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EFFECT OF NITROGEN AND COPPER LEVELS ON YIELD AND UPTAKE OF NUTRIENTS BY WHEAT CROP

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ABSTRACT

A field experiment was conducted at Lakhaoti, Bulandshahr (U.P) during rabi season of 2008-09 and 2009-2010 to study the effect of nitrogen and copper levels on yield and nutrients uptake by wheat. The results indicated that application of 150 kg N ha^{-1} produced significantly higher grain (50.73q ha^{-1}) and straw yield (61.42 q ha^{-1}) over lower levels of nitrogen. With increasing levels of copper, successive increase was observed in grain and straw yield of wheat up to 5 kg Cu ha^{-1} thereafter, yield was reduced with 10 kg Cu ha^{-1} application. Application of 150 N kg ha^{-1} recorded significantly higher protein content (15.47 %). Application of graded doses of copper noticed decreasing trends in protein content of wheat grain and straw. Increasing levels of N and Cu significantly increased the uptake of respective nutrients by the crop. An increase in Cu uptake was noted up to 100 kg N whereas N uptake increased up to 5 kg Cu ha^{-1} addition. Nitrogen application significantly increased the uptake of P, K and S by the crop. Application of 10 kg Cu ha^{-1} reduced the uptake of P, K and S by the crop. However, the effect of Cu on uptake of nutrients was statistically non-significant.

Keywords: Nitrogen, copper, yield, uptake nutrient, wheat

INTRODUCTION

Wheat is the most important and widely cultivated cereal crop in India. Productivity of wheat is decreased due to imbalanced and high analysis chemical fertilizers which have made the soils deficient in micronutrients. In addition most of the soils are deficient in nitrogen. Nitrogen is considered to be the most important and readily available plant nutrient of the major elements. It has a great stimulating influence on the development of the vegetative parts. All vital processes are associated with the presence of functionally reactive plasma in the protein of which nitrogen is present as a characteristic constituent. In addition, nitrogen is present in many other compounds, which are of great physiological importance in metabolism, such as chlorophyll, the nucleotides, and alkaloids as well as in many enzymes and vitamins. Among micronutrients, copper is important owing to its vital and indispensable role in plant growth. It is a constituent of cytochrome oxidase besides being a component of many enzymes such as ascorbic acid oxidase, phenolase laccase etc. It also promotes the formation of vitamin A in plants. Heavy dressings of copper depress the absorption of N by the crops causing a marked reduction in yield (Antil *et al.,* 1988). Such information may be of interest as the soils are becoming deficient in copper as a result of intensive cropping, continuous application of nitrogenous fertilizers and thus declining the productivity of the crops. Therefore, the present study was undertaken to investigate the effect of nitrogen and copper on yield and nutrients uptake by wheat crop.

MATERIALS AND METHODS

Field experiment was conducted in rabi season of 2008-09 and 2009-2010 at research farm of Amar Singh College Lakhaoti, Bulandshashr (U.P.). The experimental soil was sandy loam in texture. Experimental soil had 3.5 g kg^{-1} organic carbon, 170 kg ha^{-1} available N, 9.4 kg ha^{-1} available P, 150 kg ha^{-1} available K, 16 kg ha^{-1} available S, and 0.26 mg kg^{-1} available Cu, respectively. Sixteen treatment combinations comprising four levels of N (0, 50, 100 and 150 kg ha^{-1}) and four levels of Cu (0, 2.5, 5 and 10 kg ha^{-1}) were evaluated in randomized block design with three replications. As per treatments, calculated amounts of nitrogen and copper were applied through urea and copper sulphate, respectively at the time of sowing. Recommended dose of phosphorus and potassium @ 60 and 40 kg ha^{-1} was applied through single supper phosphate and muriate of potash, respectively at the time of sowing. Wheat (cv. PBW-343) was taken as test crop and sown on 6 November in both the years. The grain and straw yields of wheat were recorded at harvest of the crop. The grain and straw samples were analyzed for their N, P, K, S and Cu contents. Phosphorous content in grain and straw was estimated from the samples by Vanadomolybdo.

