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Dharmesh Kumar Singh
Associate Professor, Department of Soil Science and Agriculture Chemistry, C.B.G. Agriculture P.G. College B K T Lucknow, Uttar Pradesh, India

Hirday Narayan Tiwari
Associate Professor, Department of Soil Science and Agriculture Chemistry, C.B.G. Agriculture P.G. College B K T Lucknow, Uttar Pradesh, India

Mohit Verma
M.Sc. Student, Department of Soil Science and Agriculture Chemistry, C.B.G. Agriculture P.G. College B K T Lucknow, Uttar Pradesh, India

Corresponding Author:
Dharmesh Kumar Singh
Associate Professor, Department of Soil Science and Agriculture Chemistry, C.B.G. Agriculture P.G. College B K T Lucknow, Uttar Pradesh, India

Effect of nutrient management on yield and nutrient uptake of wheat (*Triticum aestivum* L.) under middle zone of U.P.

Dharmesh Kumar Singh, Hirday Narayan Tiwari and Mohit Verma

Abstract
The present experiment entitled "Effect of nutrient management on growth and yield of wheat (*Triticum aestivum* L.) under middle zone of U.P." was carried out at Shradheya Bhagwati Singh Agriculture Research Farm, Hajipur, Chandra Bhanu Gupta Krishi Snatkottar Mahavidyalaya, BKT, Lucknow (UP). The experiment was laid down in randomized block design with 7 treatment *viz* 100% NPK IF (T_1), 100% NPK IF + 10 kg S/ha (T_2), 100% NPK IF + 20 kg S/ha (T_3), 100% NPK IF + 5 kg Mn/ha (T_4), 100% NPK IF + 10 kg Mn/ha (T_5), 100% NPK IF + 2.5 kg Zn/ha (T_6) and 100% NPK IF + 5 kg Zn/ha (T_7) with three replications during rabi season of 2021-22. Result reveled that application of 100% NPK along with sulphur or Mn or Zinc improved the grain, straw and biological yield over 100% NPK alone. Crop fertilized with 100% NPK along with 20 kg sulphur. 100% NPK+10kg Mn ha or 100% NPK-5kg Zn ha^{-1} increased the grain, straw and biological yield significantly over its lower dose. The same trend of data was also noted in nutrient concentration and uptake of nutrients.

Keywords: Improved, nutrient, application and significantly

Introduction
Wheat (*Triticum aestivum* L) is an important cereal crop in India that belongs to the family Poaceae and provides about 60 percent of world's energy consumption. According to FAO STAT, wheat provides around 20 percent of the protein and calories consumed globally. Wheat contributes more calories to the world's diet (20%) and more protein (11%). As one of the largest wheat producers in the world, India comes in second to China. A country's food security is largely reliant on wheat, as it serves as a life- sustaining crop to its population. The wheat grain has a variety of small components that may have positive effects on human health in addition to the three major component categories of carbohydrate, protein, and cell wall polysaccharides (dietary fiber) (J. Agric Food Chem 2013) [6]. In temperate regions, wheat is the most significant staple crop, and demand for it is rising in nations that are urbanizing and industrializing Besides providing substantial amounts of energy and starch, wheat also contains numerous nutrients that are essential or beneficial for one's health, such as protein, vitamins (including B vitamins), dietary fiber, and phytochemicals.
Sulphur (S), one of the most crucial minerals for all plants and animals, is regarded as the fourth major nutrient for agricultural crop production after nitrogen, phosphorous, and potassium Sulphur is a structural constituent of organic compounds, some of which are uniquely synthesized by plants, providing humans and animals with essential amino acids (methionine cysteine and cysteine). It is involved in chlorophyll formation, and activation of enzymes and is a part of vitamins biotin and thiamine (B1). animals and man. The trace elements found in plants are organically bound. complexed and free ions. Mn is necessary for the metabolism of phenolics, chlorophylls, isoprenoids, and carotenoids Mn treatment from the outside boosts net assimilation, relative growth, and yield.
Manganese (Mn) plays important role in the metabolism of plants, animals and man. The trace elements found in plants are organically bound, complexed and free ions. Mn is necessary for the metabolism of phenolics, chlorophylls, isoprenoids, and carotenoids. Mn2+ treatment from the outside boosts net assimilation, relative growth, and yield.
Zn is crucial for plant growth because plants need the right proportions of all the key minerals for healthy growth and maximum yield. It contributes to stronger emergence, faster stand establishment, healthier root growth, greater plant vigour and increased yield.

