from weedy check and weed- free treated plots, respectively at all stages of crop growth. Applied of various weed control measures significantly reduced the total weed dry weight per unit area when compared with weedy check at all stages of crop growth, except isoproturon at 0.75 & 1.00 Kg/ ha, one hand weeding at 28 DAS at 90 days stage and isoproturon at 0.75 Kg /ha at 120 days stage. Application

of different weed control measures lowest dry weight of total weed was noticed in two hand weeding at 28 & 42 DAS and isoproturon at 0.75 Kg /ha at all stage of crop growth. At 30 days stage of crop growth two hand weeding at 28 & 42 DAS recorded significantly lower weed dry weight than isoproturon at 0.75 &1.00 Kg/ha, one hand weeding at 28 DAS and weedy check but remain at par with 2, 4-D at 0.4 & 0.5 Kg/ha. Application of various weed control measures could not reduce total weed dry weight as recorded in weed-free condition. Two hand weeding at 28 & 42 DAS use in this experiment significantly reduced total weed dry weight when compared with one hand weeding at 28 DAS, both rate of isoproturon and weedy check but it remain statistically similar with 2, 4-D at 0.4 & 0.5 Kg/ha in respect total weed dry weight at 60 days stage of crop growth. Application of various weed control measures, two hand weeding at 28 & 42 DAS recorded lower dry weight of total weed significantly when compared to isoproturon at 0.75 & 1.00 Kg/ha, one hand weeding at 28 DAS and weedy check but it remain statistically similar with 2, 4-D at 0.4 and 0.5 Kg/ha treated plots at 90 & 120 days stage of crop growth. Application of different weed control measures resulted in significantly less total weed density and weed dry weight as compared to weedy check but none of them were able to provided completely control of dominant weeds at 60 & 90 days stages of crop growth. However two hand weeding at 28 & 42 DAS both rate of 2, 4-D at 0.4 & 0.5 Kg/ha caused drastic reduction of total weeds and all dominant weeds at 60 and 90 days stages of crop growth.

TABLE 2: Dry weight of total weeds (number m^{-2}) as affected by different treatments

Treatment	Rate (kg a.i./ha	Days after sowing			
		30	60	90	120
2,4-D	0.4	2.47 (5.10)	3.36 (10.32)	6.74 (44.40)	3.70 (12.67)
2,4-D	0.5	2.28 (4.21)	3.07 (8.42)	6.34 (39.23)	3.56 (11.68)
Isoproturon	0.75	3.01 (8.04)	4.02 (15.14)	7.73 (58.73)	4.45 (18.79)
Isoproturon	1.00	2.91 (7.44)	3.85 (13.86)	7.74 (54.28)	3.98 (14.84)
One hand weeding at 28 DAS	-	2.94 (7.62)	3.84 (13.76)	3.37 (53.34)	4.00 (14.97)
Two hand weeding at 28 & 42 DAS	-	2.20 (3.84)	2.95 (7.71)	5.80 (32.60)	3.20 (9.22)
Weed -free	--	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Weedy	-	3.99 (14.90)	4.66 (20.69)	8.46 (70.51)	4.82 (22.25)
SEm+-		0.17	0.21	0.43	0.24
C.D.at 5%		0.51	0.64	1.29	0.75

Yield components

The data pertaining to number of spikes per meter square, number of grains per spike, test weight (g) and length of spike (cm) as affected by various weed control measures are compiled in Table 3. Data recoded on mean number of spikes per meter square revealed that maximum number of spikes per unit area was obtained from weed free plot and minimum number from weedy check plots. Among the different weed control measures, maximum number of spikes recoded in two hands weeding at 28 & 42 DAS than followed by 2,4-D at 0.5 Kg/ha treated plot. Among the different weed control measures, maintained their superiority in terms of number of spikes per meter square over weedy check.

The maximum number of grains spike (50) found in weed-free treated plot, whereas minimum number of grains per spike was recorded in weedy check (40). Relatively higher number of grains per spike was recorded from various weed control measures when compared with weedy check. Among the various weed control measures maximum number of grains per spike (49) was noticed under two hand weeding at 28 & 42 DAS treated plot and followed by 2,4-D at 0.4 & 0.5 Kg/ha and minimum from isoproturon at 0.75&1.00 Kg/ha and one hand weeding at 28 DAS.

