

Nutrient distribution in cashew

(ANACARDIUM OCCIDENTALE L.)

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SUMMARY

Phosphorus, potassium, calcium and sodium contents of petioles are significantly higher as compared to leaf contents. Bark is found to contribute major portion of calcium and phosphorus to the main pool. An equilibrium is found to hold good among K-Ca - Na in the leaves of flowering and non-flowering shoots. A reduction in the ratios of K/p, Ca/N and Ca/p was observed from July to November in the leaves and petioles. Non-flowering shoot petioles recorded higher ratios of K/p, Ca/N and Ca/p when compared to flowering shoots.

INTRODUCTION

Cashew (*Anacardium occidentale* L.) is mainly grown for their nuts in the tropical countries. The crop is seldom fertilized and irrigated. As a result of which, the average

production per tree has been declining gradually with the successive depletion of the nutrients from the soil year after year. Nutrient deficiencies in the soil system may imbalance the nutrient distribution pattern of the tree causing a total loss or abnormalities.

Though work was done on the mineral distribution as influenced by macro nutrients in the nutrient media by Falade (1978), no attempt was made so far to understand the plant system in relation to the elemental composition, their interactions and indices in various plant parts under field conditions.

Hence, this study was undertaken at Central Plantation Crops Research Institute, Regional Station, Vittal, Dakshina Kannada, Karnataka, India.

MATERIALS AND METHODS

Thirty five 10-year-old cashew trees were selected for sampling purpose. These trees have been receiving

250 g N, 120 g P₂O₅, and 120 g K₂O in two split doses during July and November. Sampling was done twice during the course of study i.e. July and November. Fully matured leaves as described by Kumar (1979), their corresponding petioles, bark and hard wood were collected during July. Whereas, during November, fully matured leaves and their corresponding petioles were collected from flowering and non-flowering shoots. Tissue samples were cleaned with distilled water and dried to a constant weight and ground to fine powder. Nitrogen by micro kjeldhal method, phosphorus by vanado-molybdate method, potassium, calcium and sodium by flame photometry were estimated as described by Jackson (1967). Test of significance, indices of the nutrients and correlation coefficients were worked out as described by Panse and Sukhatme (1967).

RESULTS

Nitrogen: From the Table 4, it is seen that the leaves contribute nearly 49% to the total pool, closely followed by petioles, bark and wood. Nitrogen concentration of the leaves is significantly higher as compared to petioles during July and November. However, an increase of this element both in leaves and petioles from July to November is observed (Table 2).

Nitrogen had a significant antagonistic relation with sodium closely followed by calcium in the leaves of the flowering shoots (Table 1). Nitrogen contents of leaves maintained a very high ratios with phosphorus and potassium during July and decreased at the time of flowering. Contrary to N/P and N/K ratios, N/Ca ratios has increased from July to November. The difference between flowering and non-flowering shoots for these elemental ratios both in leaves and petioles is not conspicuous (Table 3). However, N/K ratios in the petioles showed an appreciable increase from July to November.

Phosphorus: Unlike nitrogen, major contribution (32%) of phosphorus to the pool is by bark (Table 4). The contribution of this element to the phosphorus pool by leaves, petioles and wood are almost equal. Though there does not exist any significant difference in the phosphorus concentrations of the leaves and petioles during July, a conspicuous increase of this element in the petioles and leaves of flowering and non-flowering shoots during November was observed (Table 2). However, phosphorus concentration of petioles recorded significantly higher values over leaves both in flowering and non-flowering shoots. P/K and P/Ca ratios of the leaves maintained a very low values during July and thereafter increased. P/K, P/Ca and P/Na ratios in the leaves of flowering and non-flowering shoots did not vary. However, P/Ca ratios of the flowering shoot petioles maintained higher values over non-flowering shoot petioles (Table 3, 5). It may be due to translocation of Ca to the flower panicles for germination of pollen and growth of the pollen tube (Brewbaker *et al.*, 1963).

Potassium: Petioles are found to contribute nearly 38% of the potassium to the pool of the plant followed by hard wood, bark and leaves (Table 4). During July and November, petioles have recorded significantly higher contents of potassium as compared to the leaves (Table 2). However, an increase of this element both in petioles and leaves was observed from July to November. Though potassium showed antagonism with calcium in the leaves and petioles of flowering and non-flowering shoots, it could only establish a significant antagonism with calcium in the petioles of non-flowering shoots (Table 1). Potassium contents of flowering shoot leaves showed antagonism with sodium (Table 1). During July, leaves and petioles maintained a very high ratios of K/P and thereafter declined (Table 3). However, the petioles of non-flowering shoots maintained a very high ratio of K/P as compared to flower shoot petioles (Table 3, 5). This may be due to translocation of K to flower panicles where it is possibly involved in protein synthesis (Evans and Sorger 1966).

