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Effect of Salinity of Standing Water on Kharif Rice Yield Under Godavari Western Delta

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ABSTRACT

Influence of standing water salinity and depth on *kharif* rice yields were assessed in a typical salt affected and water logged areas of Godavari Western Delta, India. Standing water salinity (EC, dS m^{-1}) were monitored at weekly intervals in 48 locations at 100 x 100 m grid from 90 acres area. Mean surface water salinity were correlated with respective crop yields for 2007 and 2008 years. Standing water salinity and crop yields were highly negatively correlated for *kharif* rice yield (-0.50**for *Kharif*,07 and -0.60** for *Kharif*,08). Regression equations were developed for prediction of reduction in rice yield based on surface water salinity. Critical levels for 10%, 25% and 50% crop yield reduction for both standing water salinity were established for *kharif* rice yield.

Key words : Kharif rice yield, Standing water salinity.

In many canal commands, there has been a rise in the water table and consequent degradation of soils through water logging and secondary salt build-up and the impact of irrigation over many years has caused the ground water table to rise into root zones in these command areas, which led to reduction in crop yields. This problem is found to be aggressive along the coastal line of Andhra Pradesh. The soils of Godavari Western delta nearer to sea are experiencing a problem of salinity and water logging due to seawater intrusion and improper drainage facilities. The relation between crop production and soil salinity is often derived from controlled experiments in laboratories, pot experiments, lysimeter studies or experimental fields (Kessler and Oosterbaan, 1980),where all growth factors, except the factor under study, are maintained constant, often at optimum level. Under farmers' and field conditions, relations are subjected to a large degree of variation and they need not be the same.

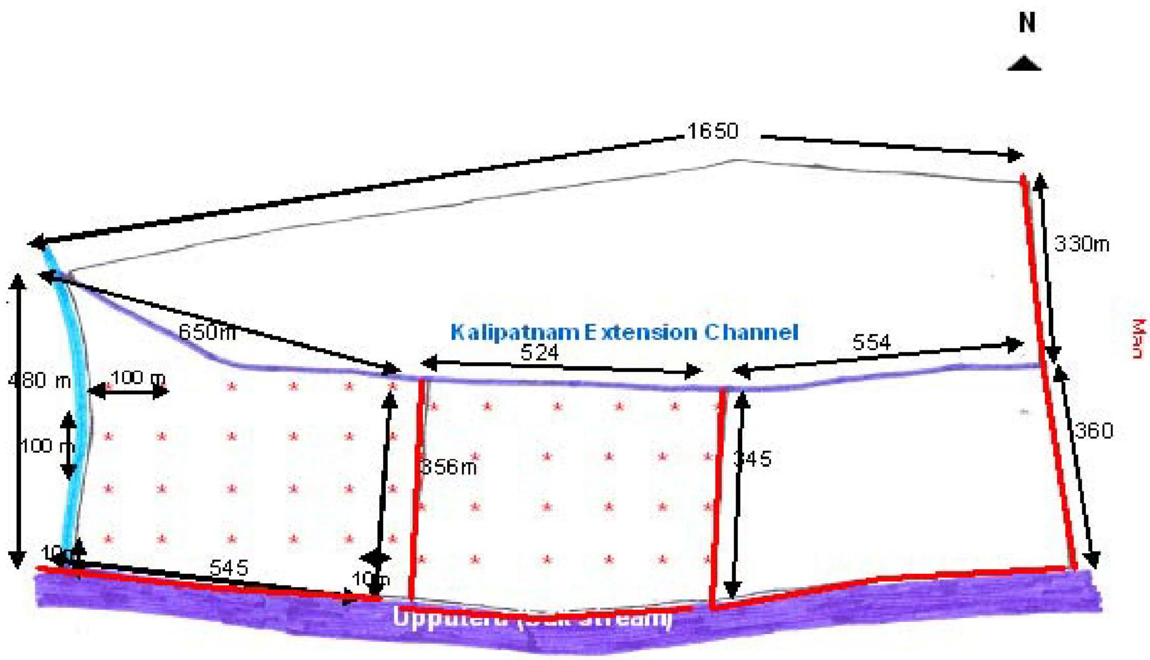
Rice is rated as an especially salt-sensitive crop (Shanon et al., 1998). The response of rice to salinity varies with growth stage. In the most commonly cultivated rice cultivars, young seedlings were very sensitive to salinity (Lutts *et al*., 1995). Yield components related final grain yield were severely affected by salinity. Panicle length, spikelet number per panicle, and grain yield were significantly reduced after salt treatments (Khatun *et al*., 1995). Salinity also delayed the emergence of panicle and flowering and decresed seed set through reduced pollen viability (Khatun *et al*., 1995). In contrast, rice was more salt tolerant at germination than at other stages (Khan *et al*., 1997).