TABLE 3: Effect of different treatments on yield components of wheat crop

Treatment	Rate (kg a.i./ha	No. of spikes/ m^2	No.of grains/spikes	Test weight (g)	Length of spiks
		301	47	41.48	10.65
2,4-D	0.4	302	47	41.50	10.80
2,4-D	0.50	291	45	40.75	10.32
Isoproturon	0.75	294	45	40.80	10.48
Isoproturon	1.00	292	45	40.85	10.36
One hand weeding at 28DAS	_	320	49	41.98	11.00
Two hand weeding at 28&42 DAS	_	328	50	42.81	11.46
Weed- free	_	266	40	37.51	9.83
Weedy	-	13.48	1.90	1.75	0.51
SEm+-	-	13.48	1.90	1.75	0.51
C.D.at 5%	-	N.S	N.S	N.S	1.55

Under weed- free plot test weight was no significantly different by application of various weed control measures. Heaviest grain was noticed and lightest under weedy check. Among the various weed control measures maximum test weight was noticed under two hand weeding at 28 and 42 DAS treated plot and minimum, for isoproturon at 0.75 kg/ha treated plot. Two hand weeding at 28 and 42 Das recorded statistically heavy grain whereas its remain at par with weed-free and various weed control measures. Lengthiest spike was found under weed-free plot while shortest spike from weedy check. Application of different weed control measures maximum length of spike was noticed under two hand weeding at 28 & 42 DAS treated plot, which was statistically at par as compared 2, 4-D at 0.4 & 0.5 Kg/ha, isoproturon at 1.00 Kg/ha one hand weeding at 28 & 42 DAS and weed-treated plots where as minimum spike length was noticed under isoproturon at 0.75Kg/ha which remain at par weedy check. Statistically similar length of spike was registered under weed control measures. Application of various weed control measures result insignificantly higher plant population per unit area, number of grains per spike and 1000-grain weight and hence significantly higher grain and straw yield were recorded in weed-free plots. In weedy condition severe crop weed competition started from 30 days of crop growth, which evidenced form higher total weed density and weed dry weight at 60 and 90 days stages of crop growth and resulted in to lowest dry matters production of crop plant at 60 & 90 days stages of crop growth. Increase in dry weight of crop plant is directly related with growth of crop. Proper growth of crop required sufficient availability of moisture, nutrient, sunlight and CO_2. If weeds were not controlled by different weed control measures than weeds were competent for aforesaid input with crop and ultimately hampered plant growth. Similar results were also recorded by Singh and Singh (2004).

Yield

The data pertaining to grain, straw and biological yield (q/ha) and harvest index as affected by various weed control measures are compiled in Table 4. Maximum and minimum grain yield were recorded in weed- free and weedy check plot, respectively. Weed-free plot recorded 45.27 per cent (14.94 q/ha) higher grain yield as compared to weedy check. The difference of grain yield between weed-free weedy plots was approved by statistically analysis. Various weed control measures were resulted significantly higher grain yield, when compared with weedy-check but remain at par among themselves. Weed- free recorded quantitatively higher grain yield than various weed control measures but it was statistically superior than 0.75 & 1.00 Kg/ha only while other weed control measures registered statistically similar grain yield as recorded in weed-free conduction. Among the various weed control measures maximum grain yield was noticed from two hands weeding at 28 & 42DAS and minimum from isoproturon 0.75 Kg/ha treated plot. Different weed control measures recorded higher grain yield by 13.7 q/ha at two hand weeding at 28 & 42 DAS, 10.20 q/ha at 2, 4-D at 0.5 Kg/ha, 10.15 q /ha at 2,4-D at 0.4Kg/ha, 8.85 q/ha at isoprpturon at 1.00 Kg/ha, 8.28 q/ha at one hand weeding at 28 DAS and 8.26 q/ha at isoprpturon at 0.75 Kg/ha as compared to weedy check, in term of per cent age these become 41.42, 30.90, 30.75, 26.00, 25.09 and 25.03% respectively. The plots which have not any competition between crop plants and weed plant recorded only 1.27 high grain yield in a hectare when compared with two hands weeding treated plot, which was subjected with natural infestation of weeds. Maximum and minimum, straw yield were recorded from weed–free and weedy check plot respectively.

