EFFECT OF DIFFERENT Ca:Mg RATIOS OF SALINE MEDIUM ON THE YIELD AND IONIC COMPOSITION OF RICE

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A laboratory study was carried out in hydroponic culture to determine the effect of different Ca:Mg ratios of saline medium on the yield and ionic composition of rice. Sodium chloride along with varying ratios of $CaCl_2$ and $MgCl_2$ was added to create salinity levels of 50 and 75 mM, respectively. Paddy and straw yield decreased with increase in salinity but decrease was comparatively less in the treatments with more Ca in the medium. Leaf Na increased while K decreased with increasing salinity. Minimum Na was recorded in the case of higher Ca application. Concentration of K was improved with Ca. Positive effect of calcium in the system caused better growth of rice.

INTRODUCTION

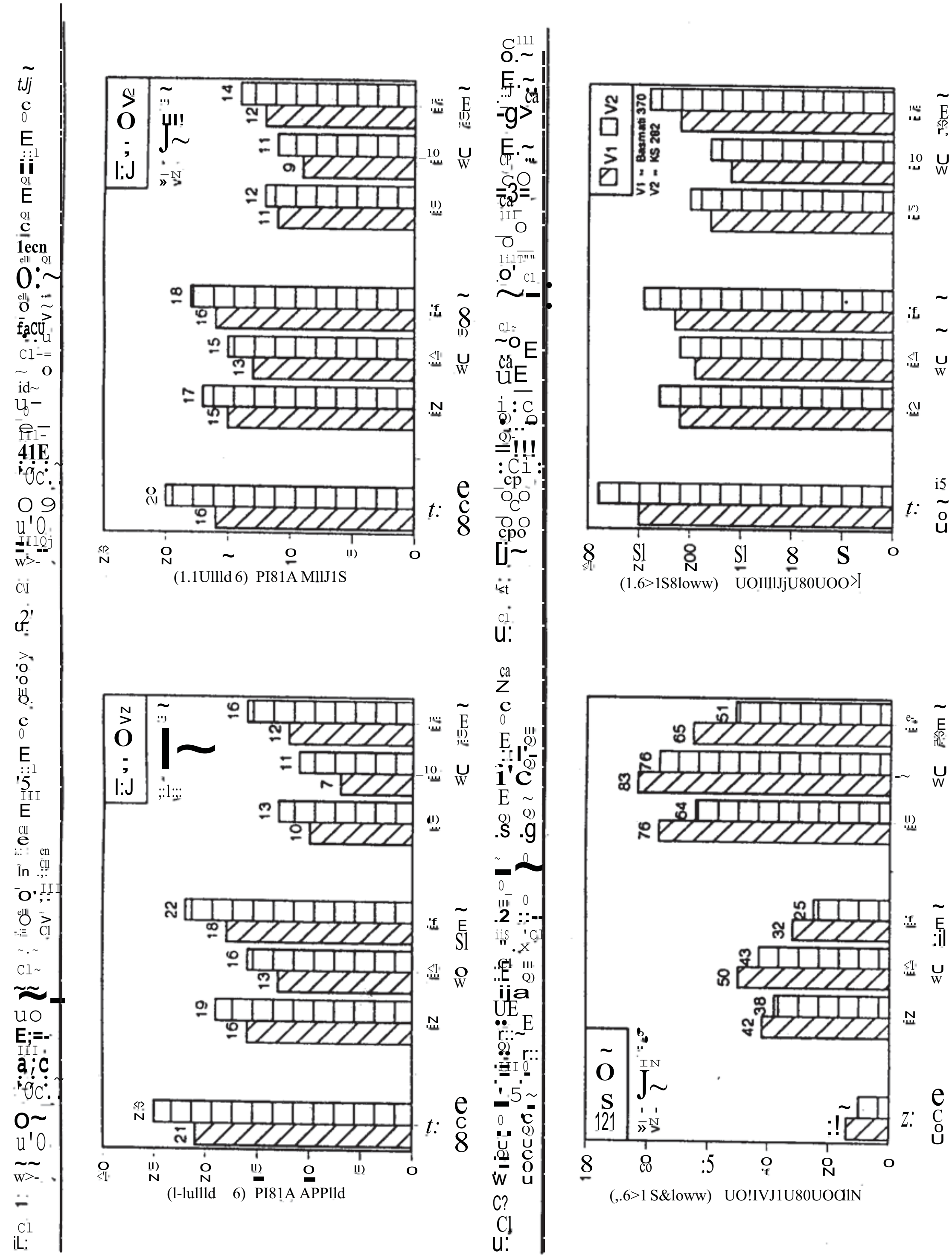
In Pakistan salinity is one of the major constraints in obtaining high crop yield. Mostly the area under rice cultivation has moderate salinity/sodality and 40-65% reduction in yield has been reported because of this problem (Aslam, 1992). Rice is important cereal crop Sown on 2.3 x I(I' hectares with the production of 3.24 x 1(i' tones (Anonymous, 1988) thus contributing significantly to national revenue.

