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Seasonal variations in the mineral composition of coconut leaves

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ABSTRACT

In order to standardize the leaf sampling time in coconut, an attempt was made to study the seasonal variations of leaf macro- and micro-nutrient contents in Sakhigopal Local coconut under coastal tracts of Orissa. It was observed that the linearity for leaf N, P, K, Mg, S, Mn and Zn was found between December and February and the coefficients of variation for most of the nutrient elements (N, P, Ca, S, Fe and Mn) were lowest during December and except manganese (22.87%), the coefficient of variation was below 20 per cent. Hence in the present study, the best sampling time could be determined as December for coconut in littoral sandy soils of Orissa.

Keywords: Coconut, Leaf sampling, seasonal variation, Sakhigopal Local, liitoral sand.

INTRODUCTION

Plant tissue/leaf analysis has become increasingly and widely used diagnostic technique for assessing plant nutrient status, especially in perennial plantation crops. The reliability of results of tissue analysis depends on sampling of index tissue at proper time, as the nutrient content of the index tissue vary throughout the year depending upon the climatic conditions *viz.,* rainfall, soil moisture, fertilizer application etc. (Foster and Chang, 3; Wahid *et al.,* 12). Sakhigopal Local is one of the most important cultivar grown along the coastal tracts of Orissa and to a reasonable extent in the inland tracts also. The sampling period identified for other varieties under different conditions/ regions may not hold good for this variety under these agro-climatic conditions. Hence, an attempt was made to study the seasonal variations of leaf macro- and micro-nutrient contents in Sakhigopal Local under coastal tracts of Orissa in littoral sandy soil and suggest an appropriate period for the coconut leaf sampling.

MATERIALS AND METHODS

Coconut palms of 35-year-old cv. Sakhigopal Local grown under similar cultural conditions at the Coconut Research Station, Directorate of Horticulture, Govt. of Orissa were selected for the study. The soil was typical littoral sand with about 89.5 % sand with very low in organic matter content and high in phosphorus and medium in potash content.

The palms were planted at a spacing of 8 m x 8 m and a recommended fertilizer schedule of 0.5 kg N, 0.32 kg P_2O_5 and 1.2 kg K_2O was applied as two split doses. Twenty five palms producing stable yields were randomly chosen from the site taking into the consideration the earlier records. Leaf samples were taken form the 14th leaf (Chapman, 1) of each palm at approximately three months interval in December, February, May (before split application of fertilizers) and September (before split application of fertilizers). The study was analyzed following the procedure described by Lim *et al.* (5) and Korikanthimath *et al.* (4) with befitting statistical procedure of mean, range, coefficient of variations. The leaf samples were collected from the leaf rank of the coconut by cutting 4-5 leaflets from the middle of the frond on both the sides. The collected materials were wiped out to remove any residual soil or dust and then oven dried at 65°C for 72 hours and powdered and subjected to analysis. It is important that neither damaged, insect-ridden, or diseased leaflets, nor dead tissue were included while collecting the samples. Leaf nitrogen content was estimated by Kjeldahal method (Singh *et al.,* 9), P by colorimetric method K by diacid digestion method Ca and Mg by EDTA colorimetric method S by following the procedure described by Chesnin and Yein (2). and the micronutrients (Fe, Mn, Cu and Zn) were determined by the procedure described by Lindsay and Norvell (10). The N, P, K, Ca, Mg and S contents were expressed as percentage and the micronutrients contents were given as ppm.

RESULTS AND DISCUSSION

The N, P and K content of the 14th leaf of the coconut palms were estimated during different times for two consecutive years and the analyzed pool data are presented in Table 1 and Fig. 1. The mean nitrogen content in the 14th leaf varied from 1.33 per cent during September to 1.53 per cent during December. However, the linearity as estimated from the coefficient of variation was observed between December and

