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EFFECT OF POTASSIUM CHLORIDE AND SODIUM CHLORIDE ON THE PERFORMANCE OF COCONUT IN A LATERITE SOIL

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Abstract: A field experiment was conducted to study the effect of NaCl on the performance of young coconut palms grown in a laterite soil at the Regional Agricultural Research Station, Pilicode. The treatments were the substitution of K_2O (applied as KCl) by Na2O (applied as Nad) to the extent of 100, 75, 50, 25 and 0 per cent. The palms receiving 50 per cent substitution of toO by Na2O retained maximum number of functioning leaves. The treatments differed significantly in their influence on nutrient uptake of the palms in the case of K, Na and Cl. Palms receiving higher amount of K or Na retained higher amount of these elements. Palms receiving neither KG nor Nad registered significantly lower uptake of Cl than palms receiving other treatments. The available K and available Na increased with increased application of K and Na respectively while the other characteristics of the soil were not affected.

INTRODUCTION

The coconut palms of the field experiment receiving different levels of K_2O and Na_2O supplied as KC1 and NaCl at the Regional Agricultural Research Station, Pilicode, Kerala were made use for the study. This experiment was laid out in 1976 with newly planted coconut seedlings, in order to evaluate the effect of NaCl on coconut palms when the treatments of NaCl were given from the very start of planting.

MATERIALS AND METHODS

The experiment was laid out in randomised block design with six treatments and four replications maintaining six palms in each plot. The treatments were as follows: (T_1) Control, (T_2) 1000 g K_2O/palm/year, (T_3) 750 g K_2O/ palm/year + 250 g Na_2O/palm/year, (T_4) 50 g K_2O/palm/year + 500 g Na_2O/palm/ year, (T_5) 250 g K_2O/palm/year + 750 g Na_2O/palm/ year, (T_6) 1000g Na_2O/palm/ year. The palms were receiving the treatments from the time of planting. In addition to the above teatments , the experimental palms received N (500 g), P_2O_5 (320 g), CaO (300 g), MgO (170 g) per palm per year as urea, superphosphate, lime and magnesium sulphate respectively and the cultural practices as recommended by the Kerala Agricultural University (KAU, 1976). The soil of the experiment site is laterite and the area receives an average annual rainfall of about 3200 mm. The soil and leaf samples were collected during 1986.

The leaf samples (10th leaf) were analysed for the various nutrients. Total N, P, K, Na, Ca and Mg were determined following standard analytical procedures (Jackson, 1958 and Hesse, 1971). For the determination of chloride, plant material was digested with HNO_3 and permanganate and the chloride was estimated by titration with $AgNO_3$ (Anon, 1972).

The observations on growth parameters such as number of functioning leaves, total number of leaves produced so far and early flowering nature of the palms recorded at the Regional Agricultural Research Station were made use for the study. A scoring technique was developed to analyse the effect of treatments on earliness of flowering. The palms which had not flowered up to 1985 were given a score of zero. The following scores were given in the increasing order, according to the earliness of flowering.

Year of flowering	Score
1985	1
1984	2
1983	3
1982	4
1981	5

The soil samples were subjected to various chemical analyses such as organic carbon, total N, available P (Bray No.1), available K (1*N* neutral NH_4OAc), available Na (1*N* neutral NH_4OAc), available chloride (water), CEC, exchangeable cations, pH and EC following standard analytical procedures (Jackson, 1958).

RESULTS AND DISCUSSION

The palms receiving 50 per cent substitution of KC1 by NaCl (T_4) retained maximum number of leaves (18.48) and the minimum (15.3) was registered by T_1 (control). The palms under treatments T_4 were significantly superior to T_1 (Table 1). This observation revealed that substitution of KC1 by NaCl to the extent of 50 per cent was beneficial to the palm with respect to the number of leaves retained. The significant correlation between number of leaves retained by coconut palms and yield was well established (Prema *et al.*, 1987). In this experiment since the palms have not reached their steady bearing age, the yield data have not been collected. But considering the total number of leaves retained by the palm as an index of yield, it may be possible to assume that maximum yield can be obtained in the treatment where KC1 is replaced by NaCl to the extent of 50 per cent. It is possible that Na may partially substitute the role of K in plants. It is also possible that the requirement of K assessed in terms of KCl may be the combined requirement of K and Cl and the requirement of K would have been overestimated to cover the requirement of Cl also. In this experiment, the number of functioning leaves registered significant positive correlation with Cl content of leaf (r = 0.4450*) and the total number of leaves produced so far (r = 0.5866**). The importance of Cl in nutrition of coconut palm is well established. A significant positive correlation between yield and Cl content of leaf had already been reported (Prema *et al.*,1987). This also suggests the validity of treating the number of leaves retained by the palm as an index of yield.

The treatments showed no significant difference in their effect on other growth characteristics, total N, P, Ca and Mg content of leaf, whereas K, Na and Cl contents of leaf were found significantly influenced by the treatments (Table 1).

