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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 P_2O_5), 233.3 g (140 g K_2O) 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 NH_4F 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 infected ovary. In the other two hosts, there was visible honeydew secretion. Sclerotial formation was not, however, observed on any of the three hosts.

TABLE 1. *Reaction of different millets and grasses to Sphacelia sorghi*

Plant species	No. of earheads inoculated	No. of earheads infected	Percentage of infection
(a) *Millets :*			
Echinocloa colona var *frumentacea*	20	0	0
Eleusine coracana	20	0	0
Panicum miliaceum	20	0	0
P. milliare	20	0	0
Paspalum scrobiculatum	20	0	0
Pennisetum typhoides	20	0	0
Setaria italica	20	0	0
Triticum vulgare	20	0	0
Zea mays	20	15	75
Sorghum caffrorum (msCK 60-A)	20	20	100
(b) *Grasses :*			
Cynodon dactylon	20	0	0
Cenchrus ciliaris	20	17	85
C. setigerus	20	9	45
Dicanthium annulatum	20	0	0
Heteropogon contartus	20	0	0
Iseilerra laxum	20	0	0
Panicum antidotale	20	0	0
P. maximum	20	0	0
Pennisetum ciliaris	20	0	0
P. hohenackeri	20	0	0
P. massicum	20	0	0
P. purpureum	20	0	0
P. ruppelli	20	0	0
P. squamulatum	20	0	0

The conidia from the infected maize cobs when examined, revealed certain variations in their shape and size (Table 2 and Figure 1). They were dimorphic; some were spherical while the others were elongated or spindle shaped. The shape and size of the conidia on *C. ciliaris* and *C. setigerus* also exhibited some variations (Table 2 and Figure 1). The conidia were elongated and thinner than those on sorghum.

TABLE 2. *Conidial measurements of Sphacelia sorghi on different hosts*

Host	Range	Mean
Sorghum caffrorum	12.5–17.5×5.0– 7.5μ	14.8×6.5μ
Zea mays		
(a) Spherical conidia	2.0– 4.0×2.0– 3.5μ	3.0×2.7μ
(b) Elongated or spindle conidia	7.5–22.5×2.5– 7.5μ	16.3×8.8μ
Cenchrus ciliaris } *C. setigerus* }	5.0–25.0×2.5–10.0μ	13.1×4.8μ

FIG. 1

Conidia of *Sphacelia sorghi* on *Cenchrus ciliaris* (1), *Zea mays* (2) and *Sorghum caffrorum* (3)

Discussion: In this investigation maize, *Chenchrus eiliaris* and *C. setigerus* were found to be infected by *Sphacelia sorghi*. Among these, maize is a new host for this pathogen in India. Futrell and Webster (1966) reported infection of maize by *S. sorghi* in Nigeria. The other two hosts are additional hosts for this pathogen not so far reported either in India or elsewhere. Although Reddy (1968) reported infection of *Pennisetum typhoides* in the present study such was not the case. This is in accordance with the observation of Futrell and Webster (1968).

C. ciliaris and *C. setigerus* are found on field bunds throughout the year and also cultivated as fodder crops in many parts of South India. These two grasses may possibly serve as collateral hosts for sorghum sugary disease pathogen. As maize is susceptible for this pathogen there is always a potential danger to maize crop either when it is grown in rotation with sorghum or in its neighbourhood.

It was interesting to note that the conidial size and shape of *S. sorghi* were altered when passed on to different hosts. On maize, dimorphic conidia comparable with the 'micro' and 'macro conidia' of *Claviceps gigantea* described by Fuentes *et. al.* (1964) on maize were observed. The spore dimensions were closer with those for *Claviceps gigantea*. The conidia on

C. ciliaris and *C. setigerus* differ distinctly from a species of *Sphacelia* with lunate conidia which occurs naturally on these grasses.

Hence based on the conidial shape and size *S. sorghi* may be considered as related to *Claviceps gigantea* and not to *Sphacelia* sp. on *C. ciliaris* and *C. setigerus*. Mantle (1968) has also related this pathogen to *C. gigantea* based on sclerotial characters. As *S. sorghi* was not able to infect *Pennisetum typhoides*, the ergot fungus occurring on this host appears to be different from that of sorghum sugary disease pathogen.

Summary: Ten cultivated millets and fourteen grass hosts were tested for their reaction to sorghum sugary disease pathogen *Sphacelia sorghi* by artificial inoculation. The pathogen infected maize, *Cenchrus ciliaris* and *C. setigerus*. The conidial size and shape of the pathogen were found to be varying on different hosts. The conidial size and shape on maize more or less resembled that of *Claviceps gigantea*. Under South Indian conditions, *C. ciliaris* and *C. setigerus* may probably serve as collateral hosts of this pathogen.

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