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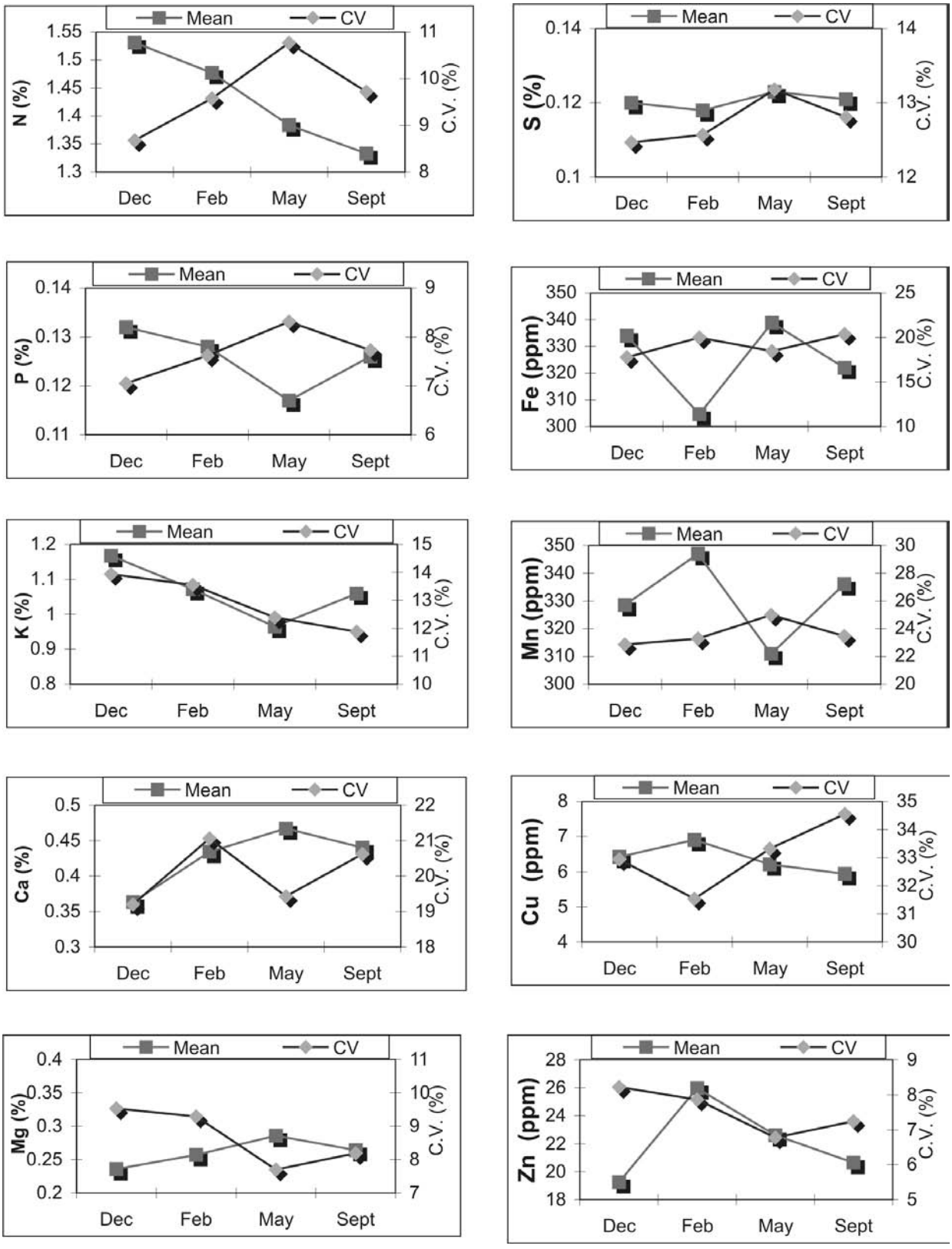

Fig. 1. Mean leaf nutrient concentrations and coefficient of variation in different months of sampling.

Table 1. Nutrient (N, P and K) content (%) in different months in coconut palm.

