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RESEARCH PAPER

Existence of Soil Flora in the Oil Palm Growing Areas of West Godavari District of Andhra Pradesh

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ABSTRACT

Soil microorganisms such as bacteria, play a central role in promoting soil fertility and plant health. The present study is aimed to isolate different groups of bacteria from the soils of various oil palm growing locations of West Godavari district, Andhra Pradesh. Soil samples were collected from different oil palm plantations and microorganisms were isolated by serial dilution and plate counting method. Twenty different genus and 72 isolates of bacteria were recorded from different locations based on morphological and biochemical characteristics, *Bacillus, Alcaligenes, Staphylococcus* and *Pseudomonas* genera being the most dominant in these areas. The study helps in monitoring the dynamics of micro organisms and management of soil in the oil palm plantations.

Key words : Oil palm, bacteria, soil fertility

INTRODUCTION

Microorganisms present in the soil play an important role in the release of nutrients and carbon dioxide required for plant growth and are generally referred to as the microbial biomass. Bacteria are the most abundant group of microorganisms present in the soil and are essential for nutrients and organic matter turnover (Horwath and Paul, 1994) and geochemical cycles such as the carbon, nitrogen, sulphur and phosphorus cycles. The number and type of bacteria present in a particular soil would be greatly influenced by geographical location i.e., soil temperature, soil type, soil pH, organic matter content, cultivation, aeration and moisture content (Davies and Williams, 1999).

Soil microbial biomass is an important soil indicator of overall soil health and quality. There is a relationship between microbial diversity and soil functionality, by considering that 80-90 % of the processes in soil are reactions mediated by microbes (Coleman and Crossley, 1996; Nannipieri and Badalucco, 2003). All organisms in the biosphere depend on microbial activity (Pace, 1997). In agriculture, bacteria are important with respect to their contribution either in the form of loss or gain in the production.

Oil palm cultivation is gaining momentum in India due to its importance as the highest edible oil yielding crop (4-6 tonnes oil/ha/yr). Around 1.5 lakh ha is under oil palm cultivation in the state of Andhra Pradesh, the highest amongst Indian states. In India, oil palm is being grown under irrigated conditions and the fertilizer requirement is much higher compared to oil palm grown under rainfed conditions. And also, oil palm is a gross feeder and demands a balanced and adequate supply of nutrients. The dose and type of fertilizers to be applied in any location should be based on complete fertilizer experiments.

The present study was undertaken for the identification and abundance of soil microorganisms in the oil palm growing soils to reveal the characteristic distribution and diversity with special reference to some bacteria. The study involves isolation, identification and enumeration of bacterial species from the soils of 13 different oil palm growing locations of West Godavari district, Andhra Pradesh.

MATERIALS AND METHODS

The investigation consisted of collection of soil samples from oil palm plantations located in 13 locations of West Godavari district, Andhra Pradesh. The area lies between 17.00^0 N and 81.16^0 E Latitude. Soil samples were collected from 0-15 cm deep pits dug in the area to be sampled. Soil was scraped along the walls of the pits and collected in polythene bags. Soil from 5 pits was pooled together and mixed. All samples were kept in plastic bags and transported to the laboratory and stored at 4^{0}C prior to analysis. Portion of these samples were air-dried and ground to pass through 2 mm sieve before the physical analysis. The samples were analyzed for pH and texture.

The temperature of the soil at 5 different sites was determined using thermometer. The thermometer was inserted into the soil up to a depth of 0-15 cm and allowed to stay for 10 minutes, after which the temperature reading was obtained. Soil pH was determined by digital pH meter by adopting standard procedures.

Microbial population was estimated by plate count method (Ravina *et al*, 1992; Thompson, 1989; Vincent, 1982). To differentiate between gram positive and gram negative bacteria, Gram's staining was done as per Todar *et al.,* 2005. Biochemical characterizations of bacteria were done by IMViC tests. Identification of microbes was done with the help of standard biochemical techniques.

RESULTS AND DISCUSSION

Soil physical properties

The soils of different locations of West Godavari district are sandy, sandy loamy and loamy sand in texture. The pH values ranged from 5 - 8, which favors microbial growth (Table 1). However, differences in the soil pH among the sampling locations were statistically significant. The soil temperature ranged between 30^{0}C and 38^{0}C. The sand percentage ranged from 44.0 - 86.5 %, silt was 5.2 - 28.2 %, clay percentage ranged from 1.9 - 31.5 %. Activity and species composition of microorganisms are generally influenced by many factors including physico chemical properties of the soil, temperature and vegetation (Jha *et al*., 1992).

