

## EFFECT OF FERTILITY AND WEED MANAGEMENT ON YIELD, NUTRIENT UPTAKE AND ECONOMICS OF WHEAT

R.S. CHAUHAN

Krishi Vigyan Kendra, Raja Balwant Singh College, Bichpuri, Agra (U.P.)

Received: December, 2013; Revised accepted: September, 2014

### ABSTRACT

A field experiment was conducted at farmers' field in Agra district (UP) during rabi seasons of 2011-13 to study the effect of fertility levels and weed management practices on the yield, quality and uptake of nutrients by wheat [*Triticum aestivum* (L.) emend. Fior & Paol.]. Treatments consisted of four levels of fertility and four herbicides were evaluated in randomized block design with three replications. Results revealed that 100% RDF (120 Kg N+ 60 Kg P<sub>2</sub>O<sub>5</sub> + 40 Kg K<sub>2</sub>O ha<sup>-1</sup>) recorded significantly highest plant height (92.4 cm), effective tillers (330.0 m<sup>2</sup>), length of ear (8.6 cm), grain ear<sup>-1</sup> (8.6), grain weight ear<sup>-1</sup> (41.5 g) and test weight (53 g). The grain (50.0 q ha<sup>-1</sup>) and straw (70.0 q ha<sup>-1</sup>) yield, net return (₹ 62,197 ha<sup>-1</sup>). The maximum B: C ratio (2.64) was noticed at 75% RD NPK was also recorded highest with 100% RD NPK treatment. The uptake of nitrogen, phosphorus and potassium also exhibited similar trend and found to be associated with grain and straw production resulted by the addition of 100% NPK fertilizers. Application of Carfentrazone-ethyl @ 50 g ha<sup>-1</sup> recorded highest plant height, yield attributing characters, grain (49.0 q ha<sup>-1</sup>) and straw yield (69.1 q ha<sup>-1</sup>) followed by Metsulfuron-methyl @ 20 g ha<sup>-1</sup> and 2,4 D @ 625 g ha<sup>-1</sup>. Post-emergence application of Carfentrazone-ethyl at 32 DAS resulted in higher net monetary returns (₹ 61245 ha<sup>-1</sup>) followed by Metsulfuron- methyl (₹ 60,918 ha<sup>-1</sup>) and 2,4 D (₹ 52,787 ha<sup>-1</sup>). Herbicidal application also increased the uptake of nutrients over control and maximum values were recorded with Carfentrazone-ethyl @ 50 g ha<sup>-1</sup>.

**Keywords:** Soil fertility, weed management, nutrient uptake, economics, wheat

### INTRODUCTION

Wheat is the second most important cereal crop in India after rice covering an area of 29 million hectare with a production of 87 million tonnes and total productivity of 2.91 t ha<sup>-1</sup>. Stagnation in wheat production and lower productivity is due to various constraints including inadequate and unbalanced nutrient application. In India the prominent wheat growing areas are in arid and semi-arid regions having sandy loam soil which are low in organic carbon and deficient in nutrients. Balanced fertilization is the key to achieve higher productivity and nutrient use efficiently. Weed infestation is also a major problem in the production of wheat. Slow growth of wheat plants at early stage and application of more fertilizer as well as irrigation right from sowing encourages the rapid growth of weeds, making the cultivation of wheat more problematic and if weeds are not controlled in time, they cause substantial loss in yields of 15-40% (Jat *et al.* 2003). The crop is infested with heavy population of common broadleaf weeds like *Chenopodium album*, *Fumaria parviflora*, *Cersium arvensis*, *Anagallis arvensis*, *Vicia hirsuta*, *Melilotus alba* /*Melilotus indica*, *Convolvulus arvensis* and *Lathyrus aphaca* are of major concern in wheat (Meena and Singh 2013). Many herbicides are used for effective control of broadleaf weeds in this crop.

Presently Carfentrazone-ethyl, Metsulfuron-methyl and 2,4 D are the most widely used post emergence herbicides. Keeping the above facts in view, a field experiment was conducted to study the effect of fertility levels and screen out suitable herbicide to control broad-leaf weeds in wheat production.

