Results of weed density, yield attributes and yield on wheat crop as influenced by varying broad spectrum herbicide treatments grown under eastern U.P. in India

Abstract

In the year 2015-16, a field experimental trial was carried out during *rabi* season in wheat crop to estimate the weed density and resultant yield as influenced by varying broad spectrum herbicide treatments. The experiment was conducted in randomized block design with four replications. Overall eight treatments were developed during the experimental period and Wheat cultivar DBW-17 is used as a test crop. Among the treatments, total weed density and total dry matter accumulation of weeds were increased up to 90 days of crop growth thereafter decreased at 120 days in weedy check, while none of the weeds were recorded in weed free plot during the crop period. Regarding wheat crop, total dry matter accumulation of crop at all stages (30 DAS-32.62, 60 DAS-278.26, 90 DAS-934.49 and 120 DAS-1276.28 g/m^2), number of spikes (303.00/m^2), number of grains/spike (51.00), test weight (40.40 g), length of spike (11.12 cm) and grain yield (5.422 t/ha) were recorded maximum in weed free plot and minimum total dry matter accumulation of crop at all stages (30 DAS-28.78, 60 DAS-207.24, 90 DAS-679.82 and 120 DAS-932.76 g/m^2), number of spikes (208.00/m^2), number of grains/spike (42.00), test weight (36.41 g), length of spike (10.31 cm) and grain yield (2.641 t/ha) were recorded in weedy check, respectively.

Keywords: *Herbicides, Weed control, Wheat, Yield attributes, Yield*

Introduction

Wheat belongs to *poaceae* family and is believed to be originated from the Middle-East region of Asia. It provides about 20 per cent of total food calories for the human race. Wheat grain constitutes starch (60-68%), protein (6-21%), fat (1.5-2.0%), cellulose (2.0-2.5%), minerals (1.8%) and vitamins, respectively. The uniqueness of wheat in contrast to other cereals is that which contains gluten protein enables leavened dough to rise by forming minute gas cells and this property enables bakers to produce light breads (Nanher *et al*., 2015).

In India, wheat grows in an area of about 31.45 million hectares with production of 107.59 million tonnes and productivity of 3421 kilograms per hectare. Apart from this, Uttar Pradesh stands 1st in area and production of 9.50 million hectares (30.19%) and 32.59 million tonnes of (30.29%). While, Punjab is highest in productivity of 5008 kg/ha (3.52%), respectively (Directorate of Economics & Statistics, DAC&FW, 2019-20).

Weed is one of the major problems in attaining low productivity in wheat as it competes with moisture, nutrients, space, light, etc., with the crop. Moreover it raises cost of production, reduction in yield and also harbours insects and plant diseases, reduce quality of farm produce and reduce land value. In India weeds are causing substantial losses in agricultural production. Weed biomass was generally lower, and yield is more, in the uniform pattern, except in one case in which a combination of factors gave one weed species an early size advantage over the crop. When weeds were controlled with herbicide, no effects of crop density or spatial uniformity on crop biomass or yield were observed (Kristensen *et al*., 2008). Moreover, at present manual weeding is also a costly affair and time consuming as well. Due to that chemical weed control now-a-days is gaining popularity. The aim of the present experimentation was to investigate the response of various herbicides and its combinations on weed biomass and grain yield in wheat crop stand.

Material and Methods

A field experiment entitled was conducted at crop research farm (Pilikothi) of Agronomy Department, Tilak Dhari Post Graduate College, Jaunpur (U.P.) during *rabi* season of 2015-16. The experimental soil was sandy loam in texture, have alkaline soil (pH 7.49), low organic carbon (0.45 %), medium available nitrogen (257.15 kg/ha), highly available phosphorus (7.0 kg/ha) and available potassium (188.16 kg/ha). There were eight treatments viz. T_1- Weedy, T_2- Weed-free, T_3- Pendimethalin at 1.0 kg a.i./ha , T_4- Clodinafop + metsulfuron at 0.04 + 0.005 kg a.i./ha, T_5- Isoproturon at1.0 kg a.i./ha , T_6- Metsulfuron at 0.005 kg a.i./ha, T_7- Sulfosulfuron at 0.03 kg a.i./ha and T_8- Metribuzin at 0.3 kg a.i./ha which was laid out in randomized block

design with four replications. Weekly mean maximum and minimum temperature varied from 18.97 to 39.06^0 C and 7.25 to 23.04^0 C respectively, whereas maximum and minimum relative humidity varies from 94.57 and 19.71 per cent respectively and total of 46.3 mm rainfall was received during the crop period. Wheat cultivar DBW-17 was grown in the experimental field. Urea, single superphosphate and muriate of potash were used to supply 140 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha, respectively. Half dose of nitrogen and full dose of phosphate and potassium were applied as basal dressing. Remaining half dose of nitrogen through urea was top dressed in two equal doses. In order to create ideal condition for good germination, pre-sowing irrigation was given 10 days before sowing. Irrigation were applied on critical growth stages of the crop. The herbicides treatment were executed at 3 and 33 DAS with the help of manually operated knapsack sprayer fitted with flat fan nozzle. The weed density and dry weight of weeds- grass and broad-leaf weeds were analyzed using transformation of square root *i.e.,* ($\sqrt{x+1}$), before carrying out analysis of variance and comparison were made on transformed values.