Morphological characteristics of colonies

The shape and colour of the colonies are important characteristics during identification of the bacteria. By morphological characteristics, shapes of the colonies were mostly round in soils of Koppulavarigudem, Bimadolu, Buttaigudem, Chepurugudem, Denduluru, Nallajarla and Kamavarapukota, except in Vegiwada, Pedavegi, Jangareddigudem and T. Narsapuram. In these areas the colonies varied from irregular (T. Narsapuram) to

Table 1: Variations in soil physical properties of oil palm growing soils

Locations	Nature of soil	Soil texture			Soil pH
		Sand (%)	Silt (%)	Clay (%)	
Pedavegi	Sandy loam red	68.9	28.2	2.7	6.5
Munduru	Sandy loam brown	61.1	25.9	12.9	6.0
Koppulavarigudem	Loamy sand red	80.0	11.4	8.5	5.0
Bhimadolu	Sandy clay loam red	63.1	5.2	31.5	5.0
Buttayagudem	Loam sand brown	86.5	11.5	1.9	6.0
Chepurigudem	Loamy sand light brown	80.5	13.8	5.6	6.0
Denduluru	Loam dark brown	44.0	44.0	16.0	6.0
Jangareddygudem	Loamy sand brown	80.0	17.5	2.5	6.0
Nallajarla	Loamy sand light brown	80.0	17.5	2.5	6.0
T.Narasapuram	Sandy loam brown	69.2	19.0	4.6	6.5
Tadepalligudem	Loamy sand light brown	77.7	19.5	2.7	8.0
Vegiwada	Loamy sand light brown	69.0	28.0	2.6	6.8
Kamavarapukota	Sandy loam brown	80.0	17.5	2.5	6.0

Table 2 : Morphological characteristics of colonies

LOCATION	SHAPE	PIGMENT	MARGIN	ELEVATION	SURFACE	DENSITY	GRAMSTAINING
Vegiwada	Mostly round, few are irregular, filamentous, rhizoid, oval, and filiform.	Mostly white and few are creamish to pink and orange.	Mostly smooth, few with lobate, few ciliate and few wavy.	Mostly flat, few umbonate, and few hilly.	Mostly shiny, and few powdery	Mostly opaque, very few are translucent.	Mostly positive bacilli, very few are – vecoccobacilli
Mundur	Mostly round, very few are rhizoid to irregular.	Few cream, few light orange	Mostly smooth, few are wavy	Mostly flat and very few are hilly.	Mostly shiny, very few are dull and powdery	Mostly opaque, very few are transparent.	Mostly +vecocci in groups, very few are –ve bacilli.
Koppula vari gudem	Mostly round	Mostly cream.	Mostly smooth, few are wavy	Mostly flat, few umbonate, and few hilly to convex.	Mostly shiny, very few are dull.	Mostly opaque, very few are transparent.	+vecocci in chains and +vecocci
Pedavegi	Mostly irregular, few with wrinkled.	Mostly cream, few with light golden.	Mostly irregular, few lobate, wavy, and smooth	Mostly hilly, very few are convex and flat.	Mostly shiny, and few powdery, and dull.	All are opaque.	-ve bacilli
Bimadolu	Mostly round	Mostly light cream.	Mostly smooth, few are wooly.	Mostly raised.	Mostly shiny, few are dull.	Mostly opaque.	-ve bacilli
Buttaya gudem	Mostly round with scalloped margin.	Cream to whitish.	Mostly smooth to wavy.	Mostly flat and raised.	Mostly dull and few are shiny	Mostly opaque few translucent.	-ve bacilli
Chepuri gudem	Mostly round.	Mostly light cream.	Mostly smooth.	Mostly flat and few convex.	All are shiny.	Mostly opaque few transparent.	-ve bacilli-vecocco bacilli
Denduluru	Mostly round and few are irregular.	Mostly cream.	Mostly smooth.	Mostly flat and few convex.	Mostly dull.	Both transparent and opaque.	Mostly+ vecocci, few –ve bacilli.
Jangareddy gudem	Mostly irregular and spreading.	White.	Mostly smooth and few are wavy.	Convex and raised	Mostly shiny.	Mostly opaque	-vecocco bacilli and –vecocco bacilli.
Nallajarla	Mostly round.	Mostly white few cream.	Mostly smooth and few are hair loc and branching.	Convex, flat, and raised	All are shiny.	Mostly opaque and few transparent.	-ve bacilli and –vecocco bacilli.
T. Narasa puram	Irregular and spreading	Mostly white few cream.	Mostly smooth and wavy.	Convex, flat, and raised	All are shiny and few are dull.	Mostly transparent and few opaque.	-vecocci bacilli
Tadepalli gudem	Mostly round and very few are Irregular.	Mostly cream few white.	Mostly smooth.	Mostly flat and few convex.	All are shiny.	Mostly opaque, few are transparent.	-ve bacilli
Kamavarapu kota	Mostly round.	Yellow to white.	Mostly irregular and smooth.	Mostly flat, and convex.	All are shiny.	Mostly opaque.	-ve bacilli

rhizoid (Munduru, Vegiwada) in shape and some are filamentous growth *(Streptococci*). Colour of the colonies was mostly cream, while some are white, pink, orange, golden and yellow in colour. Different margins were observed in bacterial colonies of different areas, ranging from smooth to wavy but most colonies were with smooth margin. The colonies had flat (Buttaigudem), raised (Bimadolu, Buttaigudem), umbonate (Koppulavarigudem) or hilly to convex (Pedavegi) elevation. Density of the colonies was opaque to translucent, however, most of the colonies were opaque in nature (Table 2).

