Indian J. Agron. **40** (4) : 695–697 (December 1995)

Effect of zinc and nitrogen fertilization on summer rice (*Oryza sativa*)

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Received: October 1993

Zinc deficiency appears to be the most important nutritional factor limiting growth and yield of wetland rice (*Oryza sativa* L.) next to nitrogen and phosphorus. It is a major component and activator of several enzymes and involved in metabolic activities, viz. auxin metabolism, protein synthesis, nucleic acid and carbohydrate metabolism, and utilization of nitrogen and phosphorus. Krishnamurthy (1979) reported synergistic effect between applied nitrogen and zinc in rice.

Hence an investigation was carried out to study the effect of zinc and nitrogen fertilization on grain and straw yields of summer rice.

A field experiment was conducted at the Central Research Station, OUAT, Bhubaneshwar, during summer season of 1991 and 1992. The treatments consisting of 2 sources of zinc (S_1, $ZnSO_4$ and S_2, Zn-EDTA), 2 methods of application (M_1, soil and M_2, foliar application) supplemented with 4 levels of nitrogen (0, 30, 60 and 90 kg/ha). The treatments were tried in randomized block design with 3 replications. Zinc sulphate (22% Zn) @ 25 kg/ha and Zn-EDTA (12% Zn) @ 500 g/ha along with 10 kg carrier were applied basal. Foliar sprays of $ZnSO_4$ at 0.4% and Zn-EDTA at 0.05% concentration were given at 25 and 35 days after transplanting.

The experimental soil was sandy loam in texture, slightly acidic in reaction (pH 6.5), medium in available N (322 kg/ha), available P (Olsen's P 14.5 kg/ha) and available K (156 kg/ha).

'Sarathi' (115 days) rice was transplanted on 25 and 15 February during 1991 and 1992 respectively at 15 cm x 10 cm spacing.

The maximum mean grain and straw yields of 45.8 and 62.1 q/ha respectively were obtained at the highest level of nitrogen. The increase over 0, 30 and 60 kg N/ha was 49.8, 20.7 and 7.3% for grain and 56.1, 25.2 and 10.1% for straw yield respectively.

Application of zinc increased the grain and straw yields significantly over no zinc application, which might be owing to better utilization of N and P for grain production through greater metabolic activities. Combined application of N and Zn increased the grain and straw yields by 7.2 and 12.9% respectively over alone application of N. The increase in both grain and straw yields was owing to their synergistic effect. Similar results were obtained by Vyas *et al.* (1990) in irrigated rice.

The sources and methods of application of Zn influenced the yield significantly in both the seasons. Among the sources, $ZnSO_4$ increased the grain and straw yields by 2.5 and 4.2% respectively over Zn-EDTA, which was due to optimal supply of Zn from $ZnSO_4$ as well as beneficial effect of sulphur present in it.

Table 1. Effect of zinc and nitrogen fertilization on yield and yield attributes of rice

Treatment	Panicles/ m^2		Fertile grains/ panicle		Test weight (g)		Grain yield (q/ha)		Straw yield (q/ha)	
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
N (kg/ha)										
0	313	314	84.0	84.6	19.71	19.74	33.0	32.7	39.9	39.4
30	346	348	98.5	96.7	20.43	20.44	39.5	38.8	49.7	48.8
60	379	373	105.6	105.8	20.82	20.79	42.5	42.7	55.0	54.5
90	402	400	111.4	111.7	21.37	21.36	46.0	45.6	62.1	62.1
CD (P = 0.05)	3	4	0.7	1.7	0.45	0.46	0.4	0.9	0.5	1.2
Zn source										
$ZnSO_4$	367	363	102.1	101.9	20.67	20.66	40.7	40.5	52.9	52.1
Zn-EDTA	354	358	97.6	97.5	20.50	20.51	39.8	39.4	50.4	50.3
CD (P = 0.05)	2	2	0.5	1.2	NS	NS	0.3	0.6	0.4	0.9
Method of application										
Soil	363	361	101.0	100.7	20.63	20.62	40.5	40.3	52.2	51.8
Foliar	356	356	98.7	98.8	20.54	20.55	39.9	39.6	51.1	50.6
CD (P = 0.05)	2	2	0.5	1.2	NS	NS	0.3	0.6	0.4	0.9

Soil application of Zn increased the grain and straw yields by 1.5 and 2.2% respectively over foliar application, which might be due to optimal supply of Zn at all phenophages from the day of planting.

The yield attributes like panicles/m^2, fertile grains/panicle and test weight, followed more or less the similar trend as that of grain and straw yields in the present investigation.

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Indian J. Agron. **40** (4) : 697–699 (December 1995)

Response of wheat (*Triticum aestivum*) to seed rate and date of sowing

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Received: August 1993

In recent years a number of high-yielding varieties of both *aestivum* and *durum* wheats have been released for cultivation. Therefore the present investigation was taken to study the effect of date of sowing and seed rate on dry-matter production and grain yield of wheat (*Triticum aestivum* L. emend. Fiori & Paol.).

The experiment was conducted in split-plot design with 3 replications during the winter (*rabi*) season of 1990–91 and 1991–92. Combinations of dates of sowing (14 and 14 December in 1990–91 and 26 November and 26 December in 1991–92) and 2 seed rates (100 and 125 kg/ha) in main plot and varieties ('WH 283', 'WH 416', 'WH 533', 'WH 147', 'HD 2329', 'Raj 3077' and 'PBW 34') were taken as subplot. Dry-matter production per m row length was recorded at 90 days after sowing (anthesis stage) in each treatment and then it was partitioned into different parts of leaves and stem. Leaf area was also observed at this stage. During the growing season of wheat 32.8 and 45.7 mm rainfall was received in 1990–91 and 1991–92 respectively. Out of which, rainfall of 20 and 22.9 mm was recorded in second week of February. The range of maximum and minimum temperature was 15.8–33.8°C and 18.3–36.7°C in 1990–91 and 2–19.5°C and 3.8–20.1°C during 1991–92.

The crop sown in November showed 8 and 24% more grain yield than that sown in December during first and second years respectively 15% in the pooled data. The in-