NUTRIENT INDEXING IN COCONUT LEAVES AND SOILS OF LAKSHADWEEP ISLANDS : 1—THE NEED FOR POTASH AND NITROGEN

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INTRODUCTION

The Lakshadweep group of islands, which lie in the Arabian Sea, consists of an archipelago of 20 islands with open reef. They lie between 8-12° N latitude and 71-74° E longitude. The altitude of island varies from 0.2 to 5 m from MSL. The annual rainfall ranges from 160 cm in the northern islands to 175 cm in the southern island (Minicoy). The temperature ranges between 32.7° to 29.4° C (maximum) and 22.4° to 26.9° C (minimum). Humidity of these islands rarely falls below 75% in the morning (8.30 hrs.) and 60% in the evening (17.30 hrs.). The sunshine hours and light intensity are high.

The most important crop of the islands is coconut which covers almost the entire cultivable area. A number of crops such as banana, papaya, chillies, brinjal, tapioca, sweet potato and grasses are grown as intercrops with coconut. Athough all the climatic factors are favourable for the good healthy growth of coconut, the average yield is only 50 nuts per palm per year. Field observations revealed that the performance of coconut palms and intercrops was less than optimum.

In a number of cases of coconut plants and the various intercrops loss of green colour of leaf from margin inwards, marginal necrosis, tip burning, yellowing and drying of immature lower leaves were noticed which appeared to be the typical symptoms of K deficiency. In view of this, a systematic investigation on nutritional status of plant and soils of the islands was undertaken and this note brings out the crucial importance of potash nutrition in these calcareous soils.

MATERIALS AND METHODS

One hundred coconut leaf samples from 14th frond leaf from different sites, 77 bulk soil samples upto 30 cm depth near the coconut base and soil samples from 25 soil profiles upto hard pan were collected from 10 islands of Lakshadweep. The leaf and soil samples were digested in diacid (HNO_3+$HCLO_4$) for total nutrients. Exchangeable potassium and sodium were determined in 1N Sodium acetate extract (pH 8.2) by flame photometer and Calcium and Magnesium by atomic absorption spectrophotometer. The total P was determined by Vanadomoloybdate yellow colour method and available P by using Olsen's reagent, organic carbon by Walkely and Black method, nitrogen by modified kjeldahl method and total calcium carbonate by rapid titration as described by Jackson (1967).

RESULTS AND DISCUSSION

Leaf analysis

The maximum, minimum and average value of N, P, K, Ca, Mg, Na and S in coconut leaf are presented in Table 1. While the P, Mg, Ca, Na and S contents in coconut leaves are optimum (more than the critical value), the potassium and nitrogen contents are low. The average value of K content in the coconut leaves of the islands ranges between 0.45 and 0.78% which is less than the critical value (0.80 to 1.0% K). Forty four per cent of the palms contained <0.50% K, 38 per cent between 0.50 and 0.80% and only 18 per cent had values above critical value. This indicates that 44% palms were severely deficient in K.

The calcareous nature of the soils accentuates the deficiency situation. This is also reflected in the negative interaction between the cations in the leaf. A negative correlation coefficient of —0.19, —0.27*, —0·55**, —0·52** and —0·70** were found between Ca and K Na and K, Mg and K, Ca + Mg and K and Ca + Mg + Na and K respectively. Further, it was marked that K content was more than 20 me/100 g when Ca + Mg + Na content was less than 60 me/100 g of dry leaves and was less than 10 me/100 g at high levels of Ca+Mg+Na, (above 80 me/100 g).

From the analysis of N values, it was found that nitrogen content in 41% palms was more than the critical level (1.80%); <1.5% in 16 per cent palms and ranging between 1.5 and 1.8 per cent in the remaining 43 per cent palms. The results indicate that about 50% palms of Lakshadweep may respond to nitrogen fertilization.

Soil analysis

The values of total and available nutrient status in surface soils are presented in Tahle 2. It is apparent from Table 2 that total K ranges between 0.010 and 0.064% and the average values in soils of the islands vary between 0.012 and 0.041%. K content decreased with depth and followed similar trend as organic carbon. Total K content in surface soil decreased or increased in proportion to the organic matter content of soil. A positive significant correlation coefficient (0.80**) was found between total K and organic carbon. This sug-

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gests that the major source of total K in the soil is organic matter. As regards the exchangeable potassium which is used as a source for recommending potassic fertilizer, the values vary from 0.4 to 4.4 mg/100 g. and the average values in the soils of the islands range between 1.3 and 2.7 mg/100 g.