Although there are extensive studies of standing water salinity and depth effects on rice, our understanding of the quantitative effects of salinity on rice yields and critical thresholds of responses with respect to modern, commonly used cultivars of India, is still limited. The objective of this study was to determine the effect of standing water salinity on *kharif* rice yields.

MATERIAL AND METHODS

Kalipatnam drainage pilot area (16^{o}23'N, 81^{o}32'E) is located in Godavari Western Delta near East coast of Peninsular India. These soils are waterlogged and saline sodic. Soils are alluvial and adjacent to salt stream (Upputeru) which is confluence sea at 9 km distance. Tidal fluctuations in the salt stream greatly influence on the ground water quality. The water table fluctuated between the soil surface in the monsoon season and 0.9 m below the ground level during *summer* season. The mean annual, *summer* and winter temperatures are 26.9^{0}C, 30.1^{0}C and 23.8^{0}C respectively and the mean annual rainfall is 853 mm. The soils of the pilot area are saline sodic with ECe of 4.03 to 16.00 dSm^{-1} during *summer* 05. The main crop at the pilot area is paddy followed by paddy with a fallow period of three months. The pilot area receives irrigation water from Kalipatnam main channel of Godavari Western Delta with an average EC of 0.3 dSm^{-1}. Flooding method of irrigation is adopted and water is allowed to flow from field to field. The excess water from the fields is drained to Upputeru through a separate drain called Magaleru drain.

Fig 1. Grid points for monitoring crop yield and standing water EC(dSm^{-1})



Crop yields were monitored at 100 m x 100 m grid (48 grid locations) from 36 ha study area (Fig. 1). For *kharif*, 07 and *kharif*, 08 seasons MTU-7029 (Swarna) was used as test variety. The crop yield was determined in sample plots of 2m x 2m. Standing water samples were collected and analysed for EC, dSm^{-1} (Richards, 1968) from the same 48 grid points at 100 m X 100 m spacing that was used for crop cut data. Linear regression equations were developed from the mean of 2007 and 2008 years, between crop yield and standing water salinity and regression coefficients were tested for significance.

RESULTS AND DISCUSSION

The results of the effect of standing water salinity on paddy yield of *kharif* ,07 and *kharif*, 08 were presented in table 1. For *kharif,* 07 mean standing water salinity ranged from 0.55 dSm^{-1} to 2.50 dSm^{-1} with an average of 1.09 dSm^{-1}. Correspondingly, *kharif*, 07 yield ranged from 3.15 t ha^{-1} to 6.41 t ha^{-1} with an average of 4.77 t ha^{-1}. For *kharif*, 08 mean standing water salinity ranged from 0.46 dSm^{-1} to 1.39 dSm^{-1} with an average of 0.94 dSm^{-1}. Correspondingly, *kharif* , 08 yield ranged from 4.56 t ha^{-1} to 5.77 t ha^{-1} with an average of 5.29 t ha^{-1}. The relation between *kharif* rice yield and standing water salinity (Figure 2) was highly correlated (R2= 0.57**) and presented below:

$$Y = -1.15x + 6.2 \quad \text{———} \quad (1)$$

Similar kind of salinity effects on reduction in yield of rice was also studied by Zeng and Shannon (2000).

Bernstein (1974) determined the salinity levels causing yield reduction of 10%, 25% and 50% in field experiments with some principal crops. Similarly, from the above developed regression equations critical levels for 10%, 25% and 50% yield reduction were computed (Table 2) for both standing water salinity and depth were established for *kharif* rice yield.

In *kharif* rice crop of Godavari Western delta salt affected and water logged soils, strong negative (P=0.01) relation was observed between rice yield and standing water salinity. Linear regression equations developed for predicting rice yield based on standing water salinity.

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Table 1. Grid Wise kharif (2007 & 2008) crop yield (t/ha) and average surface water Salinity (dSm^{-1})