Results and Discussion

Density of total weed population (No./m^2)

It is obvious from the data (Table 1) that total density of weeds was effectively controlled in weed free treatment at all growth stages. Apart from the weed free treated plot, chemically treated plots such as Pendimethalin at 1.0 kg a.i./ha at 30 DAS (11.16/m^2), Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha at 60 DAS (11.71/m^2), Isoproturon at 1.0 kg a.i./ha at 90 DAS (11.05/m^2) and Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha at 120 DAS (10.14/m^2) significantly controlled density of weeds and very least weed population was controlled in weedy check during the cropping period. The highest weed population and dry matter was observed in weedy check. Similar results also confirmed by Kaur *et al*. (2018).

Total weed dry matter accumulation (g/m^2)

The total dry matter accumulation of weeds was least reported in weed free treated plot during the cropping period. However, Pendimethalin at 1.0 kg a.i./ha at 30 DAS (2.30 g/m^2) and Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha during 60, 90 and 120 DAS (4.50, 4.71 and 4.37 g/m^2) efficiently reduced the weed dry matter accumulation during the cropping period which was depicted in Table 1. While least reduction of dry matter of weeds was noticed in Metsulfuron at 0.005 kg a.i./ha at 30 DAS interval (3.33 g/m^2) and weedy check plot during rest of the stages (6.73, 8.81 and 8.48 g/m^2). Significantly minimum dry weight of weeds was noted

in weed free plot due to least population of narrow and broad leaf weeds, while highest dry weight of weeds was recorded in weedy check. It might be due to more density and unsuppressed weed growth under untreated check plot. Similar results also reported by Sharma *et al.* (2018).

Total dry matter accumulation of wheat crop (g/m^2)

In Table 2, the dry matter accumulation of wheat crop was differed significantly with relation to various herbicides during the cropping period. Initially at 30 DAS interval, found a non-significant difference regarding dry weight of wheat stand. Later on at 60, 90 and 120 DAS interval, weed free treated plot responded a significant difference with relation to dry matter accumulation of wheat and also chemically treated plot such as Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha (266.42, 886.32 and 1222.58 g/m^2) and Metsulfuron at 0.005 kg a.i./ha (263.41, 873.83 and 1213.42 g/m^2) found at par values in obtaining higher dry weight of wheat. This provided better opportunity to the crop to utilize nutrients, moisture, light and space in better way for its proper growth and development. Similar results also reported by Shakya and Dixit (2017).

Yield attributes of wheat

Number of spikes per m^2 was influenced significantly by weed management practices in wheat. Adoption of weed free treatment resulted in significant increase in number of spikes per m^2. While, Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha (283.00/m^2) and Metsulfuron at 0.005 kg a.i./ha (279.00/m^2) found at par values. The highest number of spikes per m^2 were observed in Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha which retained the highest seed yield in wheat over weedy check.

Rest of the parameters such as number of grains/spike, test weight (g), length of spike (cm) was reported non-significantly and indicated in Table 2. However, highest readings was appeared in weed free condition crop. Application of Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha (49.00/spike, 39.55 g and 10.85 cm) and Metsulfuron at 0.005 kg a.i./ha (49.00/spike, 39.47 g and 10.82 cm) also found highest readings regarding the above parameters over weedy check which resulted in better seed yield. This might be due to effective weed control of these treatments. Similar findings also reported by Kumar *et al*. 2018.

Yield of wheat

As tabulated in Table 2, grain yield of wheat was significantly higher in weed free treated plot over weedy check. Application of Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha (4.916 t/ha) resulted statistically similar higher grain yield when compared with weed free

plot (5.422 t/ha, respectively. Gradual increase in all of the yield attributes such as no. of spikes/m^2, no. of grains/spike, test weight (g) and length of spike (cm) resulted in higher grain yield.

The higher yields under these treatments could be ascribed to better control of weeds might have favoured higher uptake of nutrients and water, which helped the plant to put optimum growth characters *viz*., plant height, effective tillers and enhanced photosynthetic activity and partitioning of assimilates, resulting in improved yield attributes like spikelets per spike, grain weight per plant and test weight by virtue of less weed count and dry weight of weeds. These growth and yield attributes evidently reflected in higher grain and straw yields under these treatments. Nanher and Singh (2015)

Low yield in check may be due to poor root growth and higher weed population could have competed with wheat crop for space, water and nutrients, thereby adversely affecting grain and straw yields. Similar results also reported by Paighan *et al.* (2013).