In wheat, if there is a zinc deficiency, boron absorption increases the growth of plants that have harmful effects. Likewise, the deficiency in Zn stimulates the uptake of phosphorous into older leaves up to toxicity. As a plant nutrient the role of zinc in crop production, including wheat cultivation, has been well established. Zinc, a micronutrient element, is required for plant growth relative to a smaller amount. The zinc ion (Zn) is absorbed by plant roots. Zinc participates in a wide variety of enzymatic processes. Auxin metabolism is one of zinc's metabolic functions. It affects the production of cytochrome. the activities of hydrogenase and carbonic anhydrase, and the stabilization of ribosomal fractions.

Information regarding systemic studies on NPK levels along with sulphur manganese and zinc for wheat crop is lacking therefore an attempt was made to study the effect of nutrient management on growth and yield of wheat under late shown condition.

Materials and Methods

An experiment entitled "Effect of nutrient management on growth and yield of wheat (*Triticum aestivum* L.) under middle zone of U.P." was conducted at the Shradheya Bhagwati Singh Agriculture Research Farm, Hajipur, Chandra Bhanu Gupta Krishi Snatkottar Mahavidyalaya, B.K.T, Lucknow (U.P.) situated at Latitude: of 26°59′ North, and Longitude: 80'54' East at an altitude of 116 meters above mean sea level. The experimental location comes under the Agro-Climatic Zones of Central Plains of Uttar Pradesh comprising Allahabad, Fatehpur, Pratapgarh, Sultanpur, Raebareli, Unnao, Lucknow, Barabanki, Sitapur, Hardoi, Kheri and Pilibhit districts which fall under this sub-zone. This area receives on an average 979 mm of rainfall; the climate ranges from dry sub-humid to semi-arid and the soil is alluvium calcareous sandy loam type. The climate of Bakshi Ka Talab is warm and temperate. In winter, there is less rainfall than in summer. The average annual temperature in Bakshi Ka Talab is 24.9°C. The precipitation is about 1045 mm per year. The driest month is November, with 2 mm of rain. With an average of 326 mm, the most precipitation falls in July. May is the warmest month of the year. The temperature in May averages 32.5 °C and January has the lowest average temperature of the year i.e., 14.7 °C. The experiment was planned with seven treatments *viz.*, 100% NPK-IF(T_1), 100% NPK-IF+ 10kg S/ha (T_2), 100% NPK-IF+ 20kg S/ha (T_3), 100% NPK-IF+ 5kg Mn/ha (T_4), 100% NPK-IF+ 10kg Mn/ha (T_5), 100% NPK-IF+ 2.5kg Zn/ha (T_6) and 100% NPK-IF+ 5kg Zn/ha (T_7) which were tested in Randomized Block Design to see their impact on growth and yield of wheat. All the treatments were replicated thrice observations on growth and yield parameters were recorded and subjected to statistical analysis to draw valid results.

Results and Discussion

Yield: A perusal of the data presented in table1 revealed that all nutrient management practices affected the grain, straw and total biological yield and harvest index significantly. Application of 100% NPK along with sulphur or Mn or Zinc improved the grain, straw and biological yield over 100% NPK alone. Crop fertilized with 100% NPK along with 20 kg sulphur. 100% NPK+10kg Mn ha or 100% NPK-5kg Zn ha^{-1} increased the grain, straw and biological yield significantly over its lower dose of micro-nutrients except 100% NPK along with either 2.5 kg Zn ha or 5 kg Zn had which was on par with each other in case of grain yield.

