

Standardization of Soil Sampling Method in Arecanut. Part I:
Variation in Fertility Gradient under Basin System
of Manuring

by

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Introduction: Basin system of manuring is a common practice in arecanut cultivation. Shallow basins with a radius of about three-fourths of a meter are opened around the base of palms where green leaf, manure and fertilizers are applied and covered with thin layer of earth. Since the usual spacing adopted for arecanut is 2.7 m × 2.7 m, there remains large area in between the palms which does not receive any fertilizer or manure. The problem of soil sampling in such a case would differ from that adopted for annual crops.

The present investigation was undertaken to study the differences if any, existing in the fertility level of soil samples collected from the basins at three lateral distances from the base of the palm and at two vertical depths for each of these lateral distances with the object of fixing suitable soil sampling technique for arecanut.

Materials and Methods: Twenty palms each annually receiving ammonium sulphate, super phosphate, muriate of potash and green leaf at the rate of 485.4 g (100 g N), 500.0 g (80 g P₂O₅), 233.3 g (140 g K₂O) and 13.6 kg respectively were selected for the present study from the NPK manurial experiment laid out at the Central Research Institute of Plantation Crops, Vittal. The experiment was initiated in the year 1961 and the palms in the treatment plot had received identical cultural and manurial treatments since then. The samples for this study were collected in March, 1970, at three lateral spots namely, 30 cm, 70 cm and 100 cm from the base of the palm at two depths *i.e.*, 0 to 25 cm and 25 to 50 cm. Tubular soil augur was used for collection of samples. Soil samples were dried in shade, passed through 2 mm sieve prior to analysis, and analysed for the following constituents by the methods briefly given below.

pH was determined using glass electrode pH meter in 1:2.5 soil-water suspension after 30 minutes of equilibrium. Organic carbon was estimated by Walkley and Black's rapid titration method (Piper, 1966). Available N was estimated by the alkaline permanganate method (Subbiah and Asija 1956). Available phosphoric acid was extracted by 0.03 N NH₄F in 0.025 N HCl

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(Bray and Kurtz, 1945). Molybdophosphoric blue colour was developed using chlorostannous acid reductant in HCl system. The colour was read in Klett-Summerson photoelectric colorimeter using red filter. Available potash was determined as per the method described by Muhr *et al.* (1965) using flame photometer.

Results and Discussion: The data collected were statistically examined. Table 1 gives the mean values for the various constituents. There were very high significant differences between samples collected at three lateral spots and for each two depths for all the constituents studied.

Available N content was significantly high in the surface samples in all the three lateral distances. This is obvious because the fertilizers were applied at the surface soil. One interesting feature of the available N status in soil samples is that the N level of the surface soil at 70 cm distance was equal to that of surface soil at 100 cm lateral distance. The available N content of subsoil at 100 cm spot was significantly higher than in the subsoil sample at 70 cm distance. Bhat and Leela (1969) reported that from 60.9 to 66.9% of all roots and from 51.3 to 55.6% of fine roots were concentrated within 50 cm radius of the palm. The percentage of all roots up to 75 cm from the palm was 70.5. The percentage of roots from 76 cm to 100 cm lateral distance was only 8.4. The equal or higher amount of available N at 100 cm lateral distance when compared to 70 cm can be explained by the non-utilisation of this nutrient by the arecanut palm because of sparse spread of roots at 100 cm distance. It may be recalled that 100 cm lateral distance falls beyond the zone of fertilizer application. The level of available N in subsoil was significantly higher at 30 cm lateral distance than the subsoil at 70 cm and 100 cm distances. Hawaii Sugar planters association in its report of experiment station committee (1958) stated the rapid leaching of ammonium sulphate in acid soils. The soil in this study is sandy loam, open textured and acidic. The data showed considerable downward movement of applied nitrogenous fertilizer.

In all the three lateral distances, the level of available P_2O_5 in surface soil was more than double from subsoil level. It is well known that the applied water-soluble and citric acid-soluble phosphates get converted to sparingly soluble iron and aluminium phosphates in acid laterite soils. This fixation may be the reason for the wide difference in available P status between two depths. Both at surface and subsoil layers, there was a very wide difference between available phosphoric acid content at 30 cm and 70 cm lateral distances. As earlier mentioned, the 30 cm lateral distance was the mid portion of the basin and the 70 cm lateral distance was in the fringe of the basin. While spreading fertilizer, the amount that falls in the centre may

