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Performance of varieties and weed control on growth, yield attributes and yield of wheat after rice

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Abstract
A field experiment was conducted during *rabi* season of 2014-15 and 2015-16 at Krishi Vigyan Kendra, Bahraich (Uttar Pradesh). Significantly lower weed density, dry matter accumulation and nutrient uptake by weeds was recorded with variety 'K-1006' as compare to 'HD-2967', 'NW-5054', 'DBW-39', 'CBW-38' and 'DBW-17'. Variety 'K-1006' produced significantly higher grain yield (52.12 q ha^{-1}) and straw yield (70.60 q ha^{-1}) over rest of the wheat varieties. Among the herbicidal treatments, post emergence application of sulfosulfuron reduced the density and dry weight of weeds, and uptake of nutrient by weeds. This treatment also gave the higher grain (49.4 q ha^{-1}) and straw yield (68.5 q ha^{-1}), which was on par with metribuzin. Weed free upto 60 DAS recorded significantly higher values of yield attributes, grain yield (53.0 q ha^{-1}) and straw yield (71.5 q ha^{-1}). This treatment had the lowest nutrient uptake by weed as compare to rest of the treatments. Variety 'K 1006' had the maximum net return (Rs. 53.9x 10^3) and benefit :cost ratio which was followed by variety 'HD 2967' with with net profit of (Rs. 498x10^3) and benefit cost ratio of 1.6.

Keywords: variety, weed control, nutrient uptake, yield, economics, wheat

Introduction
Wheat is one of the most important staple food grain crop cultivated next to rice both in area and production. It stands first in productivity amongst the cereals. Sufficient nutrient supply during growth period provides full yield potential of the crop. Weeds being a serious negative factor in crop production, are responsible for heavy loss in yield. Weeds that grow fast in association with crop plants deplete considerable amount of nutrients, and compete for soil moisture, space and solar radiation. Losses due to weeds in grain yield of wheat was reported to be 61.5 % (Yadav *et al*., 2015) [7]. Selection of suitable genotypes plays a vital role in crop production, particularly in new areas of introduction. The choice of right genotypes of wheat helps to augment crop production by 20-25%. Thus, the value of stable and high yielding genotypes has been universally recognized as an important non-cash inputs for boosting the production of wheat crop. Introduction of fast growing varieties and effective weed control measures increased the uptake of nutrients by crop, and decreases nutrients removal by weeds. Control of weeds by suitable varieties and herbicides may check the loss of these inputs to a great extent. Information pertaining to the effect of combined use of herbicides along with suitable cultivars on the productivity of wheat is meagre. Hence, the present investigation was carried out to know the effect of varieties and weed control practices on productivity of wheat after rice.

Materials and Methods
Field experiment was conducted during the *rabi* season of 2014-15 and 2015-16 at the Krishi Vigyan Kendra, Bahraich of N.D. University of Agriculture and Technology (Uttar Pradesh). The KVK farm is located at $27^0$34'N latitude and $81^0$35'E longitude with an elevation of 124 m above mean sea-level. The soil of the experimental site was sandy- loam in texture, having p^H 7.6, organic carbon 4.1 g kg^{-1}, available nitrogen, 192 kg ha^{-1}, phosphorus, 22.5 kg ha^{-1} and potassium, 202 kg ha^{-1}. The experiment was laid out in split plot design with six wheat varieties viz.'CBW-38', 'DBW-39', 'DBW-17', 'HD-2967', 'K-1006' and 'NW-5054' in main plots, and four weed control treatments viz.

sulfosulfuron (25 g ha^{-1}) and metribuzin (200g ha^{-1}), weed free upto 60 day of sowing and weedy check till maturity in sub-plots and replicated three times. The experimental crop was sown with 100kg seed ha^{-1} in lines at 22 cm apart on 25 November 2014 and 23 November 2015. The herbicides were applied as post emergence at 32 days after sowing (DAS) with the help of knapsack sprayer fitted with flat fan nozzle at a spray volume of 500 liters ha^{-1}. A uniform dose of 40 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1} was applied at sowing, and remaining 80 kg N was top dressed in two equal splits, each after first irrigation and flowering stage. Urea, diammonium phosphate and muriate of potash were used as source of nitrogen, phosphorus and potassium, respectively. The crop received four irrigations. Weed density and weed dry weight was recorded at 90 DAS of the crop from quadrats of 0.25 m^2 placed randomly at 2 places in each plot. Data on crop growth was recorded at 90 DAS. Yield attributes like spike length, grain/spike and weight of spike was recorded from 10 spike collected randomly from each plot. The grain and straw yield was recorded plot wise and then converted quintal per hectare. The weed index, and weed control efficiency was calculated as per formula i.e.