Bacterial isolations

Different bacterial isolates were isolated from oil palm growing soils of different locations (Table 3). Throughout the sampling locations, a total of 20 distinct isolates of bacteria were identified up to genus and species, of which, species of *Bacillus, Alcaligenes*, *Staphylococcus* and *Pseudomonas* genera being the most dominant. The least abundant genera were *Streptococcus, Achromobact, Microccous, Proteus, Serratia, Moraxella, Neisseria, Kingella, Lactobacillus, Klebsiella, Shewanella, Shigella*. Most of the bacteria such *as Bacillus, Actinomycetes*, *Staphylococcus* and *Streptococcus* isolated in this study have been reported by other workers (Amir and Pineau, 1998; Okoh *et al*., 1999). Soil samples exhibited high incidence of total cultureable bacteria in Muduru and Tadepalligudem locations, when compared to other locations. High microbial diversity is assumed to be critical for the stability of ecosystems by providing functional diversity and redundancy (Bell *et al*., 2005)). In the soil samples, Gram negative bacteria showed a high incidence, compared to that of Gram positive bacteria. The use of bacteria, actinomycetes and fungi in the decomposition of organic matter produces good results by taking advantage of their enzymatic activities, favoring the elimination of organic waste and providing beneficial metabolic products to the soil (Tiquia *et al*., 2002; Singh and Sharma, 2003). Taha *et al*., 1969 found that the principal genera of phosphate solubilizing bacteria were *Arthobacter, Pseudomonas, Xanthomonas, Achromobacter* and *Flavobacterium*.

This study reveals that, some of the identified bacterial species may be useful as agriculturally important bacteria for better growth of oil palm. Intensive agricultural practices were shown to affect soil microbial community composition, activity and soil physicochemical properties (Calderon *et al.,* 2001;

Table 3: Identification of bacteria by morphological and biochemical characteristics

LOCATION	BACTERIA ISOLATED
Vegiwada	*Bacillus pumilus, Acinetobactercalcoace aticus, Bacillus pantothenticus, Bacillus anthracis*
Munduru	*Alcaligenes enitrificans, Streptococcus mutans, Enterococcus casseliflavus, Staphylo coccus caseolyticus, Staphylo coccus auricularis, Bacillus badius, Bacillus pantothenticus, Staphylococcus capitis, Bacillus alvei, Achromobacterxylosoxidans, Staphylo coccus capitis, Pseudomonas stutzeri, Staphylococcus simulans, Pseudomonas diminute*
Koppulavarigudem	*Bacillus stearothermophilus (Group II), Streptococcus bovis biotype I, Bacillus lentus, Staphylo coccus caseolyticus, Staphylo coccus capitis, Pseudomonas diminute*
Pedavegi	*Achromobacterxylosoxidans, Pseudomonas diminuta, Pseudomonas putrefaciens, Salmonella pullorum, Pseudomonas cepacia, Klebsiella oxytoca*
Bimadolu	*Lactobacillus acidophilus, Salmonella typhimurium, Enterococcus faecalis, Serratiamarcescens, Alcaligenes faecalis*
Buttayagudem	*Alcaligenes faecalis, Alcaligenes denitrificans, Serratiamarce scens, Salmonella typhimurium, Alcaligenes faecalis, Staphylococcus aureus*
Chepurigudem	*Neisseria gonorrhoeae, Alcaligenes denitrificans, Acinetobacterc alcoaecticus, Salmonella typhimurium, Lactobacillus acidophilus, Pseudomonas pseudoal caligenes, Shewanell aputrefaciens, Enterococcus durans*
Denduluru	*Enterococcus casseliflovus, Staphylococcus epidermis, Micrococcus luteus, Staphylococcus aureus*
Jangareddygudem	*Alcaligenes denitrificans*, *Enterococcus faecalis*
Nallajarla	*Kingellakingae, Acinetob acterlwoffi, Neisseria haemolysans, Acinetobacter calcoaecticus*
T.Narasapuram	*Kingellakingae, Pseudomonas pseudoalcaligenes, Moraxella lacunata*
Tadepalligudem	*Alcaligenes faecalis, Micrococcus ureae, Salmonella typhimurium, Pseudomonas aeruginosa, Proteus vulgaris, Roteus mirabilis, Alcaligenes faecalis, Proteus vulgaris*
K.Varapukota	*Shigella flexneri, Neisseria gonorrhoeae*

Zhao et *al*., 2005). Hence, we must encourage the farmers towards application of biofertilizers for safe and sustainable agriculture without losing the most important asset of farmers - the soil.

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