Sodium influence the membrance leakage by displacing Ca which is important in maintaining relative permeability of membrance. It has been observed that adequate amounts of calcium in the growth medium accelerated the ahsorption and translocation of potassium in the rice and wheat under saline conditions, (Kawasaki and Moritsugu, 1978) and also resorted the normal permeability in two week old rice seedlings (Yeo and Flowers. 1985).

High Na/Ca ratio in the saline environment may impair the selectivity of the root membrance and results in positive accumulation of sodium in the, root and shoot (Muhammad *et al.,* 1987) However, limited information is available on the response of rice to Ca to Mg ratios in the growth medium. The aim of the present study was to measure the effect of different calcium to magnesium ratios of saline medium on the growth and ionic composition of two rice varieties varying in salt tolerance.

MATERIALS AND METHODS

Fourteen-day old six seedlings of two rice varieties (Basmati 370 and KS 282) were transplanted to foam plugged holes in theremopole sheets floating over 15 liters of canal water in plastic tubs containing Yoshida nutrient solution (Yoshida et al., 1976). Six days after transplantation, NaCI along with varying ratios of $CaCl_2$ and $MgCl_2$ was added


V1 = Basmati 370
V2 = KS 282

to develop final EC of 50 and 75 mM In respective tubs; the detail of treatments is:

a) Control (original nutrient solution)
b) EC 50 mM was developed by using NaCl: ($CaCl_2$ + $MgCl_2$) ratio 4: I whereas the ratios of Ca to Mg were further splited as I: I, 1:4, and 4: I. The various ratios of Na:Ca+Mg and Ca:Mg were developed when the ionic concentrations were in mM.
c) EC 75 mM developed by using NaCI: ($CaCl_2$ + $MgCl_2$) and Ca:Mg ratios in the same way as given in treatment b. Seven different treatments were arranged in the following way:

TI control (original nutrient solution)

	Na	:	Ca	:	Mg
T2	40	:	5	:	5
T3	40	:	2	:	8
T4	40	:	8	:	2
T5	60	:	7.5	:	7.5
T6	60	:	3	:	12
T7	60	:	12	:	3

Forty days after germination leaf samples were collected for ion analysis. Leaves were washed with distilled water, blotted dry, frozen, thawed and crushed thoroughly for extraction of cell sap. The sap was then centrifuged at 1500 rpm and supernatant cell sap was stored in ependorf tubes. This sap was analyzed for Na, K (on flame photometer Jenway PFP 7) Ca, Mg (on Pye unicam SP 9 atomic absorption spectrophotometer) and Cl (on coming chloride analyzer 926). At maturity, straw and paddy yield was recorded and data were subjected to orthogonal contrasts for statistical comparison.

RESULTS AND DISCUSSION

Salinity decreased the paddy and straw yield of both the rice varieties. The yields decreased more as the salinity increased, however the decrease in yield was more in case of paddy as compared to straw in both the rice varieties.

Both varieties gave more paddy and straw yield at 50 mM than at 75 mM salinity. Nevertheless, *KS-282* produced significantly higher paddy and straw at both the levels of salinity. Salinity significantly increased leaf sodium of both varieties. The leaf sodium was higher at 75 mM than at 50 mM salinity. With the increase of leaf sodium, the potassium concentration decreased steeply, however the effect was more pronounced at higher salinity level. As pointed earlier *KS-282* maintained lower concentration of Na reflecting its better tolerance ability to adverse soil conditions.

Changing the Ca to Mg ratio of the root medium at different salinity levels affected the paddy and straw yield as well as ionic concentration of leaf sap in both the rice varieties (Fig. I, 2, 3, and 4). Paddy and straw yield tended to improve only at higher Ca to Mg ratio (4: I) of the culture solution. This could be because of higher concentration of K and lower concentration of Na in plant tissue at this ratio of Ca to Mg in the saline medium (Fig. 3 and 4). Reduction in paddy yield was due to poor plant growth in the presence of toxic salts in the substrate medium, which affected fertilization and grain filling processes (Aslam et al., 1993a). The reduction in yield may also be due to water deficit in growing regions because of insufficient osmotic adjustments or increased resistance to water flow (Flowers *et a!',* 1991). Higher straw and paddy with increasing Ca to Mg ratio may be due to increased application o calcium and magnesium salts during the development of salinity which resulted in minimizing the toxic effects of sodium (Aslam *et al.,* 1990; Renel, 1992).

The increase in shoot sodium might be due to the increasing concentration of sodium in the rooting medium which ultimately resulted its excessive uptake by plants (Muhammed, 1986) or it might be due to decrease in relative rate of growth of varieties when subjected to saline environment (Aslam *et al,* 1991) as well as decrease in efficiency of Na-exclusion mechanism (Yeo *et al., 1990;* Aslam *et al.,* 1993b). The low uptake of K under saline environment might be related to the competition between K and Na and a resultant increase in the uptake of Na the cost of K (Kuiper, 1984). Improving the Ca to Mg ratios increased the concentration of K in leaves where as concentration of Na was declined. Strong evidences are available in the literature regarding the role of Ca in improving root integrity under adverse condition thereby facilitating ion selectivity mechanisms (Kent and Lauchli, 1985, Aslam *et al.,* 1990; Rengel, 1992).

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