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Effect of Various Irrigation Depths on Rice Under Saline-Sodic Conditions

Tahir Maqsood and Karamat Ali
Directorate of Land Reclamation, Punjab, Pakistan

Abstract: Relative efficiency of soil reclamation technique (vertical leaching) was tested in the field by applying different irrigation depths with and without the application of gypsum in as saline sodic soil. Rice *cv.* Basmati-385 was used as a test crop. Application of 5.0cm depth irrigation proved to be the best treatment with regard to soil reclamation and paddy yield, followed by the salt movement with gypsum application. The application of gypsum with 5.0cm depth irrigation also improved the soil characteristics like pH, SAR, ESP, EC_e and increased the soil permeability (leaching) \infiltration.

Key Words: Gypsum, Saline Sodic, Rice, Reclamation, Production

Introduction

Poor structure and low infiltration rate are the typical characteristics of dense sodic and saline- sodic soils, particularly having fine texture. For the reclamation of these soils, soluble calcium is needed for replacing adsorbed sodium. Irrigated agriculture consumes major share of good quality waters, which is decreasing because of competing non-agricultural demands and droughts around the world (Gupta, 1990; Bouwer,1994). About 70% of the salt affected soils of Pakistan are economically reclaimable if sufficient irrigation water is available and drainage, where needed, is provided (Mirza and Ahmad, 1998).

The use of gypsum application helps in water penetration along with the salts into deposited layers. But effectiveness of various irrigation water depths along with gypsum in the leaching of salts out of the root-zone cannot prolong irrigation into pot. The broad objective of this paper is to evaluate the effectiveness of gypsum at different irrigation depths on the reclamation of saline-sodic soil and rice crop yield.

Materials and Methods

A field experiment was conducted on saline sodic soil (ECe = 4.1 dS m^{-1}, texture: clay loam, SAR=94, pH_s=9.0, ESP=38.5 and GR 5.16 tons $acre^{-1}$-0.15m) at chak No. 112/15-L Reclamation Research Station Mianchannu. The experiment was laid out in RCBD with three replications and and six treatments under:

T_1 5.0 cm irrigation depth +100 % soil GR
T_2 7.5 cm irrigation depth +100 % soil GR
T_3 10.0 cm irrigation depth + 100 % soil GR
T_4 5.0 cm irrigation depth
T_5 7.5 cm irrigation depth
T_6 10.0 cm irrigation depth

After layout of experiment, composite soil samples (0-15 cm) and (15-30 cm) were collected and analysed for EC_e , SAR , pH_s and soil texture. Gypsum was broadcasted on the soil surface in the respective treatments.100 % soil GR mixed with the soil surface followed by the application of irrigation water (EC=1.01 dS m^{-1}, SAR=14.5, RSC=2.0mmol L^{-1}).Rice variety Basmati-385 was transplanted keeping row and hill distance of 20 cm. Same water was used to irrigate the each plot for the measured quantity of water. A basal dose of fertilizer (N : P : K : $ZnSO_4$: 90 : 75 : 75 : 5 Kg ha^{-1}) were also applied. Half of N as urea and full doses of P as SSP and K as SOP and Zn were applied 40 days after transplanting. To control pest attack, Novacron was sprayed twice, 30 and 60 days after transplanting the rice seedlings. The crop was raised up to maturity and organic data regarding tillers, paddy and straw yields were recorded. Post harvest soil samples were drawn and analysed for EC_e , SAR, ESP, pHs and soil texture.(U.S. Salinity Laboratory Staff, 1954).The experimental data collected were analysed statistically(Steel and Torrie, 1980).

Results and Discussion

The data (Table 2) reflect superiority T_2. The highest number of tillers per hill, paddy and straw yields were recorded in T_2 followed by T_3. The results indicated that 7.5 cm irrigation depth along with gypsum were the most effective in lowering soil SAR by the end of first rice crop. Physical characteristics of soil have been improved with gypsum and removal of sodium to provide a better environment for plant growth (Yadev and Agarwal, 1959; Gupta and Bajpai, 1977).

Table 1: Soil Analysis Results (pre-sowing)

pH	9.0
SAR	94.0
ESP	38.5
E C_e	4.1 dS m^{-1}
Ca^{2+}	0.3mmol L^{-1}
Mg^{2+}	0.3 mmol L^{-1}
CO_3^{2-}	0.5 mmol L^{-1}
SO_4^{2-}	0.2 mmol L^{-1}

More over , the application of gypsum also improved nutrient balance and Ca:Na ratio in the soil by increasing the concentration of calcium , sulpher and perhaps micronutrients (Khan *et al.*, 1990) .This salt removal might have also increased the soil permeability. In India , gypsum has been and is being supplied at normal rates to farmers in time and space owing to its safe use , being cheap and because of its prolonged effects on water conducting properties of soil (Yadev, 1973).

Table 2: Effect of Various Irrigation Depths and Gypsum on Growth Parameters

Treatment	Tillers (No. hill $^{-1}$)	paddy yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})
T_1	28.14 b	2118 b	7580 b
T_2	32.12 a	2491 a	8014 a
T_3	29.33 b	2241 b	7790 b
T_4	22.25 c	1819 c	6870 c
T_5	24.33 c	1990 c	6950 c
T_6	23.80 c	1912 c	6912 c

Means with different letters in a column differ significantly according to DMRT (P=0.05)

Even the physical presence of gypsum in soils lowers crust , hard-setting and soil strength (Rahman and Rowel, 1979; Simson *et al.*, , 1979; Ayres and Westcott, 1985) to favour seed germination (Hassan , 2000) which is one of the greatest problem in salt-affected soils.

Table 3: Soil Analysis Results (post-harvest)

pH	8.6
SAR	61.5
ESP	47.6
EC_e	3.1dSm^{-1}
Ca^{2+}	0.5 mmol L^{-1}
Mg^{2+}	0.5 mmol L^{-1}
$CO3^{2-}$	0.5 mmol L^{-1}
$SO4^{2-}$	0.3 mmol L^{-1}

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