### MATERIALS AND METHODS

A field experiment was conducted at farmers' field Village-Nagla Vishnu, (27°25' N, 77°9' E and at altitude of 163.4 meter mean sea level Agra district (Uttar Pradesh) during rabi seasons of 2011-13. The soil was sandy loam in texture and slightly alkaline in reaction (pH 8.10), low in organic carbon (3.5 g kg<sup>-1</sup>), available nitrogen (157 kg ha<sup>-1</sup>), phosphorus (9.8kg ha<sup>-1</sup>) and potassium (110 kg ha<sup>-1</sup>). The experiment was laid out in randomized block design, comprising four fertility levels (control, 50, 75 and 100% RDF) and four herbicides (weedy check, Carfentrazone-ethyl @ 50 g ha<sup>-1</sup>, Metsulfuron-methyl @ 20 g ha<sup>-1</sup> and 2,4 D @ 625 g ha<sup>-1</sup> at 32 DAS) was replicated thrice. Nitrogen was applied through urea (after deducting the quantity of nitrogen applied through DAP), phosphorus through diammonium phosphate (DAP) and potassium through muriate of potash. Wheat (variety PBW 502) was sown in the second week of November in both the years using 100 kg seed ha<sup>-1</sup>. As per treatment, the total quantity of phosphorus and potassium and half dose of nitrogen

were applied at the time of sowing. The remaining 305

half of nitrogen was top dressed at first irrigation

applied at CRI stage. Herbicides as per treatment i.e. Carfentrazone-ethyl @ 50 g ha<sup>-1</sup>, Metsulfuron-methyl @ 20 g ha<sup>-1</sup> and 2,4 D @ 625 g ha<sup>-1</sup> were applied at 32 days after sowing of wheat, with the help of a knapsack sprayer fitted with flat fan nozzle with a spray volume of 600 litre/ha. The crop was grown with all recommended package of practices except the treatments under investigation. The crop was harvested at physiological maturity. The growth, yield attributes and yields (grain, straw) were recorded at harvest. The grain and straw samples were analyzed for their nitrogen content by modified Kjeldahl method. Vanadomolybdo phosphoric acid yellow colour method and flame photometer were followed for the estimation of phosphorus and potassium in di-acid digest, respectively. The economics was computed using the prices of inputs and outputs as per prevailing market rates. The uptake of nutrients was calculated using the yield data in conjunction with their respective contents. The data generated for both years were pooled together and statistically analyzed.

## RESULT AND DISCUSSION

### Growth characters

Application of 100% RD NPK (120 Kg N+ 60 Kg P<sub>2</sub>O<sub>5</sub> + 40 Kg K<sub>2</sub>O ha<sup>-1</sup>) registered the highest value of growth characters while lowest values were obtained in control (Table 1). The mean plant height increased from 84.1 cm at control to 92.4 cm at 100% NPK. The greater availability on nutrients in soil due to increasing fertilizer application might have enhanced meristematic activity (multiplication and elongation of cells) leading to increased plant height. Jat *et al.* (2014) reported similar results. The pooled data analysis revealed that weed management practices favourably influenced the plant height of wheat at harvest over weedy check. Significantly tallest plants were recorded with the application of Carfentrazone-ethyl @ 50 g ha<sup>-1</sup> followed by Metsulfuron-methyl @ 20 g ha<sup>-1</sup>. The lowest value of plant height was recorded under weedy check (Hada *et al.* 2013).

Table 1: Effect of fertility levels and herbicides on growth and yield attributes of wheat.