It therefore appears that almost all the crops growing in these soils are prone to K deficiency. The analysed data of soil and leaf samples of coconut also confirmed the deficiency of K in coconut and soils. If potassium is a primary factor among Ca, Mg, Na and K, deciding the coconut yield as several workers (fremond *et al* 1964, Prevot *et al* 1963, Smith 1969 and Wahid *et al* 1974) have suggested, the levels of K must be increased to optimise the yield per palm in the islands. The Ca and Na contents in the soil are very high and to have proper cation ratios in leaves of plants, it is necessary to increase the native and available K in soil to ensure the optimum absorption of K from the soil by plants. As there is lack of K bearing mineral in these soils and the organic matter is the main source of K, it is advisable to maintain the organic matter in the soil by recycling of all available organic wastes (leaf litter, sheath, pith of coconut, grasses, night soil) with minimum use of chemical fertilizers. Since soil is highly calcareous and the loss of ammoniacal nitrogen is quite possible, nitrogenous fertilizer with sufficient amount of organic waste should be added in split doses by sub-soil placement. Promotional efforts on the use of N and K fertilizer and periodical nutrient indexing as reported in this study will go a long way in increasing the yield of coconut and other crops in these islands.

ACKNOWLEDGEMENT

The authors are grateful to Dr. K. V. Ahamed Bavappa, former Director of CPCRI, Kasaragod, for his keen interest in this problem and providing all facilities for collection and analysis of samples.

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TABLE 1

Range of Total Nutrients of Coconut Leaves

Location	No. of samples	N%	P%	K%	Na%	Ca%	Mg%	S%
Kalpeni	11	2·01—1·43 (1·78)	0·18—0·12 (0·14)	0·76—0·38 (0·60)	1·00—0·21 (0·49)	0·73—0·40 (0·56)	0·42—0·27 (0·36)	0·130—0·074 (0·106)
Minicoy	10	2·20—1·20 (1·75)	0·15—0·10 (0·13)	0·98—0·27 (0·54)	0·60—0·32 (0·49)	0·95—0·40 (0·56)	0·88—0·21 (0·46)	0·146—0·051 (0·097)
Kiltan	7	1·98—1·32 (1·64)	0·18—0·12 (0·14)	1·16—0·31 (0·56)	0·57—0·37 (0·51)	0·63—0·32 (0·46)	0·56—0·30 (0·40)	0·088—0·060 (0·073)
Kavaratti	15	2·12—1·46 (1·78)	0·21—0·08 (0·13)	1·32—0·30 (0·75)	0·58—0·16 (0·35)	0·72—0·22 (0·45)	0·52—0·21 (0·35)	0·144—0·046 (0.086)
Cheriam	6	1·90—1·69 (1·78)	0·15—0·10 (0·12)	0·87—0·58 (0·78)	0·32—0·18 (0·26)	0·67—0·44 (0·55)	0·45—0·31 (0·36)	0·116—0·046 (0·088)
Chetlat	4	1·87—1·17 (1·48)	0·16—0·10 (0·13)	0·93—0·38 (0·66)	0·68—0·41 (0·51)	0·54—0·24 (0·40)	0·35—0·25 (0·31)	0·134—0·056 (0·096)
Agatti	7	1·96—1·27 (1·63)	0·16—0·10 (0·13)	0·80—0·32 (0·45)	0·61—0·37 (0·45)	0·61—0·22 (0·45)	0·62—0·30 (0·46)	0·103—0·074 (0·084)
Kadmath	9	2·01—1·10 (1·60)	0·13—0·10 (0·11)	0·70—0·25 (0·49)	0·96—0·18 (0·55)	0·84—0·32 (0·46)	0·49—0·26 (0·36)	0·097—0·046 (0·069)
Amini	10	1·94—1·46 (1·70)	0·15—0·12 (0·14)	1·34—0·35 (0·59)	0·66—0·41 (0·53)	0·65—0·31 (0·46)	0·52—0·22 (0·38)	0·125—0·069 (0·069)
Androth	21	2·27—1·43 (1·78)	0·17—0·10 (0·14)	0·77—0·30 (0·48)	0·74—0·27 (0·52)	0·62—0·33 (0·51)	0·52—0·22 (0·37)	0·162—0·042 (0·104)

Figure in parenthesis is the average value.