The available nutrient status of the soil except available K and available Na and basic soil chemical properties like pH, EC and CEC were not significantly influenced by the substitution of KC1 by NaCl to various extent (Table 2).

The uptake of N, P, Ca and Mg did not vary significantly by the application of treatments. This shows that the proportion of K or Na applied to the soil does not affect the uptake of other nutrients from the soil. The K, Na and Cl uptakes differed significantly (Table 1). The gradation in K content clearly reflects the influence of the treatments. The maximum amount of K was seen in palms receiving 1000 g K_2O (T2) and the minimum in T_6 (1000 g Na_2O). The increase in the content of K in T_1 (no Na or K) over T_6 (1000 g Na_2O) is attributed to the antagonism between K

Table 1. Effect of treatments on growth and nutrient uptake of coconut palms under sodium chloride trial in a laterite soil

Sl.No.	Treatment g/palm/year		No. of functioning leaves/palm	No. of leaves produced so far	Early flowering index	Nutrient content of leaf, %						
	K_2O	Na_2O				N	P	K	Na	Ca	Mg	Cl
1	0	0	15.30	73.86	1.00	2.050	0.193	0.954	0.214	0.522	0.223	0.598
2	1000	0	17.21	73.33	1.94	2.091	0.175	1.857	0.153	0.421	0.194	0.717
3	750	250	18.23	78.25	2.58	2.163	0.172	0.515	0.175	0.435	0.198	0.769
4	500	500	18.48	79.29	2.38	1.926	0.172	1.308	0.209	0.453	0.210	0.726
5	250	750	18.16	72.73	2.63	2.011	0.151	1.203	0.279	0.475	0.202	0.673
6	0	1000	17.48	77.46	2.38	1.799	0.163	0.798	0.406	0.496	0.242	0.667
CD (0.05)			2.84	NS	NS	NS	NS	0.298	0.066	NS	NS	0.0763

Table 2. Influence of sodium chloride applied to coconut palms on soil chemical properties

Sl.No.	Treatment g/palm/year		Organic carbon %	Total N %	Available nutrients, kg/ha				Exchangeable cations cmol(+)/kg		pH	EC dS/m	CEC cmol(+)/kg
					P	K	Na	Cl	Ca	Mg			
1	0	0	0.665	0.090	58.08	119	106.22	94.837	1.58	0.759	5.15	0.175	8.291
2	1000	0	0.663	0.073	52.03	553	104.17	74.858	1.66	0.837	5.49	0.188	7.918
3	750	250	0.666	0.080	57.97	525	120.00	109.821	1.77	0.678	5.46	0.200	8.044
4	500	500	0.680	0.086	47.56	343	124.24	69.864	1.51	0.457	5.20	0.154	7.253
5	250	750	0.773	0.077	53.43	329	144.75	104.826	1.93	0.978	5.23	0.175	8.261
6	0	1000	0.674	0.077	54.07	154	193.98	89.843	1.72	0.704	5.3	0.200	7.714
CD (0.05)			NS	NS	NS	134	50.59	NS	NS	NS	NS	NS	NS

and Na. Similar observation was reported by Prema *et al.*, (1987a). Antagonism between K and Na was also evident from the negative correlation of K content of leaf with available Na in soil (r = -0.4414*), Na content of leaf (r = -0.6289**) and exchangeable Na percentage (r = -0.4074*). However, the correlation between K and Na in soil or leaf is partially due to the effect of treatment because in treatments except T_1 (control), the rates of application of K_2O increase while that of Na_2O decrease and vice versa.

Palms receiving the highest amount of Na (T_6, 1000 g Na_2O) retained the highest amount of Na in their leaves (0.406 per cent). The minimum value (0.153 per cent) was recorded by T_2 (1000 g K_2O) which received no application of NaCl. The treatment T_1 (control) recorded a relatively higher value than T_2. This can be attributed to the antagonism between K and Na, since K applied to T_2 would have suppressed the uptake of Na.

Significant negative correlations were observed between K content of leaf and Ca content of leaf (r = -0.7118**) and between K content of leaf and Mg content of leaf (r = -0.4669*). These correlations indicate the antagonism between K and Ca and also between K and Mg.

The data on the Cl content of leaf in different plots ranged from 0.550 to 0.861 per cent (Table 1). The treatment T_1 (control) which received no application of Cl recorded the minimum value for this element which was significantly lower from other treatment mean values. All other treatments were statistically on par. This is obviously due to the fact that the amount of Cl applied in these treatments either as KCl or as NaCl, remained almost the same irrespective of the proportion of K_2O or Na_2O except T_1.

The application of treatments did not adversely affect the soil pH, EC or CEC. But there was marked variation in the content of available K and available Na in soil. Treatments receiving higher amount of K invariably retained higher amount of this element in soil (Table 2). The treatment receiving highest amount of Na (T_6) registered significantly higher value of available Na in soil (Table 2).

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