Month	Nitrogen			Phosphorus			Potassium		
	Range	Mean	CV (%)	Range	Mean	CV (%)	Range	Mean	CV (%)
Dec.	1.30-1.75	1.53	8.68	0.11-0.15	0.132	7.05	0.82-1.40	1.17	13.94
Feb.	1.23-1.71	1.47	9.58	0.11-0.14	0.128	7.62	0.78-1.26	1.07	13.55
May	1.08-1.62	1.38	10.77	0.10-0.13	0.117	8.31	0.73-1.12	0.96	12.39
Sept.	1.13-1.56	1.33	9.72	0.11-0.14	0.126	7.73	0.82-1.22	1.06	11.88

February. The lowest coefficient of variation was recorded in the data obtained in December. The mean phosphorus content varied from 0.12 per cent during May to 0.13 per cent during December. The lowest coefficient of variation was obtained in December and the linearity was found between December and February. The mean potassium content in the 14th leaf of the palms ranged between 0.96 and 1.17 per cent during May and December, respectively. Although, the linearity was observed between December and February, lowest coefficient of variation was obtained in September.

Seasonal fluctuations in the nutrient concentrations of the leaf might be due to the degree of variability in climatic conditions. Certain physiological processes of the plant are much affected by the climatic variations which ultimately influence the composition of the plant (Sanyal and Mitra, 8). It is also pointed out that seasonal changes in the foliar nutrients might be due to the effect of differences in soil moisture and aeration conditions on the availability of these elements. Leaf nitrogen was found to decline steadily from December to September. Leaf phosphorus content increased slightly after May which corroborated the findings of Wahid *et al.* (12). Similarly, leaf potassium level increased until December and decreased thereafter upto May.

The calcium content ranged from 0.27 to 0.48 per cent in December, 0.29 to 0.60 per cent in February, 0.33 to 0.63 per cent in May and 0.31 to 0.62 per cent in September among the palms under study (Table 2). The mean calcium content varied from 0.36 per cent in December to 0.47 per cent during May. The linearity as assessed from the coefficient of variation was observed between May and September. However, the lowest coefficient of variation was observed in December.

It was observed that the mean magnesium content in the 14th leaf in different months varied from 0.236 per cent during December to 0.286 per cent in May. The linearity was observed between December and February. The lowest coefficient of variation was, however, estimated in May. Leaf calcium and magnesium content increased after December upto May and slightly decreased thereafter during September. Antagonism between K and Mg has also been reported by Poovarodom *et al.* (7) for durian.

The sulphur content of the leaves did not vary markedly among different months under study and it ranged from 0.118 to 0.123 per cent during February and May, respectively. The linearity was observed between December and February. The lowest coefficient of variation for sulphur was also recorded during December. Smilde and Leyritz (14) also reported significant differences between month of sampling in leaf N, P, K, Ca and Mg contents of oil palm. It was observed that with the fall in K level: Ca and Mg levels increased. Such a trend could be due to the antagonism in the uptake of mono- and di-valent cations (Wahid *et al.,* 11).

The iron content in the 14th leaf of different palms chosen for the study ranged between 242 to 463, 200 to 444, 231 to 468 and 219 to 456 ppm in December,

Table 2. Nutrient (Ca, Mg and S) content (%) in different months in coconut palm.

Month	Calcium			Magnesium			Sulphur		
	Range	Mean	CV (%)	Range	Mean	CV (%)	Range	Mean	CV (%)
Dec.	0.27-0.48	0.36	19.20	0.20-0.29	0.24	9.53	0.09-0.14	0.12	12.47
Feb.	0.29-0.60	0.43	21.06	0.22-0.31	0.26	9.29	0.09-0.14	0.12	12.57
May	0.33-0.63	0.47	19.43	0.25-0.33	0.29	7.70	0.09-0.15	0.12	13.18
Sept.	0.31-0.62	0.44	20.62	0.23-0.31	0.26	8.19	0.09-0.15	0.12	12.81

Table 3. Nutrient (Fe, Mil, Cu and Zn) content (ppm) in different months in coconut palm.