Treatment	Plant height (cm)	Effective tillers m <sup>2</sup>	Length of ear (cm)	Grains ear <sup>-1</sup>	Grain weight ear <sup>-1</sup> (g)	Test weight (g)
<b>Fertility levels</b>						
Control	84.1	301.4	8.0	43.0	36.8	50.1
50% RD NPK	89.2	317.8	8.3	44.8	38.7	51.8
75% RD NPK	91.5	324.2	8.4	45.2	40.2	52.4
100% RD NPK	92.4	330.0	8.6	45.9	41.5	53.0
S.Em±	1.55	2.96	0.04	0.19	0.05	0.55
C.D. (P=0.05)	4.30	7.99	0.11	0.51	0.13	1.48
<b>Herbicides</b>						
Weedy check	84.6	300.0	8.3	43.8	37.1	50.6
Carfentrazone-ethyl	92.0	329.8	8.3	45.9	41.2	52.6
Metsulfuron- methyl	91.1	325.6	8.4	45.2	40.0	52.5
2, 4-D	89.5	318.0	8.3	44.0	38.9	51.6
S.Em±	1.55	2.96	0.04	0.19	0.05	0.55
C.D. (P=0.05)	4.30	7.99	0.11	0.51	0.13	1.48

### Yield attributes

Important yield attributes such as effective tillers hill<sup>-1</sup> was recorded significantly maximum under 100% NPK over control (Table 2). Grains ear<sup>-1</sup>, grain weight ear<sup>-1</sup> and length of ear were also significantly higher under application of 100% NPK. In case of test weight, significant differences were observed among fertility levels and maximum value was recorded under 100% NPK. Application of fertilizers has supplied adequate amount of nutrients that helped in expansion of leaf area which might have accelerated the photosynthesis rate and in turn increased the supply of carbohydrates to the plants.

Similar results were reported by Jat *at el.* (2014). Data (Table 1) indicated that application of Carfentrazone-ethyl @ 50 g ha<sup>-1</sup> produced significantly higher values of yield attributes (grain ear<sup>-1</sup>, grain weight ear<sup>-1</sup> and test weight) of wheat compared to weedy check. The values of test weight of wheat were 52.2, 52.5 and 51.6 g with the application of Carfentrazone-ethyl @ 50 g ha<sup>-1</sup>, Metsulfuron-methyl @ 20 g ha<sup>-1</sup> and 2,4-D @ 625 g ha<sup>-1</sup>, respectively. Among these herbicides, Carfentrazone-ethyl @ 50 g ha<sup>-1</sup> was more effective in improving yield attributes followed by Metsulfuron-methyl @ 20 g ha<sup>-1</sup> and 2,4-D @ 625 g ha<sup>-1</sup> by

controlling the weeds. Bharat and Kachroo (2007) and Jat *et al.* (2014) also reported similar results.

R.S. CHAUHAN

306

## Yield

Application of graded levels of NPK fertilizers to wheat significantly enhanced the grain and straw yield (Table 2) over control. Highest grain and straw yield were recorded with 100% RD NPK (120 Kg N+ 60 Kg P<sub>2</sub>O<sub>5</sub> + 40 Kg K<sub>2</sub>O ha<sup>-1</sup>) over rest of the NPK levels. Applications of 100% NPK increase the grain and straw yield of wheat to the tune of 33.3 and 35.0 percent over the control, respectively. Higher biological yield with increasing levels of fertilizers to wheat could be ascribed to enhance availability over lower doses of nutrients. This finding confirms the observation of Hada *et al.* (2013). Significant increase in grain yield of wheat with increased levels of fertilizers might be due to improvement in yield attributes. Significant increase in straw and biological yield owing to fertilizer application might be because of increased plant height and profused tillering (Jat *et al.* 2013). The grain and straw yield increased significantly by

different weed control treatments over the weedy check. The increases in grain yield due to Carfentrazone-ethyl @ 50 g ha<sup>-1</sup>, Metsulfuron-methyl @ 20 g ha<sup>-1</sup> and 2,4-D @ 625 g ha<sup>-1</sup> over weedy check were 26.4, 25.5 and 13.4 percent, respectively. The lowest grain and straw yield were obtained under weedy check which was due to the fact that weed plants in weedy check were under competitive stress for all resources. As yield is resultant of yield attributes, maximum value of these parameters due to less crop weed competition in Carfentrazone-ethyl treated plots resulted in the highest grain yield (Table 2). Similar trends were also observed in respect of straw and biological yield. The increase in yield with these herbicides was due to significant reduction in growth of weeds which consequently resulted in the better expansion of yield components and thus gave high yield of wheat. The improvement in yield with herbicides was also reported by Jain *et al.* (2014).

