

Original Research Article

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Effect of Phosphorus, Sulphur and Zinc on Growth, Yield and Yield Attributes of Wheat (*Triticum aestivum*)

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ABSTRACT

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A field experiment was conducted during the Rabi season 2012-2013 and 2013-2014 at Agronomy Research Farm of NDUAT, Faizabad, to study the effect of phosphorus, sulphur and zinc on wheat (*Triticum aestivum* L). Pooled data revealed that the growth parameters, yield attributes and yield increased significantly with application of 50 kg P₂O₅, 20 kg S and 10 kg Zn ha⁻¹.

Introduction

Wheat is one of the most important cereal crops of India with diverse uses. Intensive cultivation has resulted in depletion of soil nutrients to a great extent thus nutrient requirement of crops has increased considerably during the last few years. Phosphorus is the backbone of any fertilizer management programme and plays a key role in energy related activities and development of root system. Sulphur performs many physiological functions like synthesis of sulphur containing amino acids which have a positive role in improving quality of grain. The soil of U.P. is deficient in micronutrient such as zinc, sulphur and boron. The application of N, P, K, S, and Zn containing fertilizer in proper proportion is necessary to augment the productivity of wheat. Hence, the effect of various nutrients in balanced

proportion on yield of wheat will be of immense significance to understand the nutrient requirement because crops reach their full yield potential with adequate supply of various nutrients. Zinc is also an important micronutrient reported deficient in Indian soils and plays a significant role in various enzymatic and physiological activities of the plant body. It helps in the formation of chlorophyll and auxins. The present investigation was therefore conducted to find out efficient and balanced use of fertilizers for sustainable crop production in wheat.

Materials and Methods

The investigation was carried out during the winter (rabi) season of 2012-13 and 2013-14 at Kumarganj, Faizabad. The soil was silt

loam with 8.15 pH 0.43 organic carbon, 0.32 EC, available N (137.0 and 196.0 kg/ha). P (19.0 and 21.0 kg/ha), S (6.50 and 6.52 kg/ha), Zn (0.54 and 0.57 ppm) and medium in K (251.0 and 241.0 kg/ha). The experiment was laid out in split-plot design with 3 replications. Main plots were fertilized with 3 levels of phosphorus (25, 50 and 75 kg P₂O₅ ha⁻¹) and Subplots were fertilized with 3 levels of sulphur (0, 20 and 40 kg S/ ha) and 2 levels of zinc (0, and 10 kg Zn/ha). Wheat variety 'HUW-234' was sown on 20 December 2012 during the first year and 23 December 2013 during the second year using a seed rate of 125 kg/ha at a row spacing of 20.0 cm. A common dose of 120 kg N/ha was applied in 3 splits (half basal, one-fourth first and one-fourth at second irrigation). Sulphur was applied through elemental sulphur, phosphorus as diammonium phosphate and zinc applied through zinc oxide basal placed as per treatments.

Results and Discussion

Growth characters Pooled data (Table 1) revealed that application of 50 kg P₂O₅/ha significantly increased the plant height, dry matter accumulation and total shoots which was significantly superior over 25kg P₂O₅/ha application but remained at par with 75 kg P₂O₅/ha. This may be attributed to better proliferation of roots and increased uptake of nutrients. The finding confirms the results of Karimi *et al.*, (2015) and Noonari *et al.*, (2016).

Application of 20 kg S/ha significantly increased the plant height, dry matter accumulation and total shoots over no application. Further increase in level of S at 40 kg/ha could not bring significant improvement in these parameters. The greater photosynthetic activity and chlorophyll synthesis due to sulphur fertilization seemed to have promoted vegetative growth. Similar

result was reported by Chaudhary *et al.*, (2003) and Hrivna *et al.*, (2015)

Zinc fertilization at 10 kg/ha significantly enhanced all these growth parameters over the control. Zinc plays a pivotal role in regulating the auxin concentration in plant and nitrogen metabolism and might have improved these growth attributes. Singh *et al.*, (1996) and Choudhary *et al.*, (1997) also recorded significantly higher shoots/m row length and dry matter production of wheat over control.