Month	Iron			Manganese			Copper			Zinc		
	Range	Mean	CV (%)	Range	Mean	CV (%)	Range	Mean	CV (%)	Range	Mean	CV (%)
Dec.	242-463	334	17.79	220-560	329	22.87	2.9-10.1	6.42	32.94	16.1-21.8	19.25	8.22
Feb.	200-444	305	20.01	201-572	347	23.29	3.3-10.5	6.91	31.53	22.6-29.7	25.98	7.86
May	231-468	339	18.48	162-516	311	24.99	3.0-9.8	6.21	33.32	20.0-25.6	22.61	6.77
Sept.	219-456	322	20.39	185-545	336	23.47	2.8-9.4	5.94	34.55	18.0-23.5	20.64	7.24

February, May and September, respectively (Table 3). The mean iron content varied from 304.6 ppm in February to 339 ppm in May. The linearity was observed between February and May. However, the lowest coefficient of variation for iron was observed in December. The mean manganese content ranged from 311 to 347 ppm during May and February, respectively. The coefficient of variation varied from 22.87 (December) to 24.99 per cent (May). The linearity was observed between December and February. The copper content in the 14th leaf ranged from 2.9 to 10.1 ppm in December. The respective figures for February, May and September were 3.3 to 10.5, 3.0 to 9.8 and 2.8 to 9.4 ppm. The mean copper content varied from 5.94 ppm in September to 6.91 ppm in February. The linearity was observed between May and September. However, the lowest coefficient of variation was obtained during February. It was noticed from the data that leaves sampled in December contained 16.1 to 21.8 ppm of zinc, whereas the respective figures for February, May and September, were 22.6 to 29.7, 20.0 to 25.6, and 18.0 to 23.5 ppm. The mean zinc content ranged between 19.25 ppm during December and 25.98 ppm during December and February, respectively. The linearity was observed between December and February. The lowest coefficient of variation for zinc was, however, obtained in May.

REFERENCES

1. Chapman, H.D. 1964. Foliar sampling for determining the nutrient status of crops. *World Crops* **16**: 37-46.

2. Chesnin, L. and Yein, C.H. 1950. Turbidimetric determination of sulphur. *Proc. Amer. Soc. Soil Sci.,* **15**: 149-51.

3. Foster, H.C. and Chang, K.C. 1977. Seasonal fluctuations in oil palm leaf nutrient levels. *MARDI (Malaysian Agricultural Research and Development Institute, Kuala Lumpur). Res. Bull.* **5**: 74-90.

4. Korikanthimath. V.S., Gaddi, A.V. and Gowda, S.J. Anke 2003. Selection of index leaf in cardamom (*Elettaria cardamomum* Maton.) for nutrient diagnosis. *Indian J. Hort.* **60**: 108-12.

5. Lim, T.K., Luders, L. and Poffley, M. 1999. Seasonal changes in durian leaf and soil mineral nutrient element content. *J. Plant Nutr.* **22**: 657-67.

6. Lindsay, W.L. and Norvell, W.A. 1978. Development of a DTPA test for zinc, iron, manganese and copper. *Soil Sci. Soc. Amer. J.* **42**: 421-28.

7. Poovarodom, S., Tawinteung, N., Mairaing, S., Prasittikhet, J. and Ketsayom, P. 2000. Seasonal variations in nutrient concentrations of durian (*Durio zibethinus* Murr.) leaves. *Acta Hort.* **564**: 235-42.

8. Sanyal, D. and Mitra, S.K. 1990. Standardization of leaf sampling technique for mineral composition of litchi cv. Bombai. *Indian J. Hort.* **47**: 371-75.

9. Singh, D., Chhonkar, P.K. and Pandey, R.N. 1999. *Soil-Plant-Water Analysis: A Methods Manual.* IARI, New Delhi.

10. Smilde, K.W. and Leyritz, M.J.P. 1965. A further investigation on the errors involved in leaf sampling of oil palms. *J. Nigerian Inst. Oil Palm Res.* **4**: 251.

11. Wahid, P.A., Kamala Devi, C.B. and Pillai, N.G. 1974. Inter-relationship among root CEC, yield and monovalent and divalent cations in coconut. *Plant Soil* **40**: 607-19.

12. Wahid, P.A., Kannan, K., Kamalam, N.V. and Venugopal, V.K. 1981. Genotypic and seasonal variations in the mineral nutrition of coconut palm. *J. Plantation Crops* **9**: 105-11.

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