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Influence of Salinity and Nitrogen on Growth and Yield of Rice in Coastal Saline Soils of Machilipatnam

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ABSTRACT

A field experiment was conducted to study the effect of salinity and nitrogen on rice at Agricultural Research Station, Machilipatnam during wet season of 2003 and 2004. The results indicated that higher salinity (6.5dsm^{-1}) reduced Leaf area index, number of productive tillers, number of grains/panicle and grain yield compared to lower salinity level (4 dsm $^{-1}$). 1000 grain weight was not affected by salinity. Application of nitrogen @ 150 kg ha $^{-1}$ increased number of productive tillers, number of grains/panicle and grain yield both under high and low saline conditions. Highest average grain yield of 4.18 t ha^{-1} was recorded at 4 dsm $^{-1}$ with application of 150 kg ha $^{-1}$ which was significantly superior to all other treatments.

Key words : Influence of Nitrogen, Rice, Salinity.

Presence of excess salt is one of the most wide spread soil toxicity problems in many rice growing areas. In India, it accounts for 8.5 million hectares of land and the yield reduction is estimated to the tune of 30-50% (Babu *et al.* 2005). Nitrogen is the major nutrient, which determines the growth and development of the crop. Response to increasing levels of Nitrogen was quadratic and significant (Sharma and Mitra, 1990) .The present study was taken up to know the relation between Salinity and response to Nitrogen under the coastal saline soils of Machilipatnam.

Material and Methods

The field experiment was conducted in the E block of Agricultural Research Station, Machilipatnam, during wet season of 2003 and 2004. The soil was sandy loam with a pH of 7.9 and E.C ranging 4 to 8 ds m^{-1} and was low in organic carbon (0.31 and 0.39%), available N (162.0 and 170 kg ha^{-1}), P_2O_5 (16.5 and 19.6 kg ha^{-1}) and K_2O (78.0 and 82.0 kg ha^{-1}). The rice genotype MTU -2077 was sown in July and transplanted in August with N levels of 0,75,125 and 150 kg ha^{-1} and the experiment was laid out in randomized block design (with factorial concept) with three replications. The trial has been transplanted under the natural coastal saline soils at E.C. 4.0 and 6.5 ds m^{-1}.

Nitrogen in three splits at basal, tillering, panicle initiation stage and half of K_2O at basal and remaining at panicle initiation and full dose of P_2O_5 as basal were applied. All other recommended package of practices were followed. Biometrical observations on Leaf area index (LAI), yield components and grain yield were recorded after harvest of the crop.

Results and Discussion

Analysis of variance for various traits *viz*., grain yield, 1000 grain weight, productive tillers per hill, grains per panicle and Leaf area index is presented in Table 1.

The average grain yield recorded at 4 ds m $^{-1}$ was 2.99 t ha^{-1}. It was significantly superior to the 1.96 t ha^{-1} recorded at 6.5ds m^{-1}. There was a significant improvement in average grain yield of rice with increase in N dose from 0-150 kg ha^{-1}. Among the 'N' levels highest average yield (3.62 t ha^{-1}) was obtained with application of 150 kg N ha$^{-1.}$ It was significantly superior to rest of the N levels. As the treatment combinations are concerned, highest average yield (4.18 t ha^{-1}) was obtained at 4 ds m^{-1} with application of 150 kg N ha^{-1}. It was significantly superior to the other treatment combinations. There was a decrease in grain yield of rice with 6.5 ds m^{-1} EC compared to 4 dsm^{-1} at each level of nitrogen tested. Higher salinity levels resulted in reduced plant growth, fewer productive tillers, lower grain wt/ panicle and increased spikelet sterility, which finally results in reduced yields (Rammohan *et al.* 2000). Vorobyov and Zhurba (1995) reported 4.2 times increase in grain yield of rice under saline conditions due to higher fertilization compared to standard conditions.

EC levels did not show any significant difference on 1000 grain weight . However, N levels significantly influenced the test weight. With

Table 1. Influence of Salinity and Nitrogen on yield components, grain yield and Leaf area index in rice.