Overall, 100% NPK+5kg Zn ha recorded significantly highest grain yield (39.46 q ha^1), straw yield (71.93 q ha^{-1}) and biological yield (110.73 q ha^{-1}) over rest of the nutrient's management practices, however being at par with 100% NPK+2.5kg Zn ha^1 for grain yield. Application of 100% NPK-IF recorded significantly lowest yield as compared to rest of the treatments. The harvest index (%) was reduced with 100% NPK along with sulphur @ 20 kg ha^1, Mn @ 10 kg ha^1, and zine @ 5 kg ha^1 over their lower dose like su. phur 10 kg ha^1, Mn @ 5 kg ha and zinc @ 2.5 kg ha^1. Crop received 100% NPK+IF alone recorded the lowest values of harvest index (34.46%). The percent increase in grain yields due to 100% NPK-IF+5kg Zn ha^1.was recorded to the line (38.63 q ha^1), (35.43 q ha^1), (34.43 q ha^1), (37.96 q ha^1), (36.70 q ha^1), and (28.66 q ha^1) over 100% NPK+2.5kg Zn ha^1, 100% NPK+10kg Mn ha^1, 100% NPK+5kg Mn ha^1, 100% NPK+20kg S ha^1, 100% NPK+10kg Sha^1, and 100% NPK-IF, respectively. Abbas *et al.* (2011) [1] recorded more yield by Mn application, inorganic fertilizer and FYM application was also responsible for production of higher yield (Chaoudhary *et al.* (2022) [2].

Nutrient Content in grain and straw

The data on content of N, P, K, S. Mn, and Zinc was analyzed statistically and presented in table 2. The content of N, P, K, S, Mn and Zn was affected statistically due to different mutrient management practices. The combined use of 100% NPK+ micro-nutrient increased the content of different nutrient in grain and straw significantly over 100% NPK alone. Application of 100% NPK+5 kg Zn ha recorded the maximum values of N, P, K, S. Mn and Zn in grain and straw significantly over 100% NPK+ Mn or 100% NPK+ sulphur or 100% NPK alone. Thus, administration of sulphur, Mn or Zine along with 100% NPK was found to be more effective as compared to 100% NPK-IF with regards to content of N. P. K. S. Mn and Zn in grain and straw.

Uptake of nutrients in grain and straw

The data on uptake of nutrients was obtained by multiplying the content of nutrient into its respective yield. Thus, uptake of nutrients is dependent on the grain and straw yield of respective treatment. The data on uptake of different nutrients was obtained and analyzed statistically. The pertaining to uptake of various nutrients are presented in table 3.

A critical examination of data presented in table 3 revealed that uptake of various nutrients was affected statistically. The data further revealed that the uptake of nutrients was increased significantly with 100% NPK applied with micro-nutrients like sulphur, Mn and Zn at two doses over 100% NPK alone. Uptake by grain from crop fertilized with 100% NPK along with 5 kg Zn ha recorded the maximum uptake of N (47.13 kg ha^{-1}), P (15.07 kg ha^{-1}), K. (17.34 g ha^{-1}), S (8.61 kg ha^{-1}), Mn (68.57 g ha^{-1}), and Zn (101.7 g ha^{-1}) through grain Similar higher uptake of nutrients like N, P, K. S. Mn and Zn in straw was also observed with above treatment. However, the lowest uptake of N, P, K, S. Mn and Zn through grain and straw was noticed with 100% NPK applied alone these results are in close conformity with the results of Gul *et al.* (2011) [3], Hryvna *et al.* (2015) [4], Keram and Singh (2014) [5], Khourgami *et al.* (2008) [7], Singh and Kumar (2011) [11] and Singh *et al.* (2014) [5].