$$WI = \frac{\text{Grain yield in weed free plot (q/ha)} - \text{Grain yield in treated plot (q/ha)}}{\text{Grain yield in weed free plot (q/ha)}} X\ 100$$

$$WCE\ (\%) = \frac{\text{Weed dry weight in weedy check plot} - \text{Weed dry in treated plots}}{\text{Weed dry weight in weedy check}} X\ 100$$

Data to so recorded were subjected to statistically analsis as per processor given by Chandel -1978.

Results and Discussion

Effect on weed

Varity 'K-1006' and HD 2967 was on par with each other but produced significantly the lowest weed population (78.3 m^{-2}) and weed dry matter production (81.2 g m^{-2}) as compared to 'NW-5054', 'DBW-39', 'CBW-38' and 'DBW-17' (Table 1). Reduction in weed density and dry matter accumulation by 'K-1006' and 'HD-2967' was mainly due to better growth. The values of highest leaf area index and dry matter production was higher due to smothering effect on growth of weeds by variety K–1006 followed by HD 2329 (Table-1). The maximum weed suppressing ability was recorded in cultivar 'K-1006' followed by 'HD-2967', 'NW-5054', 'DBW-39', 'CBW-38' and 'DBW-17'. The maximum weed control efficiency with 'K-1006' and 'HD-2967' was mainly due to lower density and dry weight of weeds. Variety K 1006 depleted lowest amount of N (14.7 kg/ha), P (15.3 kg/ha) and K (8.1 kg/ha) by weeds due to lower dry matter production by weeds (Table 1).

Post emergence application of sulfosulfuron (25 g ha^{-1}), and metribuzin (200 g/ha) was on par but recorded significantly the lowest weed population and weed dry weight over weedy check. However, weed free upto 60days of sowing recorded significantly lower weed density and dry weight of weeds as compare to rest of the treatments. Similar lower dry weight of weed due to post emergence application of sulfoslfuron was reported by Verma *et al* (2008) [6]. Weed fee plot recorded the lowest amount of N, P and K owing to lowest population and dry matter of weeds. Weedy check recorded the maximum amount of nutrients. This was mainly due to higher weed dry weight. Similar lower nutrient uptake by weeds in wheat crop was reported by (Pandey *et al.*, 2007) [5]. Among the herbicidal treatments, sulfosulfuron recorded highest weed control efficiency (78.2%) followed by metribuzin (77.2 %) due to lower weed dry matter and nutrient depletion by weed.

Table 1: Effect of different varieties and weed control on weed density, weed dry weight, WI, WCE and nutrient uptake by weeds at 90 days after sowing (mean of two years)

Treatment	Weed Density (m^2)	Weed dry weight (g/m^2)	WI (%)	Weed Control Efficiency (%)	Nutrient uptake by weeds (kg ha^{-1})			LAI	Dry matter accumulation (g/m^2)
					N	P	K		
Varieties									
CBW-38	92.4	95.4	38.0	61.9	17.2	18.9	9.6	5.59	63.07
DBW-39	90.0	92.8	38.24	62.9	17.8	18.5	9.3	5.80	51.22
DBW-17	98.7	101.0	40.3	59.7	18.2	20.1	10.2	5.42	52.60
HD-2967	81.2	83.5	30.33	66.6	15.1	16.6	8.4	6.59	62.40
K-1006	78.3	81.2	32.45	67.5	14.7	15.3	8.1	6.75	65.28
NW-5054	85.8	88.6	35.36	64.6	16.1	17.6	8.9	6.02	66.60
CD (P=0.05)	5.2	6.4	-	-	0.9	1.2	0.5	-	-
Weed Control									
Sulfosulfuron	52.2	54.6	20.8	78.2	9.9	10.8	5.5	6.50	63.61
Metribuzin	55.5	57.0	22.75	77.2	10.4	11.5	5.8	6.10	62.72
Weed free	15.2	8.2	-	100.0	0.0	0.0	0.0	6.77	66.50
Weedy Cheek	242.4	250.5	-	0.0	47.8	52.6	25.2	5.20	49.23
CD (P=0.05)	17.10	20.6	-	-	4.2	4.5	2.1	-	-