be more than at the edge of basin. The very high significant difference of available P_2O_5 at these two lateral spots can be explained by the above fact. The lateral distance of 100 cm fell outside the zone of fertilizer application. The level of available P_2O_5 at this distance was less than 5 ppm. Fifty per cent of the surface samples had only traces of this nutrient and it was still lower in subsoil layer. The study clearly indicates that there is a very little lateral movement of applied P in the soil. The results also showed that when large quantity of super phosphate was applied, fixing capacity of surface soil got satisfied and further, water-soluble phosphate moved down. The green leaf added along with the fertilizer might also play a role here. Humate ion is reported to displace phosphate ion. The decaying organic matter supplies humate ion which may displace adsorbed phosphate. The organic acids released during the decomposition of organic matter may assist in solubilising fixed phosphates which moved down to lower layers. Savant *et. al.* (1970) studied under laboratory condition the movement of phosphate fertilizers in lateritic sandy loam soil. After incubation for 21 days, they observed that the maximum lateral movement was about 10 mm from the spot at which phosphate fertilizer was placed. This study was carried out in glass Petri dishes and therefore there is no scope for downward movement. Under field conditions in open textured soil, there is a free downward movement and scope for lateral movement of phosphate will be very little.

The level of available K_2O in surface soil samples at all the three lateral distances was significantly higher than in subsoil. At each depth, there was significant difference between lateral distances. Movement of potash ion in soil layer is also not free. When large quantities of potassic fertilizer are added to the surface soil, downward movement occurs. The concentration of available K_2O was maximum at 30 cm, less at 70 cm, and the least at 100 cm in both the layers.

The organic carbon content of the surface soil samples was significantly higher than in subsoil samples at all the three lateral distances. This is expected since the organic matter was incorporated only in the surface layer. It is interesting to note that the level of organic carbon in subsoil at 70 cm was significantly lower than the corresponding samples at 30 and 100 cm lateral distances. No plausible explanation can be offered for this phenomenon.

The surface soil samples at 30 cm and 70 cm lateral distances had significantly lower pH than the corresponding subsoil samples. The pH of the soil sample collected at 100 cm was significantly higher than the samples collected at 30 and 70 cm lateral distances at both the depths. At 100 cm, the pH of the surface sample was higher than subsoil sample though the difference did not reach the level of significance. Ammonium sulphate is a

physiologically acid fertilizer. Since it carries an acid radical, it becomes a serious cause of inefficiency in acid soils. Owensby *et. al.* (1969) noted the lowering of soil pH by the application of N at the rate of 60 lb per acre and more.

The increase in soil acidity by the continuous use of sulphate of ammonia without the addition of necessary lime as corrective is an established fact (Bear, 1953). In the present study, lowering of the pH was seen only at 30 and 70 cm lateral distances, but not at 100 cm. This is because the 100 cm lateral distance was outside the zone of fertilizer addition and therefore no lowering of pH was seen at this place.

Summary and Conclusion: Soil samples collected at 30 cm, 70 cm and 100 cm lateral distances from the base of the areca palms under basin system of manuring were analysed for their fertility constituents. The results of the investigation have been brought out as under :

1. There was considerable downward movement of applied nutrients in the soil. The rate of movement was $N > K > P$.
2. Application of ammonium sulphate lowered the soil pH appreciably.
3. There was highly significant difference in the fertility levels of soils collected at different lateral distances from the base within one meter radius of the palm. This necessitates for a new soil sampling technique that needs to be worked out for obtaining representative soil samples for the evaluation of nutritional problems in arecanut crop.

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TABLE 1. Mean values of different fertility constituents and pH in soil samples collected from arecanut garden

Depth in cm	Available N p.p.m.			Available P ₂ O ₅ p.p.m.			Available K ₂ O p.p.m.			Organic-carbon %			pH		
	0-25	25-50	Mean	0-25	25-50	Mean	0-25	25-50	Mean	0-25	25-50	Mean	0-25	25-50	Mean
30	167.44	140.56	154.0	185.21	97.83	141.52	164.15	108.75	136.45	0.7025	0.4660	0.5843	4.49	4.39	4.44
70	153.30	114.48	133.89	72.38	19.24	45.81	77.23	60.25	68.74	0.5595	0.2755	0.4175	4.82	4.39	4.60
100	150.92	127.61	139.27	4.25	2.64	3.44	45.95	32.85	39.40	0.4535	0.3525	0.4030	5.11	5.06	5.09
L. S. D. (P=0.05)	7.17	8.10	4.32	59.63	26.52	31.50	22.28	13.57	13.27	0.06	0.05	0.04	0.14	0.11	0.08
L. S. D. (P=0.01)	9.62	10.87	5.72	80.00	35.58	41.76	29.89	18.21	17.60	0.08	0.06	0.06	0.20	0.15	0.10

Lateral distance in cm