Table 1: Effect of nutrient management on yield (qha^{-1}) of wheat

Treatments	Yield			
	Grain Yield (qha^{-1})	Straw Yield (qha^{-1})	Biological Yield (qha^{-1})	Harvest Index (%)
100% NPK-IF	28.66	54.50	83.16	34.46
100% NPK-IF+ 10kg S/ha	36.70	63.03	99.73	36.80
100% NPK-IF+ 20kg S/ha	37.96	66.26	104.22	36.42
100% NPK-IF+ 5kg Mn/ha	34.43	57.83	92.26	37.32
100% NPK-IF+ 10kg Mn/ha	35.43	60.16	95.59	37.06
100% NPK-IF+ 2.5kg Zn/ha	38.63	69.23	107.86	35.81
100% NPK-IF+ 5kg Zn/ha	39.46	71.93	111.39	35.43
S.Em +	0.31	0.42	0.62	0.37
CD at 5%	0.96	1.30	1.91	1.14

Table 2: Effect of nutrient management on Nutrient Content in grain and straw of wheat

Treatments	Grain						Straw					
	N	P	K	S	Mn	Zn	N	P	K	S	Mn	Zn
100% NPK-IF	1.12	0.38	0.437	0.215	17.51	26.02	0.400	0.095	1.288	0.204	13.66	11.71
100% NPK-IF+ 10kg S/ha	1.14	0.38	0.437	0.231	17.53	26.21	0.407	0.097	1.311	0.219	13.67	11.79
100% NPK-IF+ 20kg S/ha	1.15	0.39	0.449	0.238	17.56	26.25	0.411	0.101	1.323	0.226	13.70	11.81
100% NPK-IF+ 5kg Mn/ha	1.18	0.38	0.437	0.216	17.80	26.15	0.421	0.102	1.357	0.205	13.88	11.77
100%NPK-IF+ 10kg Mn/ha	1.20	0.39	0.449	0.219	18.00	26.21	0.429	0.098	1.380	0.208	14.04	11.79
100%NPK-IF+ 2.5kg Zn/ha	1.22	0.39	0.449	0.223	17.75	26.34	0.436	0.010	1.403	0.212	13.85	11.85
100% NPK-IF+ 5kg Zn/ha	1.26	0.40	0.460	0.225	17.80	26.45	0.450	0.102	1.449	0.214	13.88	11.90
S.Em +	0.002	0.004	0.002	0.001	0.009	0.001	0.004	0.003	0.005	0.003	0.001	0.000
CD at 5%	0.007	0.010	0.010	0.003	0.020	0.002	0.010	NS	0.010	0.009	0.030	0.001

Table 3: Effect of nutrient management on Nutrient Uptake by grain and straw of wheat

Treatments	Grain						Straw					
	N	P	K	S	Mn	Zn	N	P	K	S	Mn	Zn
100% NPK-IF	32.10	10.89	12.52	6.16	50.18	74.57	21.80	5.18	70.20	1.11	74.45	63.82
100% NPK-IF+ 10kg S/ha	41.84	13.95	16.04	8.48	64.34	96.19	25.65	6.11	82.63	1.38	86.16	74.31
100% NPK-IF+ 20kg S/ha	43.65	14.80	17.04	9.03	66.66	99.65	27.23	6.69	87.66	1.50	90.78	78.25
100% NPK-IF+ 5kg Mn/ha	40.63	13.08	15.05	7.44	61.29	90.03	24.35	5.90	78.48	1.19	80.27	68.07
100%NPK-IF+ 10kg Mn/ha	42.52	13.82	15.91	7.76	63.77	92.86	25.81	5.90	83.02	1.25	84.46	70.93
100%NPK-IF+ 2.5kg Zn/ha	47.13	15.07	17.34	8.61	68.57	101.7	30.18	0.69	97.13	1.47	95.88	82.04
100% NPK-IF+ 5kg Zn/ha	49.72	15.78	18.15	8.88	70.24	104.37	32.37	7.34	104.23	1.54	99.84	85.60
S.Em +	0.37	0.04	0.34	0.01	0.32	0.04	1.23	0.06	0.53	0.18	0.78	0.02
CD at 5%	1.18	0.14	1.06	0.03	1.01	0.12	3.84	0.19	1.65	0.58	2.41	0.07

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