Table: 2 Effect of fertility levels and herbicides on yield of wheat

Treatments	Grain Yield (q ha <sup>-1</sup> )	Straw yield (q ha <sup>-1</sup> )	Biological Yield (q ha <sup>-1</sup> )	Harvest index (%)	Net returns (₹ ha <sup>-1</sup> )	B: C ratio
<b>Fertility levels</b>						
Control	37.50	52.50	90.00	41.67	44375	1.97
50% RD NPK	44.75	63.09	107.84	41.50	54534	2.59
75% RD NPK	48.10	67.82	115.92	41.49	60457	2.64
100% RD NPK	50.00	70.00	120.00	41.67	62197	2.55
S.Em±	1.04	1.57	1.35	-	-	-
C.D. (P=0.05)	2.80	4.23	3.64	-	-	-
<b>Herbicides</b>						
Weedy check	38.75	54.63	93.38	41.50	46613	2.25
Carfentrazone-ethyl	49.00	69.11	118.11	41.49	61245	2.57
Metsulfuron-methyl	48.65	68.14	116.79	41.66	60918	2.60
2, 4-D	43.95	61.96	105.91	41.50	52787	2.33
S.Em±	1.04	1.57	1.35	-	-	-
C.D. (P=0.05)	2.80	4.23	3.64	-	-	-

## Quality

Increasing levels of N, P and K increased the protein content and yield of wheat grain from 11.3 to 12.6% and 421.9 to 628.1 kg ha<sup>-1</sup>. Application of 100% NPK recorded an increase of 48.8% in protein yield over control. The increase in protein content and yield with 100% NPK might due to improved nutritional environment in the rhizosphere as well as in plant system leading to enhanced translocation of nutrients in reproductive parts. These observations are in conformity with the findings of Dhaka and Pathan (2013). Application of herbicides also improved the protein content and yield of wheat. The maximum value of protein content (12.1%) and yield (591.1 kg ha<sup>-1</sup>) were recorded with Carfentrazone-ethyl @ 50 g ha<sup>-1</sup>. There was no significant difference in protein content due to various herbicides. The higher yield of

protein with the application of Carfentrazone-ethyl may be attributed to higher grain production.

## Nutrient uptake

There was a significant effect of different fertility levels on the nutrient uptake of wheat over the control (Table 3). Highest uptake of nitrogen, phosphorous and potassium was observed with application of 100% NPK. The uptake of nitrogen, phosphorous and potassium by grain was found higher to the tune of 48.8, 70.2 and 61.1 percent with 100% NPK over the control respectively. The nutrient uptake is a function of their content in crop. This might be owing to increased availability of nutrients due to addition of fertilizers. These results are in conformity with those of Dhaka and Pathan (2013). A perusal of the data (Table 3) revealed an increase in uptake of nitrogen, phosphorous and potassium by wheat crop was observed in weed control treatments

over the weedy check. Application of Carfentrazone-ethyl @ 50 g ha<sup>-1</sup> was significantly superior to weedy check

check in respect of utilization of nutrients.

*Effect of fertility and weed management on yield and economics of wheat*

Improvement in yield in weed control treatments resulted in higher uptake of nutrients. Similar finding

was recorded by Chopra *et al.* (2008) and Hada *et al.* (2013).

Table 3: Effect of fertility levels and herbicides uptake of nutrients (kg ha<sup>-1</sup>) and protein in wheat