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phosphoric yellow colour method and potassium content by flame photometer. Sulphur content was estimated by turbidimetric method (Chesnin and Yien, 1951) in the extract obtained after digestion with HNO_3 and perchloric acid. Copper in the diacid extract was determined on an atomic absorption spectrophotometer. Nitrogen content in grain and straw samples was estimated by modified Kjeldahl method (Jackson 1973). Protein content in grain was computed by multiplying nitrogen percentage with 6.25.

RESULTS AND DISCUSSION

Application of 150 kg N ha^{-1} resulted in the maximum yield of grain and straw of wheat which was significantly higher than those obtained with 0, 50 and 100 kg N ha^{-1}. Pooled data also indicated that application of 150 kg N ha^{-1} produced significantly higher grain yield (50.73q ha^{-1}) and the increase was 38.2 % over the control. The highest straw yield of was also obtained with 150 kg N ha^{-1} application in both the years. The effect of N in improving the yield of wheat appears to be due to low nitrogen content in soil. Better supply of nitrogen might have created the favorable condition for vigorous vegetative and reproductive growth of the crop which correspondingly increased the yield of the crop. Sharma *et al.* (2000), Singh *et al.* (2007), Yadav *et al.* (2005) and Meena *et al.* (2012) also observed similar results. With increasing levels of copper, successive increase was observed in grain and straw yield of wheat up to 5 kg Cu ha^{-1} application. Thereafter, grain and straw yield was reduced with 10 kg Cu ha^{-1} application. The grain yield increased from 42.70 to 45.09 q ha^{-1} in first year and from 43.84 to 45.94 q ha^{-1} in second year with an increase in level of copper from 0 to 5 kg ha^{-1}. The corresponding increases in stover yield were from 52.01 to 54.14 and 53.07 to 55.38 q ha^{-1}. Poongothai and Mathan (2002), Singh and Prakash (2009) also reported an increase in yield of maize and wheat crop, respectively with copper application.

Table 1: Effect of nitrogen and copper application on grain and straw yield and protein content of wheat

Treatments	Grain yield (q ha^{-1})			Straw yield (q ha^{-1})			Protein in grain (%)		
	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean
Nitrogen (kg ha^{-1})									
0	36.34	37.11	36.72	44.33	44.97	44.70	13.25	13.31	13.28
50	42.38	43.38	42.88	50.81	52.56	51.68	14.00	14.12	14.06
100	47.42	48.42	47.92	56.51	57.43	56.97	14.87	14.81	14.84
150	50.21	51.25	50.73	61.18	61.68	61.42	15.50	15.43	15.47
CD (P=0.05)	1.23	1.52	1.46	1.61	1.40	1.49	0.20	0.23	0.22
Copper (kg ha^{-1})									
0	42.70	43.84	43.30	52.01	53.07	52.54	14.56	14.56	14.56
2.5	44.31	45.19	44.75	53.71	54.25	53.98	14.43	14.50	14.47
5.0	45.09	45.94	44.51	54.14	55.38	54.76	14.31	14.31	14.31
10.0	44.18	45.18	44.68	52.96	53.92	53.44	14.25	14.25	14.25
CD (P=0.05)	1.23	1.52	1.46	1.61	1.40	1.49	0.20	0.23	0.22

Protein percentage in grain and straw increased significantly with increasing levels of nitrogen application. Application of 150 kg N ha^{-1} recorded significantly higher amount of protein content (15.47 %) over other levels of nitrogen and lowest value of 13.28 % was noticed in control. Meena et al. (2012) also reported similar increase in protein percentage in barley with nitrogen application. Application of graded doses of copper noticed a decreasing trend in protein content of wheat grain and straw. Minimum protein content 14.25 % was observed with 10 kg Cu ha^{-1} application indicating an antagonistic effect. Similar results were reported by Singh (1994).

The mean nitrogen removal by the wheat grain and straw increased from 77.9 to 125.2 kg ha^{-1} and from 26.2 to 44.4 kg ha^{-1}, respectively as the dose of nitrogen increased from 0 to 150 kg ha^{-1} (Table 2). This increase can invariably be attributed to increased grain and straw yield and higher nutrient demand for plant growth. Similar results were reported by Meena et al. (2012). Application of lower levels of copper increased the nitrogen uptake and a reduction was noted at higher level (10 kg ha^{-1}) of copper due to lower grain and straw production. The improvement in nitrogen uptake with lower levels of copper was mainly due to higher yields of grain and straw of wheat. Kumar *et al.* (2010) reported similar results.

