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Response of N and Zn on Physico-Chemical Properties of Soil and Yield of Wheat under Alluvial Soil Condition

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Abstract

The present investigation with nine treatments having three levels of nitrogen and zinc each as urea and zinc sulfate was carried out under alluvial soil condition of Allahabad during 2006-07 on wheat (HD-2285) to study the responce of different levels of bulk nutrients on physico-chemical properties of soil and production of the crop. Maximum available nitrogen and zinc were found under combination of N_2Zn_2 where 140 kg of nitrogen and 30 kg of zinc per hectare were supplied to the plot. Other physico-chemical properties also show its significant role by application of different combination of nitrogen and zinc except control. The data on growth character particularly plant height, dry matter and number of tillers also reveal that there were significant differences between various treatment combination whereas 140 kg N and 30 kg zinc per hectare show maximum (97.15 cm, 10.80 g/plant and 16.54 tillers/plant) after 120 days of planting. Similar was the case with the other characters also. Maximum grain and straw yield (45.03 and 58.54 q/ha) were observed with higher level of nutrient combination (140 kg N and 48 kg Zn/ha) to the soil as also the length of panicle, number of grain and test weight.

Key words : Nitrogen, Zinc sulfate, Soil properties, Wheat yield.

Wheat forms the most cultivated field crop, constitute highest consumed staple food of world population (62—65%) (1). In terms of production, wheat (*Triticum* spp.) occupies the prime position among the food crops in the world. In India, it is the second most important food crop being next to rice and contributes to the total food grain production of the country to the extent of about 32% (2). Nitrogen is a primary nutrient absorbed by wheat crop from soil in large proportions i.e. at 80—120 kg/ha is the limiting factor affecting crop production. However, low nitrogen content of Indian soils further accelerates the problem delaying crop establishment ; hence, there is a need for judicious additional application of nitrogenous fertilizers for replenishing the crop requirement. The zinc is an essential component required in the biosynthesis of plant hormone such as, iodole acetic acid (IAA) is a component of a variety of enzymes i.e., carbonic anhydrases, alcohol dehydrogenase. The necrotic areas intensity resulting in the collapse of the affected leaves near the middle earing and maturity is delayed (3). The zinc deficiency in wheat can be corrected by adding zinc sulfate (23—35%).

Methods

The experiment was undertaken in 2006-07 during *rabi* season at Allahabad Agricultural Institute —Deemed University, Soil Science Research Farm. The soil of the experimental plot was sandy loam,

Table 1. Physico-chemical properties of soil before sowing.

Soil properties	Percent analyzed value	Method followed
Sand	60.0	Bouyoucous hydro-meter
Silt	26.0	
Clay	14.0	
Texture of soil	Sandy loam	
Soil pH	7.5	Digital pH meter
EC (dS/m)	0.85	Electrical conductivity meter
Organic carbon (%)	0.45	Walkley and Black (4)
Available N kg/ha	270	Kjeldhal method
Available P_2O_5 kg/ha	24	Olsen et al. (5)
Available K_2O kg/ha	170	Toth and Prince (6)
Available Zn kg/ha	0.50	Shaw and Dean method (7)

Table 2. Effect of different levels of N and Zn on growth characters of wheat crops.

Treatments	Plant height (cm)				Dry weight (g/plant)				No. of tillers/plant			
	30	60	90	120	30	60	90	120	30	60	90	120
N_0Zn_0	14.50	45.52	85.54	87.65	0.29	1.25	2.85	7.50	0.52	5.60	8.50	8.60
N_0Zn_1	14.75	51.35	89.20	92.30	0.31	1.38	2.90	8.00	0.62	9.05	8.95	13.50
N_0Zn_2	14.80	51.56	90.31	94.35	0.32	1.42	3.20	8.20	0.65	9.26	9.54	13.60
N_1Zn_0	14.95	52.72	91.82	95.20	0.35	1.60	5.30	8.50	0.67	9.36	11.30	13.75
N_1Zn_1	15.02	53.30	92.32	95.68	0.41	2.75	5.67	8.90	0.73	9.48	11.85	14.05
N_1Zn_2	15.70	53.85	92.82	96.75	0.42	2.92	5.97	9.70	0.74	9.45	12.60	15.10
N_2Zn_0	15.81	54.25	92.95	96.76	0.43	1.95	5.80	9.30	0.76	9.48	11.96	14.50
N_2Zn_1	15.85	55.25	93.54	96.95	0.48	2.94	6.20	10.50	0.80	9.80	12.10	15.65
N_2Zn_2	16.50	56.04	94.50	97.15	0.53	2.97	6.35	10.80	0.90	10.50	12.25	16.54
Mean	15.32	52.65	91.44	94.75	0.39	2.13	4.92	9.04	0.71	9.11	11.01	13.92
F-test	NS	S	S	S	NS	S	S	S	NS	S	S	S
SE ±	–	0.31	0.42	0.43	–	0.18	0.06	0.09	–	0.09	0.14	0.16
CD at 5%	–	0.66	0.88	0.91	–	0.38	0.12	0.20	–	0.19	0.00	0.35

alluvial in nature (pH 7.5), low in available N and medium in P and K. The experiment consisted of nine treatments with three levels of nitrogen as urea, N_0 = 0 kg N/ha, N_1 = 120 N kg/ha, N_2= 140 N kg/ha and three levels of zinc as zinc sulfate, Z_0 = 0 kg Zn/ha, Z_1=15 kg Zn/ha, Z_2 = 30 kg Zn/ ha in three replications. Important soil characters of experimental field are in presented Table 1.

