

Short Scientific Reports

Occurrence of Phosphate Solubilising Microorganisms in the Root Region of Arecanut Palms*

The arecanut cultivation is mainly restricted to the heavy rainfall belts. There are three distinct regions in Karnataka state namely, coastal, *malnad* and *maidan* area, where arecanut is cultivated. The fertilizer recommendation to arecanut is 100g N : 40g P : 140g K of which phosphate fertilizer is applied at a lower level. The availability of phosphorus (P_2O_5) to the plants is limited due to the phosphorus fixation in soil by the Al^{+++} and Fe^{++} ions. †The phosphate solubilising microorganisms play an important role in mobilising the phosphate and making it available to the plant. The occurrence of large numbers of phosphate dissolving microorganisms in the rhizosphere of plants was reported by many workers (Gerretsen, 1943; Louw and Webly, 1959; and Mehta and Bhide, 1970; Nair and Subba Rao, 1977). The present study deals with the occurrence and activity of the phosphate solubilising microorganisms in the root region of arecanut palms.

The soils were collected from the root region of the arecanut palms at 0-30 cm depths. The samples were collected from three locations of Karnataka state; Koppa - Sringeri area (Chikmagalur district), Thirthahalli (Shimoga district) and Central Plantation Crops Research Institute, Regional

Station, Vittal (Dakshina Kannada district). The Koppa-Sringeri and Thirthahalli represent *malnad* area whereas Vittal represents interior coastal area. The samples were collected from three palms in each locality and were mixed to have one composite sample. The non-rhizosphere soil was collected from the adjoining area. The soils were analysed for pH and organic carbon content.

Quantitative enumeration of phosphate solubilising microorganisms was carried out using modified Pikovskaya's medium (Pikovskaya, 1948) by soil dilution and plate count method of Timonin (1940). The purified cultures of phosphate solubilising bacteria, fungi and actinomycetes were maintained on nutrient agar (NA), Martin's rose bengal agar and Kuster's agar respectively. Bacterial isolates were identified based on the cultural, morphological and biochemical characters as described in Bergey's Manual of Determinative Bacteriology (VIII Edition, 1975). Fungal isolates were identified based on morphology and sporulation and the actinomycetes were numbered without identification.

In vitro estimation of the solubilisation of tricalcium phosphate by the different cultures were done by the

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method of Sethi and Subba Rao (1968). The pH of medium was measured on a pH meter at the end of incubation.

A range of bacteria, fungi and actinomycetes producing clear zone in modified Pikovskaya's medium were counted after three days of incubation for bacteria and five days for fungi and actinomycetes (Table I). The phosphate solubilising microorganisms was more in the rhizosphere of arecanut palms as compared to the non-rhizosphere soil.

Among the bacterial isolates, *Bacillus* sp., *Pseudomonas* sp. (2 isolates) and an unidentified bacterium were associated in the phosphate solubilisation. The fungal isolates were represented by *Aspergillus niger*, *Aspergillus* sp. (2 isolates) and *Penicillium* (2 isolates). Three actinomycetes were also isolated. The non-rhizosphere soil had a *Pseudomonas* sp., *Aspergillus* sp. and an actinomycete isolate and all other isolates were from the root region of arecanut palms. The different isolates showed varied degree of solubilisation of tricalcium phosphate (Table II). The *Pseudomonas* sp. isolated from arecanut rhizosphere recorded phosphate solubilisation to the extent

of 40.05 per cent. Fungal isolates *Aspergillus niger* and *Aspergillus* sp. were capable of solubilising inorganic phosphate to an extent of 45.6 per cent and 39.8 per cent respectively. Similarly a fungal isolate of *Aspergillus niger*, obtained from the root region of coconut palms has solubilised 49.00 per cent of the tricalcium phosphate (Nair and Subba Rao, 1977).

Microbial solubilisation of inorganic phosphate is brought about by the production of organic acids (Chhokkar and Subba Rao, 1967). The reduction of pH could primarily be due to the production of 2-ketogluconic acid by *Pseudomonas* sp. and citric acid by *A. niger* and *Aspergillus* sp. (Louw and Webley, 1959). The application of green leaf and farm yard manure (FYM) in arecanut plantation is a common practice by the growers and the organic matter addition encourages the proliferation of microflora in the root region. Rhizosphere studies have indicated that among the fungal flora, next to *Trichoderma* sp., the *Aspergillus* sp. were abundant in the root region (Bopaiah, 1979). Since the phosphate solubilising microorganisms occur in large numbers in the root region, rock phosphate appli-

Table I. Counts of phosphate solubilising microorganisms, pH and organic carbon content in different rhizosphere soils*

Location	Soil			
	pH	Organic carbon (%)	P-solubiliser	
			Non-rhizosphere 10 ³	Rhizosphere 10 ³
Koppa-Sringeri (Chikmagalur dist.)	5.65	1.03	2.00	8.33
Thirthahalli (Shimoga Dist.)	5.30	0.78	1.63	10.66
Vittal (Dakshina Kannada Dist.)	5.60	0.86	2.66	12.00

* Average of three replications

Table II. *The pH and solubilisation of tricalcium phosphate*

Isolate	P ₂ O ₅ in mg/50 ml medium* (Av. of triplicate)**	Ca ₃ (PO ₄) ₂ solubilised (%)	pH of the culture filtrate ***
<i>Bacillus</i> sp.	0.68	6.12	6.43
<i>Pseudomonas</i> sp. I	5.50	40.05	3.50
<i>Pseudomonas</i> sp. II (NR)	0.49	4.39	6.56
Unidentified bacteria	0.38	3.08	6.50
<i>Aspergillus niger</i>	11.04	45.60	3.00
<i>Aspergillus</i> sp. I (NR)	4.28	18.69	5.50
<i>Aspergillus</i> sp. II	9.85	39.80	4.88
<i>Penicillium</i> sp. I	1.61	6.99	6.13
<i>Penicillium</i> sp. II	0.78	3.34	6.05
Actinomycetes I	0.70	6.67	6.50
Actinomycetes II	0.23	1.00	6.18
Actinomycetes III (NR)	0.48	4.28	6.53

* 25 mg of tricalcium phosphate incorporated in 50 ml of the medium for bacteria and 50 mg for actinomycetes and fungi

** Value are expressed after subtracting the control values

*** pH of the culture medium after sterilization was 6.5

NR= Non rhizosphere soil

cation could be recommended to arecanut plantation. Further phosphate solubilising microorganisms overcome

the problem of phosphate fixation by dissolving the fixed phosphate and make it available to the palm for absorption.

Central Plantation Crops Research Institute
Regional Station, Vittal 574 243
Dakshina Kannada Dist., Karnataka, India.

B. M. BOPAIAH

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