Grain yield (t ha^{-1})

		EC	
N.levels	4.0 ds m^{-1}	6.5 ds m^{-1}	Mean
F_1 (0)	1.39	0.98	1.18
F_2 (75)	2.93	1.71	2.32
F_3 (125)	3.47	2.12	2.80
F_4 (150)	4.18	3.06	3.62
Mean	2.99	1.96	
	N levels	EC	N X EC
CD (P=0.05)	0.23	0.16	0.326

1000 grain weight(g)

		EC	
N.levels	4.0 ds m^{-1}	6.5 ds m^{-1}	Mean
F_1 (0)	17.67	17.38	17.53
F_2 (75)	18.76	18.30	18.53
F_3 (125)	21.30	21.27	21.28
F_4 (150)	22.48	22.60	22.54
Mean	20.05	19.89	
	N levels	EC	N X EC
CD (P=0.05)	0.587	NS	NS

Productive Tillers / Hill

		EC	
N.levels	4.0 ds m^{-1}	6.5 ds m^{-1}	Mean
F_1 (0)	5.16	3.26	4.21
F_2 (75)	6.51	4.58	5.55
F_3 (125)	8.53	6.28	7.40
F_4 (150)	11.95	8.03	9.99
Mean	8.04	5.54	
	N levels	EC	N X EC
CD (P=0.05)	0.846	0.59	NS

No. of Grain/Panicle

		EC	
N.levels	4.0 ds m^{-1}	6.5 ds m^{-1}	Mean
F_1 (0)	37.00	36.00	36.50
F_2 (75)	89.33	61.16	75.25
F_3 (125)	133.83	83.50	108.66
F_4 (150)	171.83	104.16	138.00
Mean	108.00	71.20	
	N levels	EC	N X EC
CD (P=0.05)	10.94	7.73	15.47

Leaf Area Index

		EC	
N.levels	4.0 ds m^{-1}	6.5 ds m^{-1}	Mean
F_1 (0)	3.58	2.51	3.05
F_2 (75)	4.69	3.46	4.07
F_3 (125)	5.66	4.47	5.06
F_4 (150)	6.75	5.30	6.03
Mean	5.17	3.93	
	N levels	EC	N X EC
CD (P=0.05)	0.426	0.301	NS

increase in N levels from 0 to 150 kg ha^{-1}, there was a significant improvement in 1000 grain weight.

The average number of tillers / hill decreased significantly with increase in salinity from 4 to 6.5 dsm^{-1}. Smetanin and Dolagikh (1996) reported reduction in productive shoots with increase in salinity level. Application of 150 kg N ha^{-1} produced significantly the highest number of tillers /hill compared to rest of nitrogen levels. Nitrogen is the chief nutrient for vegetative growth and production of more tillers. By reducing it, there was decrease in number of tillers.

There was significant improvement in number of grains per panicle^{-} at lower EC level (4 dsm^{-1}) compared to higher EC level (6.5 dsm^{-1}). The average numbers of grain per panicle^{-} were lowel (36.50) with no nitrogen application and increased significantly to 75.25 with application of 75 kg N ha^{-1}. The average number of grains per panicle also increased from 108.66 to 138.00 by increasing N level from 125 to 150 kg ha^{-1}. Thus, there was significant improvement in average number of grains per panicle with increase in N level (Murthy *et al.*, 1992). At 4 dsm^{-1} EC, application of 150 kg N ha^{-1} recorded significantly higher number of grains per panicle (171.83) compared to all other treatments.Number of grains panicle^{-} were significantly higher at lower EC (4 dsm^{-1}) level compared to higher EC (6.5 dsm^{-1}) level, at each level of nitrogen, except with no nitrogen.

There was significant reduction in average LAI value with increase in EC. It was 5.17 at 4 dsm^{-1} where as at 6.5 dsm^{-1} it was reduced to 3.93. With increase in N application from 75 to 150 kg ha $^{-1}$, there was a significant improvement in LAI from 4.07 to 6.03. Soil chloride salinisation resulted in decreased in rice plant photosynthetic activity, decreased foliar surface and net plant productivity and also above ground matter (Vorabyov and Zhurba, 1995)

These results clearly indicated that higher salinity (6.5dsm^{-1}) reduced Leaf area index, number of productive tillers and number of grain/panicle and grain yield compared to lower salinity level (4 dsm $^{-1}$). However, 1000 grain weight was not affected by salinity. Application of nitrogen @ 150 kg ha $^{-1}$ increased number of productive tillers, number of grain/panicle and grain yield both under high and low saline conditions.

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