Nitrogen application increased the phosphorus uptake by grain from 7.3 to 12.1 kg ha^{-1} and by straw from 4.7 to 8.3 kg ha^{-1} with 150 kg N ha^{-1}. This increase in P uptake with nitrogen application seems to be associated with increased P availability with a concomitant increased P uptake by the crop (Chaudhary et al. 1997). The mean P uptake by wheat grain and straw decreased at all the levels of copper over control. However, minimum uptake was noted at 10 kg Cu ha^{-1} level which might be due to depressive effect of copper. Singh and Prakesh (2009) reported similar resulrs. The K uptake by wheat grain and straw increase significantly with N levels over control and maximum K uptake was recorded at 150 kg N ha^{-1}. The K uptake increased from 17.9 to 26.8 kg ha-1 in grain and from 98.5 to 138.3 kg ha^{-1} in straw with 150 kg N ha^{-1} due to increase in grain and straw yield. Similar results were reported by Singh et al. (2007). The K uptake by wheat crop was not affected significantly with copper levels. However, K uptake was reduced at 10 kg Cu ha^{-1} over control.

Table 2: Effect of nitrogen and copper application on uptake of N, P, K, S (kg ha^{-1}) and Cu (g ha^{-1}) by wheat crop

Treatments	Nitrogen		Phosphorus		Potassium		Sulphur		Copper	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Nitrogen (kg ha^{-1})										
0	77.9	26.2	7.3	4.7	17.9	98.5	6.5	4.6	37.9	29.8
50	96.5	33.0	9.5	5.6	21.7	115.0	7.9	5.7	43.3	32.8
100	113.6	38.3	11.0	7.2	24.9	127.2	9.5	7.1	47.8	36.6
150	125.2	44.4	12.1	8.3	26.8	138.3	10.7	8.1	46.8	36.1
CD (P=0.05)	8.22	2.22	0.49	0.35	0.73	5.10	1.72	1.08	8.54	6.03
Copper (kg ha^{-1})										
0	101.5	35.9	10.2	7.0	22.7	117.8	9.1	6.9	32.9	22.8
2.5	104.9	36.1	10.1	6.7	23.1	121.1	8.9	6.6	40.9	30.0
5.0	104.1	35.8	10.0	5.4	23.1	122.0	8.7	6.2	46.5	38.9
10.0	102.6	34.2	9.6	5.8	22.4	118.4	8.1	5.8	55.4	43.6
CD (P=0.05)	NS	NS	0.49	0.35	NS	NS	NS	NS	8.54	6.03

Sulphur uptake by wheat grain and straw increased from 6.5 and 4.6 kg ha^{-1} at control to 10.7 and 8.1 kg ha^{-1} with 150 kg N ha^{-1}, respectively. Increase in S uptake because of N application could be due to the synergistic effect of N and S in plants. The lower levels of copper had a synergistic effect on sulphur uptake by the wheat crop. The higher level of copper (10 kg ha^{-1}) had an adverse effect on S uptake as compared to lower levels, which may be due to lower yields of grain and straw. The uptake of copper by wheat grain and straw increased with N application over control. The increase in copper uptake with N addition was mainly due to increased grain and straw production (Singh and Swarup 1982). Applications of copper significantly increased the mean copper uptake by wheat grain from 32.9 to 55.4 g ha^{-1}. The corresponding increase in Cu uptake by straw was from 22.8 to 43.6 g ha^{-1}. This increase in copper uptake with its addition may be ascribed to higher grain and straw yield and copper concentration in crop. Similar results were reported by Singh and Swarup (1982), Barik and Chandel (2001) and Singh and Prakesh (2009).

On the basis of study, it may be concluded that the 150 kg N ha^{-1} and 5.0 kg Cu ha^{-1} application seems to be optimum dose for enhancing the productivity of wheat in alluvial soil. These results indicate that in light textured soils of Bulandshahr, copper could be yield limiting nutrient in near future.

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