TABLE 2

Range of Total and Available Nutrient Status of soils

Location		pH	$CaCO_3$	Org. C%	Nitrogen %	Total P%	Total K%	Total Mg%	Total Sodium %	Available p ppm	Exchangeable K mg/100g	Exchangeable Mg mg/100g
1		2	3	4	5	6	7	8	9	10	11	12
Kalpeni	(i)	8·6	94·8	2·20	0·280	0·350	0·028	1·13	0·74	40	2·9	1·8
	(ii)	7·8	72·3	0·80	0·062	0·020	0·012	0·36	0·50	4	1·4	1·2
	(iii)		85·0	1·21	0·128	0·199	0·017	0·62	0·60	21	1·8	1·5
Minicoy	(i)	8·5	95·0	5·70	0·57	0·178	0·032	0·90	0·72	28	3·0	4·4
	(ii)	7·4	87·3	0·65	0·060	0·011	0·010	0·28	0·62	8	1·0	1·2
	(iii)		88·8	1·99	0·190	0·033	0·021	0·54	0·66	15	1·7	2·3
Kilton	(i)	8·9	96·3	2·72	0·28	0·300	0·030	0·90	0·86	19	3·2	5·6
	(ii)	8·3	92·0	0·43	0·045	0·038	0·012	0·54	0·70	5	1·2	1·2
	(iii)		93·0	1·22	0·123	0·118	0·020	0·70	0·75	10	1·8	3·4
Kavarathi	(i)	8·8	96·3	2·25	0·187	0·250	0·046	0·86	0·82	32	3·1	3·4
	(ii)	7·8	63·3	0·85	0·081	0·103	0·010	0·15	0·70	4	0·4	1·0
	(iii)		85·3	1·36	0·130	0·072	0·020	0·48	0·75	14	1·7	2·5
Cheriyam	(i)	9·1	89·8	0·95	0·089	0·041	0·014	0·85	0·72	25	1·9	4·3
	(ii)	8·2	74·3	0·58	0·047	0·013	0·010	0·64	0·70	4	1·4	2·2
	(iii)		83·3	0·70	0·071	0·027	0·012	0·72	0·73	15	1·6	3·1
Chetlat	(i)	8·6	96·3	1·87	0·160	3·800	0·064	0·71	0·84	122	4·2	3·8
	(ii)	8·2	78·8	0·39	0·061	0·740	0·022	0·25	0·70	8	1·0	1·0
	(iii)		85·3	1·17	0·097	2·380	0·041	0·42	0·78	62	2·9	2·5
Agatti	(i)	8·8	94·3	3·95	0·333	0·096	0·026	0·66	0·78	13	2·0	6·7
	(ii)	8·2	83·3	0·72	0·082	0·041	0·014	0·51	0·62	4	0·8	1·6
	(iii)		87·3	1·51	0·124	0·063	0·017	0·059	0·71	7	1·8	3·1
Kadmath	(i)	8·4	96·3	2·48	0·188	0·370	0·017	0·54	0·86	41	2·2	4·0
	(ii)	7·8	70·0	0·70	0·073	0·53	0·016	0·11	0·62	12	0·5	1·4
	(iii)		86·3	1·57	0·141	0·122	0·033	0·22	0·68	20	1·4	2·7
Amini	(i)	8·6	87·5	4·08	0·367	4·500	0·042	0·64	0·86	159	2·5	3·8
	(ii)	7·6	74·3	0·58	0·052	0·700	0·018	0·12	0·42	57	0·6	1·8
	(iii)		81·6	1·39	0·133	1·220	0·027	0·38	0·71	125	1·7	2·5
Androth	(i)	9·0	94·3	4·56	0·460	3·150	0·046	0·54	0·82	99	14·4	4·8
	(ii)	7·8	67·8	0·72	0·060	0·040	0·016	0·12	0·42	11	0·8	1·5
	(iii)		83·5	1·71	0·165	0·950	0·027	0·25	0·68	52	2·7	3·0

(i) Maximum value

(ii) Minimum value

(iii) Average value