Yield attributes and yield

Phosphorus fertilization at 50 kg P₂O₅/ha significantly increased effective shoots/m row length, grains/spike, spike length, test weight and grain, straw and biological yields of wheat over 25 kg. This could be attributed to the fact that phosphorus plays a key role in root development, energy transformation and metabolic processes in plant Brady (1986) also observed beneficial effect of phosphorus on the fruiting of plants and ascribed the beneficial effect to better translocation of desired metabolites to the yield contributing parts of the plant. These results' are in confirmity with those of Mumtaz *et al.*, (2014) and Noonari *et al.*, (2016).

Successive increase in sulphur levels up to 20 kg/ha significantly improved effective shoots, grains/spike, spike length and seed, straw and biological yields. The increase beyond 20 kg S/ha was non-significant. Since available sulphur status of the experimental fields was medium (6.50 and 6.52 kg/ha S). S application improved nutritional environment of rhizosphere as well as plant system as evident from greater uptake of nutrients (Table 2) and ultimately metabolic and photosynthetic activity, resulting in better development of yield attributes and yield. Similar result were reported by Dwivedi *et al.*, (2014) and Inamullah (2014).

Table.1 Effect of phosphorus, sulphur and zinc on growth parameter, yield attributes and yield of wheat

Treatment	Plant height	Dry matter accumulation (g per running meter)	Number of effective shoots (m ⁻¹ row length)	Spike length (cm)	Number of spikelets spike ⁻¹	Number of grains spike ⁻¹	1000-grain weight(g)	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)
Phosphorus levels (P₂O₅kg ha⁻¹)										
P ₂₅	77.22	152.83	57.04	7.73	19.85	36.43	31.78	30.56	42.05	72.60
P ₅₀	83.76	165.73	71.48	8.93	23.05	42.16	33.30	35.71	47.73	83.43
P ₇₅	87.15	172.47	74.56	9.17	23.74	43.53	33.93	36.73	49.48	86.21
SEm±	1.42	3.83	1.38	0.17	0.48	0.82	0.63	0.65	1.01	1.67
CD at 5%	5.59	14.35	5.42	0.68	1.87	3.22	NS	1.90	3.97	6.56
Sulphur level (kg ha⁻¹)										
S ₀	78.37	152.92	59.67	7.89	20.43	37.48	32.24	31.59	42.95	74.54
S ₂₀	83.965	166.89	70.97	8.79	22.68	41.95	33.10	35.08	47.52	82.59
S ₄₀	85.8	171.22	72.43	9.08	23.52	42.83	33.66	36.33	48.80	85.12
SEm±	1.28	2.32	1.00	0.16	0.31	0.78	0.60	0.65	0.67	1.57
CD at 5%	3.7	6.71	2.89	0.46	0.90	2.24	NS	31.59	1.94	4.53
Zinc levels (kg ha⁻¹)										
Zn ₀	80.28	160.86	65.83	8.36	21.81	39.67	32.56	33.41	45.55	78.96
Zn ₁₀	85.14	166.49	69.56	8.82	22.62	41.84	33.45	35.25	47.28	82.53
SEm±	1.04	1.89	0.82	0.13	0.25	0.63	0.49	0.53	0.54	1.28
CD at 5%	3.02	3.47	2.36	0.38	0.73	1.83	NS	1.56	1.58	3.71

Zinc fertilization @ 10 kg/ha significantly enhanced all the yield attributes and grain, straw and biological yields over the control. The increase in yield and yield attributes due to Zn fertilization might be the fact that Zn plays an important role in bio-synthesis of IAA and initiation of primordia for reproductive parts were reported by Mishra *et al.*, (2001).

On the basis of the results it could be concluded that a combination of 50 kg P₂O₅ 20 kg S and 10 kg Zn ha⁻¹ proved to be most effective for improving the growth, yield attributes and yield of wheat.

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