Calcium: The maximum contribution of calcium to the main pool is by bark (32.4%) followed by petioles (30.3%) (Table 4). From July to November, calcium concentration of leaves and petioles came down substantially. However, petioles maintained their superiority with respect to this element over leaves during both the seasons (Table 2). Calcium concentrations of leaves of flowering and non-flowering shoots showed a significant

synergistic relationship with sodium (Table 1). However, an insignificant antagonism was observed with sodium contents of petioles in flowering and non-flowering shoots. Calcium maintained slightly higher ratios with sodium in the leaves and petioles of non-flowering shoots. Though there is a decline in the ratios of Ca/P, Ca/N from July to November, non-flowering shoots always maintained higher ratios of these elements during November (Table 3, 5).

DISCUSSION

The major contribution of nitrogen by leaves is obviously of their synthesizing nature of carbohydrates in their chlorophyll molecules. Higher contents of nitrogen during November may be due to increased light intensity whereby the photosynthesis increases resulting in net synthesis of carbohydrate as described by Hoover, *et al.* (1934). These results are in conformity with that of Klepper and Hageman (1969), who recorded higher contents of nitrate reductase in the leaves followed by stem and petioles of apple seedlings.

The major contribution of phosphorus and calcium to the pool by bark may be due to its lignification where lignin consists of mainly calcium in the form of calcium oxalates and under low level of phosphates in the soil system (Table 6) calcium increases permeability to phosphates absorption by screening electronegative charges on the roots and thus increasing accessibility of absorption sites to phosphates mainly in the bark where phloem tissue is embedded. The phenomenon is in conformity with Robson *et al.* (1970) who illustrated with legumes.

The lower values for potassium contents during July may be due to continuous washings of the canopy with rain water and also low temperatures. With the rise in the temperatures, potassium contents of leaves and petioles from July to November increased and calcium contents decreased.

Sodium is found to hold up in petioles without translocating to the leaves. This phenomenon is observed by Pearson (1967) who noticed that translocated sodium was held up in the stem of bean plants.

From the data, it is seen that the presence of high degree of Ca in the soil during July (Table 6) promoted development of K absorbing capacity, resulting in self depressive effect of Ca absorption. This is in conformity with the relation of Ca-Na-Rb observed by Waisel (1962) in barley roots. This demonstrates that protein synthesis is involved in the development of K absorbing capacity of flowering trees and suggest so that calcium may have effect on basic physiological processes concerned with development of ion absorption. Rains and Floyd (1970) demonstrated this type of phenomenon with *P. vulgaris*. The synergistic relation between Ca and Na and antagonistic relation of Ca and Na with K may not be considered as a chemical interaction among K, Ca and Na on the hypothetical carrier but is extracted as a change in the constant in the Kinetic equation as described by Leggett (1968).

TABLE 1
CORRELATION COEFFICIENTS (r) OF N, P, K, Ca AND Na CONTENTS OF LEAVES AND PETIOLES OF FLOWERING AND NON-FLOWERING SHOOTS OF CASHEW

Elements	Flowering shoots		Non-flowering shoots	
	Leaves	Petioles	Leaves	Petioles
N - K	0.3057	0.0451	-0.1150	0.1273
N - Ca	-0.2751	0.1205	0.0733	-0.0209
N - Na	-0.3666*	-0.1932	0.1641	-0.0783
K - Ca	-0.1854	-0.0384	-0.0164	-0.4293**
K - Na	-0.4257**	-0.0159	0.0141	0.0039
Ca - Na	0.4207**	-0.0473	0.3788*	-0.0869

* Significant at 5% level ** Significant at 1% level.