Results and Discussion

Effect on Growth of Wheat

The data on plant height (cm), dry matter (g/plant) and number of tillers (per plant) reveal that there was significant difference between various treatment combinations. The increasing trend of plant height was maintained after 30 to 60 DAS onwards in each of the treatments upto 90 DAS. Then this increasing trend became slow. Whereas, dry matter contents in each treatment after 90 to 120 DAS were maximum compared to initial growth stage. Further, the number of tiller emergence was maximum at initial growth phase. While, it was minimum during later development phase i.e., 90 to 120 days interval.

At 30 days, the plant height, dry matter and number of tillers were maximum under treatment combination (N_2Zn_2) and these values were 16.50 cm, 0.53 g/plant and 0.90 tillers/plant respectively. The effect of nitrogen with combination of zinc sulfate was found to be statistically significant except of 30 DAS i.e., all the treatment combinations are significantly different from each other (Table 2). Similar results were also reported earlier (8—10) respectively.

At 60, 90 and 120 DAS the plants having maximum height (56.04, 94.50 and 97.15 cm), dry matter (2.97, 6.35 and 10.80 g/plant) and number of tillers/plant (10.50, 12.25 and 16.54) were observed in N_2Zn_2 treatment.

Effect on Yield Attributes and Yield of Wheat

The length of panicle (13.50 cm) was obtained in both the treatments N_2Zn_2 and N_1Zn_2 which were statistically at par (13.35) with N_2Zn_1. Similar findings were also reported (11). The no. of grains per panicle

Table 3. Effect of different levels of nitrogen and zinc sulfate on yield of wheat.

Treatments	Length of panicle (cm)	No. of grains/ panicle	Grain yield (q/ha)	Straw yield (q/ha)	Test weight (g)
N_0Zn_0	10.54	35.80	33.05	49.32	30.06
N_0Zn_1	12.25	40.50	39.56	50.12	31.95
N_0Zn_2	12.75	40.90	39.35	52.15	32.05
N_1Zn_0	12.85	41.57	41.85	54.75	34.65
N_1Zn_1	13.35	42.25	46.25	58.26	37.45
N_1Zn_2	13.50	42.54	47.27	60.67	38.90
N_2Zn_0	12.95	42.26	50.56	57.43	36.05
N_2Zn_1	12.96	43.57	52.90	68.20	39.85
N_2Zn_2	13.50	44.60	54.45	76.00	40.50
Mean	12.73	41.55	45.03	58.54	35.71
F-test	S	S	S	S	S
SE ±	0.08	0.28	0.44	0.73	0.31
CD at 5%	0.18	0.59	0.93	1.55	0.66

Table 4. Effect of different levels of nitrogen and zinc sulfate on soil status.

Treatment	pH (1 : 2)	OC (%)	EC (dS/m)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)	Zn (kg/ha)
N_0Zn_0	6.8	0.42	0.81	254.95	24.50	138.35	0.48
N_0Zn_1	6.9	0.45	0.82	260.75	25.57	142.05	0.51
N_0Zn_2	7.0	0.50	0.83	259.60	28.05	152.52	0.56
N_1Zn_0	7.1	0.45	0.81	269.51	30.73	157.78	0.51
N_1Zn_1	7.2	0.48	0.83	268.50	31.05	162.98	0.52
N_1Zn_2	7.3	0.49	0.84	265.30	31.85	169.43	0.61
N_2Zn_0	7.2	0.45	0.82	272.57	31.90	170.09	0.50
N_2Zn_1	7.3	0.48	0.83	276.27	32.35	171.05	0.53
N_2Zn_2	7.4	0.51	0.84	280.90	33.96	175.36	0.75

was found to be maximum (44.60) with combination N_2Zn_2 followed by N_2Zn_1 (43.57) while other combination N_1Zn_1, N_1Zn_2 and N_2Zn_0 were statistically at par (Table 3). Similarly, grain and straw yield q/ha were maximum in treatment N_2Zn_2 ((54.45, 76.00) followed by treatment N_2Zn_1 (52.90, 68.20). About 33.90% increases in straw yield was recorded in N_2Zn_2 combination (76.00 q/ha) over control (49.32 q/ha). Similar findings were also observed (12, 13). Both the treatments N_2Zn_2, N_2Zn_0 were found to be statistically at par (40.50 and 39.85). Similar results were also reported earlier (14).

Effect on Soil Properties

The maximum available nitrogen (280.90 kg/ha) was found under treatment N_2Zn_2 followed by N_2Zn_1 (276.27 kg/ha) (Table 4). Similarly, available zinc was also found to be maximum under N_2Zn_2 combination followed by treatment N_2Zn_1 having (0.75 and 0.61 kg Zn/ha) respectively. Other combinations also showed significant difference over control. The minimum available nitrogen and zinc was obtained in control (254.95 kg N/ha), (0.48 kg Zn/ha) respectively. The available P was obtained better in all treatment compared to before sowing analysis of soil, moreover combination N_2Zn_2 gave maximum available P 33.96 kg P_2O_5/ha. The statistical analysis showed significant difference in all treatment combinations. The K status was obtained maximum in N_2Zn_2 followed by N_2Zn_2 and N_2Zn_0 (175.36, 171.05 and 170.09 kg K_2O/ha) respectively. The EC (dS/m) of soil ranged from 0.83 to 0.85 dS/m which indicates the soluble salt concentration in the soil was far below the toxic limits and also did not exhibit any specific trend in its distribution. Organic carbon (OC %) of the experimental soil varied from 0.42 to 0.50% the surface soil showed hig-her content of organic carbon and decreased uniformly with increasing soil depth. The pH of the soil ranged from 6.8 to 7.4, which reveals that the soil is neutral in reaction, so all the nutrients are easily available to plants.

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