Use of herbicides reduced weed competition resulting in availability of more moisture, plant nutrients and space to the crop. It is apparent that weeds significantly affected the yield attributing characters which cumulatively resulted in lower biological and grain yield. Similar results also reported by Choudhary *et al.* (2016).

Table 1. Response of total weed density and total dry matter accumulation of weeds to various weed management practices

Treatments	Density of total weed population (No./m^2)				Total dry matter accumulation of weeds (g/m^2)			
	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS
Weedy	16.62 (276.50)	19.26 (372.00)	19.80 (392.50)	13.90 (193.50)	3.24 (9.63)	6.73 (44.89)	8.81 (76.89)	8.48 (71.39)
Weed free	1.00 (00)	1.00 (00)	1.00 (00)	1.00 (00)	1.00 (00)	1.00 (00)	1.00 (00)	1.00 (00)
Pendimethalin at 1.0 kg a.i./ha	11.16 (124.00)	13.06 (170.25)	13.69 (187.75)	11.44 (130.00)	2.30 (4.33)	4.86 (22.86)	5.94 (34.47)	5.57 (30.16)
Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha	16.49 (272.25)	11.71 (137.50)	12.16 (149.25)	10.14 (102.00)	3.21 (9.56)	4.50 (19.33)	4.71 (21.37)	4.37 (18.23)
Isoproturon at 1.0 kg a.i./ha	16.48 (274.75)	14.14 (200.00)	11.05 (121.75)	12.26 (150.25)	3.24 (9.58)	5.35 (27.77)	6.42 (40.39)	6.10 (36.41)
Metsulfuron at 0.005 kg a.i./ha	16.62 (277.25)	12.04 (144.75)	12.53 (157.00)	10.49 (109.50)	3.33 (10.17)	4.56 (19.97)	5.12 (25.35)	4.85 (22.69)
Sulfosulfuron at 0.03 kg a.i./ha	16.44 (270.50)	14.53 (211.00)	15.21 (231.25)	12.47 (156.00)	3.22 (9.46)	5.56 (30.02)	6.60 (42.89)	6.26 (38.32)
Metribuzin at 0.3 kg a.i./ha	16.39 (269.25)	13.67 (186.50)	14.11 (201.00)	11.81 (139.00)	3.22 (9.43)	5.18 (25.97)	6.18 (37.33)	5.85 (32.38)
SEm±	0.712	0.544	0.549	0.462	0.151	0.229	0.225	0.215
C.D. at 5%	2.107	1.612	1.625	1.367	0.447	0.679	0.667	0.636

Original data given in parenthesis was subjected to square root (+ 1) transformation before analysis

Table 2. Response of yield attributes and yield of wheat to various weed management practices

Treatment	Total dry matter accumulation (g/m^2)				Yield attributes and yield				
	30 DAS	60 DAS	90 DAS	120 DAS	No. of spikes/m^2	No. of grains/ spike	Test weight (g)	Length of spike (cm)	Grain yield (t/ha)
Weedy	28.78	207.24	679.82	932.76	208.00	42.00	36.41	10.31	2.641
Weed free	32.62	278.26	934.49	1276.28	303.00	51.00	40.40	11.12	5.422
Pendimethalin at 1.0 kg a.i./ha	31.36	232.83	808.13	1109.21	251.00	47.00	37.12	10.67	3.709
Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha	30.26	266.42	886.32	1222.58	283.00	49.00	39.55	10.85	4.916
Isoproturon at 1.0 kg a.i./ha	29.92	222.04	732.02	1053.74	234.00	46.00	36.98	10.53	3.257
Metsulfuron at 0.005 kg a.i./ha	30.89	263.41	873.83	1213.42	279.00	49.00	39.47	10.82	4.639
Sulfosulfuron at 0.03 kg a.i./ha	29.15	216.25	719.62	992.26	224.00	46.00	36.48	10.49	3.207
Metribuzin at 0.3 kg a.i./ha	28.82	226.16	753.23	1067.52	240.00	47.00	37.05	10.59	3.595
SEm±	1.300	7.613	26.437	40.811	8.431	1.779	1.447	0.361	0.177
C.D. at 5%	NS	22.542	78.275	120.835	24.96	NS	NS	NS	0.525

Conclusion

It is concluded that herbicidal application of Clodinafop + Metsulfuron at 0.04 + 0.005 kg a.i./ha effectively controlled weed density which reduced competition in accumulation of applied inputs in wheat crop resulted in better growth in yield attributes and yield.

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Plate : 1 General view of crop

Plate : 2 Tagging of crop plant

Plate : 3 Recording of data

Plate : 4: Irrigation in experimental crop