Table 2: Effect of varieties and weed control on crop growth, yield attributes, yield and economics of wheat (Mean of two years)

Treatment	Plant height (cm)	Effective tillers (m^2)	Spike length (cm)	No. of spike lets/spike	Grains/ Spike	Test wt. (gm)	Grain yield (q/ha)	Straw yield (q/ha)	Cost (x10^3 Rsha^{-1})	Net Returns (x10^3 Rsha^{-1})	B:C ratio
Varities											
CBW-38	87.5	324	8.3	17.6	44.2	44.6	45.84	68.32	36.5	43.0	1.17
DBW-39	84.2	332	8.8	19.0	51.3	40.5	46.30	62.20	36.5	43.8	1.20

DBW-17	76.7	301	8.4	18.4	46.8	42.1	42.77	57.76	36.5	37.7	1.03
HD-2967	87.5	352	9.7	18.5	52.4	40.6	49.75	67.24	36.5	49.8	1.36
K-1006	90.1	390	10.1	18.0	44.6	43.1	52.12	70.60	36.5	53.9	1.47
NW-5054	99.4	334	8.9	18.2	49.2	41.2	47.44	71.56	36.5	45.8	1.25
CD (P=0.05)	5.8	37.6	0.8	0.9	3.2	1.9	3.8	5.1		4.5	0.11
Weed Control											
Sulfosulfuron	89.2	344	9.1	18.6	49.1	43.3	49.4	68.5	35.7	50.0	1.40
Metribuzin	88.7	340	9.0	18.5	48.8	43.3	49.0	67.8	35.2	49.8	1.41
Weed free	95.9	355	9.4	19.2	51.0	43.9	53.0	71.5	40.7	51.2	1.26
Weedy cheek	76.5	315	8.5	16.9	43.5	37.5	38.1	54.2	34.6	31.5	0.91
CD (P=0.05)	5.6	12.9	0.3	0.8	3.0	2.6	3.4	6.0		4.1	0.12

Effect on crop growth and yield attributes

The tallest plants were recorded in 'NW-5054' followed by 'K-1006' and 'HD-2967'. The values of all yield attributes were higher significantly with 'K-1006' followed by 'HD-2967' but both varieties recorded significantly higher values of all yield attribute over 'DBW-17', 'DBW-39' and 'CBW-38'. Higher yield attributes with these varieties may be attributed to higher availability of plant nutrients to crop. Among the weed control treatments sulfosulfuron being on par with metribuzin resulted in significantly taller plants, more LAI, dry matter accumulation and higher values of yield attributes as compared to weedy check. However weed free upto 60 DAS recorded significantly higher values of LAI, dry matter accumulation and yield attributes over rest the treatments.

Effect on yield

Variety 'K 1006' and HD 267 being at par but produced significantly the higher grain and straw yield over rest of the varieties. The higher yield with these varieties may be due to higher values of yield attributes, LAI and dry matter accumulation by crop because of higher availability of nutrients due to lower weed population and dry weight. Variety 'DBW – 17' recorded the lowest yield (42.77 q/ha). Significantly higher grain and straw yield was recorded under weed free treatment over rest of the treatment. Weed free increased the grain yield and straw yield by 39.1% and 31.9%, respectively over weedy check. Application of sulfosulfuron @ 25 g ha^{-1} produced significantly higher grain and straw yield over metribuzin @ 20 g /ha and weedy check treatment. This was because of efficient control of weeds resulted in higher availability of plant nutrient as compare to weedy check. Weedy check had vigorously growth of weeds which caused heavy competition with crop plant for nutrient, moisture, space and sunlight throughout growing period, and finally poor yield attribute and grain yield of crop.

Economics

The highest net returns (Rs 53,890) ad benefit: cost ratio (1.47) was realized with the variety 'K-1006', which were significantly higher than rest of the varieties, except variety 'HD-2967'. Among the herbicidal treatments, the maximum net returns was accured with sulfosulfuron @ 25 g ha^{-1} followed by metribuzin, but the benefit: cost ratio was marginally high in metribuzin @ 200 g ha^{-1}. Meena and singh (2013) [4] reported increase net profit with the application of sulfosulfuron applied as post emergence.

Conclusion

Variety 'K-1006' should be groun with post emergence application Sulfosulfuron @ 25 /ha to realize higher grain yield and benefit: cost ratio after rice.

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