TABLE 2
NITROGEN, PHOSPHORUS, POTASSIUM, CALCIUM AND SODIUM CONTENTS OF LEAVES AND PETIOLES

Time of sampling	Nature of the shoots		Nitrogen (%)	Phosphorus (%)	Potassium (%)	Calcium (%)	Sodium (%)
JULY	Vegetative shoots	Leaf	1.483	0.0221	0.4500	0.7571	—
		Petioles	0.797	0.0229	1.6214	1.4214	—
		t' value	11.813*	0.3342	17.8303*	9.2350*	—
NOVEMBER	Flowering shoots	Leaf	2.163	0.1382	1.1385	0.1085	0.0775
		Petioles	1.348	0.1913	2.1028	0.3062	0.1256
		t' value	11.507*	6.9714*	16.9308*	8.8715*	10.6418*
	Non-flowering shoots	Leaf	2.392	0.1409	1.2200	0.1157	0.0749
		Petioles	1.275	0.1754	1.9657	0.3891	0.1281
		t' value	14.275*	4.3733*	13.1362*	12.2883*	11.0406

* Significant at 5% level.

TABLE 4
PERCENTAGE OF NUTRIENT IN DIFFERENT PARTS OF CASHEW ON WHOLE PLANT BASIS

	Whole Plant*	Leaves**	Petioles**	Bark**	Wood**
N	3.0800	48.18	25.88	18.83	7.11
P	0.0972	22.76	23.58	31.89	21.60
K	4.1180	11.36	38.13	20.40	30.11
Ca	4.6984	16.11	30.25	32.36	21.28

*Percentage on dry weight basis. **Percentage on whole plant basis.

TABLE 3

NUTRIENT INDICES IN THE LEAVES OF FLOWERING AND NON-FLOWERING SHOOTS OF CASHEW

Nutrient	JULY							NOVEMBER													
	<i>Vegetative shoots</i>							<i>Flowering shoots</i>							<i>Non-flowering shoots</i>						
	N	P	K	Ca	Na	Ca	Na	N	P	K	Ca	Na	Ca	Na	N	P	K	Ca	Na		
Na	—	—	—	—	—	—	0.0358	0.5608	0.0681	0.7143	0.0775	0.0313	0.5316	0.0614	0.6474	0.0749					
Ca	0.5105	34.2579	1.6824	0.7571	—	—	0.0502	0.7851	0.0953	0.1085	1.4000	0.0484	0.8211	0.0948	0.1157	1.5407					
K	0.3034	20.3720	0.4500	0.5943	—	—	0.5300	8.2381	1.1385	10.4391	14.6903	0.5100	8.6586	1.2200	10.5445	16.2284					
P	0.0149	0.0221	0.0491	0.0291	—	—	0.0638	0.1382	0.1214	1.2737	1.7832	0.0589	0.1409	0.1155	1.2178	1.8812					
N	1.483	67.1040	3.2955	1.9587	—	—	2.163	15.6512	1.8999	19.9354	27.9096	12.392	16.9766	1.9607	20.6742	31.9359					
N	P	K	Ca	Na	Ca	Na	N	P	K	Ca	Na	N	P	K	Ca	Na					

TABLE 5

NUTRIENT INDICES IN THE PETIOLES OF FLOWERING AND NON-FLOWERING SHOOTS OF CASHEW

Nutrient	JULY							NOVEMBER								
	<i>Vegetative shoots</i>							<i>Reproductive Shoots</i>								
	N	P	K	Ca	Na	Ca	Na	N	P	K	Ca	Na	Ca	Na		
Na	—	—	—	—	—	—	0.0932	0.6565	0.0597	0.4102	0.1256	0.1005	0.7303	0.0652	0.3292	0.1281
Ca	1.7834	62.0699	0.8766	1.4214	—	—	0.2271	1.6006	0.1456	0.3062	2.4378	0.3052	2.2184	0.1979	0.3891	3.0375
K	2.0344	70.8035	1.6214	1.1407	—	—	1.5599	1.5599	2.1028	6.8674	16.7421	1.5417	11.2070	1.9657	5.0519	15.3450
P	0.0287	0.0229	0.0141	0.0161	—	—	0.1419	0.1913	0.0909	0.6247	1.5231	0.1376	0.1754	0.0892	0.4508	1.3692
N	0.7970	34.8035	0.4916	0.5607	—	—	1.3480	7.0465	0.6410	4.4023	10.7325	1.2750	7.2691	0.6486	3.2768	9.9532
N	P	K	Ca	Na	Ca	Na	N	P	K	Ca	Na	N	P	K	Ca	Na

TABLE 6

SOIL NUTRIENT STATUS (%) OF THE CASHEW ORCHARD				
Av. Nitrogen	0.0250
Phosphorus	0.0033
Potassium	0.0108
Calcium	0.0159

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