TABLE 4: Effect of different treatment on grain yield, straw yield, biological yield and harvest index of wheat crop

Treatment	Rate (kg *a.i.*/ha)	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index
		43.15	65.10	108.25	0.40
2,4-D	0.4	43.20	65.41	108.61	0.40
2,4-D	0.50	43.26	64.18	105.44	0.39
Isoproturon	0.75	41.58	65.16	106.74	0.39
Isoproturon	1.00	41.28	64.12	105.40	0.39
One hand weeding at 28DAS	_	46.67	65.82	112.49	0.41
Two hand weeding at 28&42 DAS	_	47.94	66.12	114.06	0.42
Weed- free	_	33.00	55.60	88.60	0.37
Weedy	-	1.4	2.87	4.48	0.01
SEm+-	-	0.14	2.87	4.48	0.01
C.D.at 5%	-	4.2	N.S.	13.58	N.S.

The straw yield was significantly influenced by adoption of various weed control measures. Among the various weed control measures maximum straw yield was recorded by two hand weeding at 28 & 42 DAS treated plot (65.82 q/ha) followed by 2,4-D at 0.5 Kg/ha (65.41 q/ha) and 2,4-D at 0.4 Kg/ha (65.10 q/ha) treated plot. Different weed control measures provided higher straw yield compared with weedy check 2, 4-D at 0.5 Kg/ha was able to produced second higher straw yield, next to weed-free plot and remain at par with weedy check. Minimum and maximum, biological yield were recorded from weedy and weed-free plot, respectively. The biological yield was significantly influenced by adoption of various weed control measures. Application of various weed control measures resulted into significantly higher biological yield when compared with weedy check but remain at par

among them. None of the various weed control measures could archived as much as biological yield as recorded in weed-free. All weed control measures produced statistically on par biological yield as registered in weed – free, except two hand weeding at 28 & 42 DAS. Among the different weed control measures, maximum biological yield was recorded from two hand weeding at 28 & 42 DAS treated plot (112.49 q/ha), 2, 4-D at 0.5 Kg/ha was able to produce second highest yield, next to weed-free plots. Harvest index as recorded various weed control measures, weed-free and weedy check plot remain statistically unaffected, whereas, maximum harvest index (0.42) was noticed in weed-free and minimum in weedy check (0.73). Among different weed control measures, maximum harvest index was noticed from two hand weeding at 28 & 42 DAS (0.41) treated plot followed by 2,4-D at 0.5 Kg/ha (0.40) & 0.40 Kg/ha (0.40) and minimum harvest index from isoproturon at 0.75 K/ha (0.39) & 1.00 Kg/ha (0.39) and one hand weeding 28 DAS (0.39) treated plot.

The reason for higher grain yield in various weed control measures treated plots were due to low dry weight of weeds and less density of total weed, which in turn provide favorable environment for growth and development of crop. Singh and Singh (2004) also reported similar results. The higher grain yield per hectare in weed-free plots and various weed control measures treated plots were mainly due to higher yield attributing characters at harvest index. The higher yield attributing characters in weed-free and different weed control measures treated plots as compared to weedy plot may be because of better growth of plant as evident from higher dry matter accumulation at different stages of crop growth. Application of various weed control measures significantly increased the grain yield over weedy check. This is attributed higher dry matter accumulation in crop leading to higher number of grain per spike and test weight. Two hands weeding at 28 & 42 DAS increase the grain yield by 41.42 % over weedy check and remain at par with weed free. The increase in grain yield under other weed control measures were accompanied with an increase in length of spike, number of spikes, number of grains per spike and test weight. Similar results were also recorded by Singh and Singh (2004), Sardana *et al.* (2001), Tiwari and Vaishya (2004), Punia *et al*. (2005), Singh *et al.* (2005) and malik *et al.* (2005).

CONCLUSION

Based on above experiment findings it is concluded that for achieving higher yield and better weed management of the wheat, two hand weeding at 28 & 42 DAS were sufficient to control dominant weeds of wheat crop and ultimately increase the grain yield by 13.67q/ha (41.42 %) as compare wheat to weedy check besides above, it also improved performances of wheat.

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