Treatment	Protein	Protein yield (kg ha <sup>-1</sup> )	Nitrogen		Phosphorus		Potassium	
			Grain	Straw	Grain	Straw	Grain	Straw
<b>Fertility levels</b>								
Control	11.3	421.9	67.5	26.3	9.4	5.3	18.0	95.6
50% RD NPK	11.8	525.8	84.1	33.4	12.1	7.6	22.8	116.1
75% RD NPK	12.2	586.2	93.8	37.3	14.4	8.8	25.9	126.1
100% RD NPK	12.6	628.1	100.5	39.9	16.0	10.5	29.0	131.6
SEm±	0.04	11.55	1.81	1.05	0.70	0.66	0.51	2.11
CD (P=0.05)	0.11	31.18	4.88	2.83	1.89	1.78	1.37	5.69
<b>Herbicides</b>								
Weedy check	11.8	455.3	72.9	28.9	10.9	6.6	19.8	100.5
Carfentrazone- ethyl	12.1	591.1	94.6	37.3	13.7	9.0	26.0	128.5
Metsulfuron- methyl	12.1	586.8	93.9	36.8	14.1	8.2	25.8	125.4
2, 4-D	11.9	521.9	83.5	33.5	12.70	8.1	22.9	115.2
SEm±	0.04	11.55	1.81	1.05	0.70	0.66	0.51	2.11
CD (P=0.05)	0.11	31.18	4.88	2.83	1.89	1.78	1.37	5.69

### Economics

Application of 100% NPK was more economical with higher net returns ` 62197 ha<sup>-1</sup> than their lower doses. The lowest values of net return ` 44375 ha<sup>-1</sup> as well as B:C ratio (1.97) were recorded in control. This trend in economic returns was mainly owing to the treatment effect on the grain and straw yield. The result of best performing treatment (Carfentrazone-ethyl @ 50 g ha<sup>-1</sup>) was significantly superior to rest of the treatments with higher net

returns ` 61,245 ha<sup>-1</sup>. Similar results were reported by Jat *et al.* (2013) and Singh, (2012). Weedy check treatment resulted lowest net return and B:C ratio. This was due to lower crop yield and poor weed control. From the results, it was concluded that broad-leaf weed control in wheat should be done by post emergence application of Carfentrazone-ethyl @ 50 g ha<sup>-1</sup> at 32 days after sowing and crop should be fertilized with 120 Kg N+ 60 Kg P<sub>2</sub>O<sub>5</sub> + 40 Kg K<sub>2</sub>O ha<sup>-1</sup> in prevailing conditions of Agra region.

### REFERENCES

- Bharat, R. and Kachroo, D. (2007) Effect of different herbicides on mixed weed flora, yield and economics of wheat (*Triticumastivum*) under irrigated conditions of Jammu. *Indian Journal of Agricultural Sciences* **77** (6): 383-386.
- Chopra, N.K. Chopra, N. and Singh, H. P. (2008) Assessment of nutrient uptake by weeds and crop and its subsequent effect on grain quality of wheat (*Triticumastivum*). *Indian Journal of Agricultural Sciences* **78**: 540-542.
- Dhaka, B. R. and Pathan, A. R. K. (2013) Response of wheat to integrated nutrient management in typicustipsammet. *Annals of Plant and Soil Research* **15** (1): 50-53.
- Hada, N., Nepalia, V. and Tomar, S. S. (2013) Influence of balanced nutrition, weed control and sowing methods of yield and nutrient uptake by durum wheat. *Annals of Plant and Soil Research* **15** (1): 19-22
- Jackson, M.L. (1973) *Soil chemical Analyses*. Prentice Hall of India Private Limited, New Delhi.
- Jain, V., Jain, N. and Kewat, M. C. (2014) Effect of application of post-emergence herbicides at different levels of available soil moisture content in irrigated wheat (*Triticum astivum*). *Indian Journal of Agronomy* **59** (1): 91-95.
- Jat, R. S., Nepalia, V. and Jat, R. L. (2003) Effect of weed control and sowing methods on production potential of wheat. *Indian Journal of Agronomy* **48** (3): 192-195.
- Jat, S.L., Nepalia, V., Chaudhary, J. and Singh, D. (2014) Effect of nitrogen and weed management on productivity and quality of durum wheat (*Triticum durum*). *Indian Journal of Agronomy* **59** (2): 281-285.
- Meena, B.L. and Singh, R.K. (2013) Response of wheat (*Triticum astivum*) to rice (*Oryza sativa*) residue and weed management practices. *Indian Journal of Agronomy* **58** (4): 521-524
- Singh, R.J. (2012) Weed management in irrigated wheat (*Triticum astivum*) with special reference to butter cup weed *Ranunculus* spp.

in north-west Himalayas. *Indian Journal of Agricultural Sciences* **82** (8): 706-710.