Grid No	Standing water salinity ($dS\ m^{-1}$)	Yield ($t\ ha^{-1}$)	Standing water salinity ($dS\ m^{-1}$)	Yield ($t\ ha^{-1}$)
	Kharif, 2007		Kharif, 2008	
1	1.03	4.67	0.87	5.51
2	1.20	4.62	0.96	5.62
3	1.13	4.83	0.96	5.30
4	1.38	4.46	0.90	5.46
5	0.92	5.67	0.82	5.62
6	0.85	5.78	0.83	5.62
7	0.80	5.36	0.82	5.67
8	0.67	5.78	0.61	5.41
9	0.88	6.30	0.88	5.67
10	0.90	4.62	1.00	5.67
11	0.89	4.83	1.07	5.46
12	0.90	4.20	1.02	5.62
13	0.83	6.41	0.79	5.72
14	0.75	6.20	0.74	5.72
15	0.67	5.15	0.65	5.41
16	0.55	6.14	0.56	5.72
17	0.55	4.62	0.61	5.77
18	0.78	6.30	0.58	5.70
19	0.95	6.30	0.85	5.72
20	0.94	4.73	0.80	5.41
21	0.85	5.04	0.84	5.41
22	0.78	5.67	0.70	5.41
23	0.72	4.20	0.58	5.41
24	0.82	4.52	0.46	5.62
25	0.85	4.31	0.52	5.00
26	0.85	6.30	0.65	5.14
27	1.16	3.68	0.95	5.14
28	1.27	3.68	1.17	5.24
29	0.80	6.30	0.99	5.00
30	0.78	5.15	0.94	5.14
31	0.84	6.30	1.00	4.56
32	0.81	5.15	0.90	5.24
33	0.81	3.94	0.86	5.24
34	0.79	4.62	1.02	4.85
35	0.82	3.68	1.10	5.14
36	0.87	3.68	1.15	5.24
37	1.10	3.94	1.37	5.19
38	1.46	3.94	1.32	4.70
39	0.95	3.68	1.14	5.24
40	1.02	3.62	1.00	4.85
41	1.80	4.25	1.36	5.14
42	1.94	4.36	1.25	5.04
43	1.51	4.20	1.16	4.70
44	1.62	3.99	1.30	5.04
45	2.28	3.41	1.23	5.04
46	2.35	3.15	1.19	5.14
47	2.47	3.68	1.39	4.66
48	2.50	3.41	1.28	4.75

Figure 2. Relationship between *kharif* (2007 & 2008) rice Yield (t ha^{-1}) and surface water salinity (dS m^{-1})

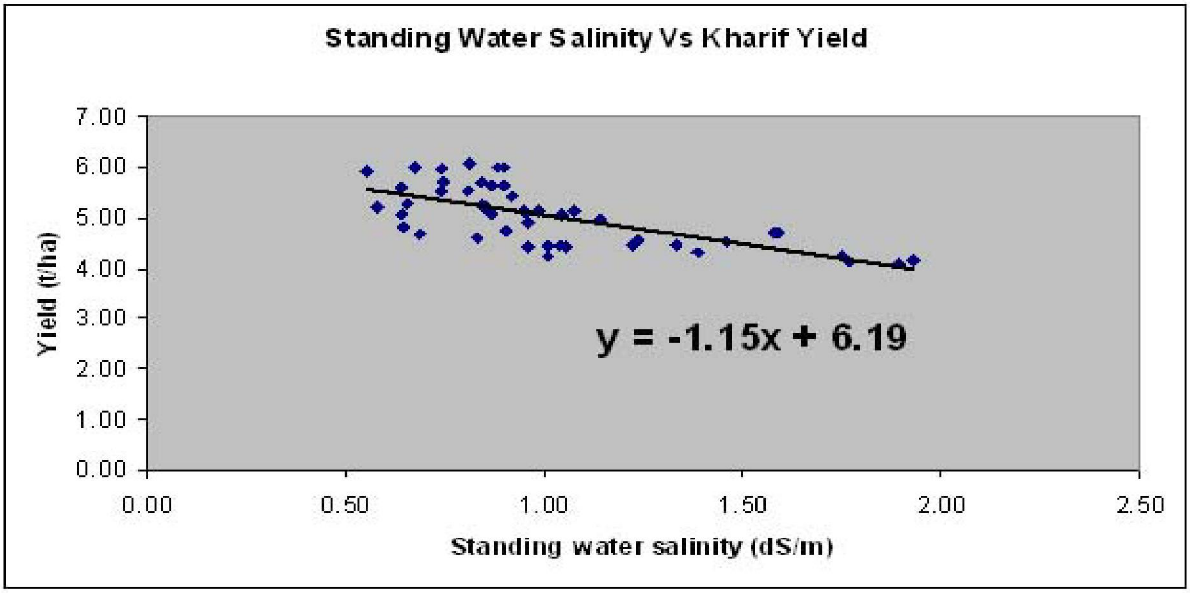

Table 2. Regression equations and critical levels for yield reduction in *kharif* rice (2007 & 2008)

S.No.	Parameter	Equation	Threshold level		
			10% Yield loss	25% Yield loss	50% Yield loss
1.	Standing water salinity (dSm^{-1})	Y = -1.15x + 6.2	0.5	1.3	2.7

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