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Short communication

Diversity of bacteria in the rhizosphere of major horticultural crops in the tropical homesteads of Kerala

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ABSTRACT

A study was conducted on bacterial diversity associated with the crops of homestead gardens of three diverse and important districts of Kerala with the prime objective of identifying the beneficial micro-organisms. In homesteads, *Bacillus* sp. was the most predominant among the bacterial isolates in all the soil samples collected. Actinomycetes diversity was less. Only *Streptomyces griseus* and *S. albus* were identified in the teak, banana, coconut, mangosteen, sapota, *gummi gutta* and betel vine of Ernakulam district, whereas, *S. griseus* was the only species of actinomycetes identified in coffee and banana in Wayanad district and coconut and arecanut in Palakkad district.

Key words: Actinomycetes, bacteria, microbial diversity, horticultural crops, tropical homesteads.

Homesteads are the important symbol of staggered settlement pattern in Kerala that influences the unique living standards of people, cultural identity and socio-economic features. Horticulture perennial crops mostly plantation, spice and fruit crops form the major components of Kerala homegardens. The most preferred crop in homesteads are coconut followed by banana, spices, vegetables etc. Knowledge of microbial diversity is weak for soil bacteria which has direct influence on a wide range of soil processes and growth of crops. However, both composition and diversity of soil bacterial communities are influenced by a wide range of biotic and abiotic factors (Buckley and Schmidt, 1). Bacterial diversity associated with wheat in the Uttarkashi district revealed 133 different bacterial isolates in two rainfed and two irrigated areas (Joshi and Bhatt,4). Li-hua Xu *et.al*. (5) reported the presence of *Streptomyces, Micromonospora*, *Actinomadura* and *Nocardia* in almost all types of soil selected in the study. As there is variation in the microbial diversity under different soil types with different host plant, the present studies were aimed to determine the diversity of bacteria in the rhizosphere soils of major plantation crops under three diverse and distinct regions in tropical homesteads of the Kerala.

The rhizosphere soil samples were collected from homesteads in Ernakulam, Wayanad and Palakkad districts of Kerala. The bacteria and actinomycetes were isolated by pour-plate method using serial-dilution technique (Johnson and Curl, 3). For isolation of bacteria, 10^{-6} dilution was used with soil extract agar media and nutrient agar media. Similarly, the dilution used for actinomycetes was 10^{-5} with Kenknight's agar media. All the isolates of bacteria were purified by streak- plate method and actinomycetes were purified by single-spore method (Choi *et al*., 2) on a suitable media. After incubation at 28°C +/- 2, the bacteria and actinomycetes population were counted after 2, 5, 7 and 14 days of incubation. The bacterial cultures were subjected to morphological and biochemical characterization as described in Bergey's Manual of Determinative Bacteriology for the identification of bacteria. Identity of these isolates was further confirmed at Institute of Microbial Technology (IMTECH), Chandigarh. The identity of actinomycetes cultures were done at National Centre for Fungal Taxonomy (NCFT), New Delhi.

Among the bacterial population, highest population was noticed in the homesteads of Ernakulam district followed by Palakkad and Wayanad district. The actinomycetes population was highest in the Wayanad district followed by Ernakulam and Palakkad districts. In coastal region (Ernakulam district), there was more bacterial diversity in the homesteads. The bacteria found in the rhizosphere soils of homesteads in Ernakulam were *Bacillus* sp*., Paenibacillus* sp., *Lysinibacillus* sp., *Pseudomonas* sp., *Brevibacter* sp. and *Staphylococcus* sp. (Table 1). The actinomycetes *Streptomyces griseus* and *S. albus* were common in the rhizosphere of teak, banana, coconut, mangosteen, sapota, *gummi gutta* and betel vine. In the case of high range region (Wayanad district), the bacteria recorded were *Bacillus sp*., *Alcaligenes feacalis* and *Acinetobacter* sp. Among

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Table 1. Identification of bacteria and actinomycetes in the rhizosphere of plantation crops in the selected homesteads of Kerala.

Area	Host	Bacteria with isolate code	Actinomycetes with isolate code
Ernakulam	Nutmeg	*Bacillus* sp. (EKM 1N), *Bacillus* sp. (EKM 5N), *Bacillus megaterium* (EKM 4N), *Bacillus* sp. (EKM 5C), *Pseudomonas salomonii* (EKM 6N)	*Streptomyces griseus* (EKM 9N), *Streptomyces griseus* (EKM 3COC)
	Colocasia	*Bacillus sp* (EKM 6 COL), *Paenibacillus* sp. (EKM 1CS)	Not obtained
	Coconut	*Bacillus sp* (EKM 7C), *Lysinibacillus* sp. (EKM 1A), *Bacillus cereus* (EKM 4C), *Bacillus cereus* (EKM 1C), *Staphylococcus* sp. (EKM 3COC)	*Streptomyces griseus* (EKM 1C-3)
	Arecanut	*Paenibacillus* sp. (EKM 8A), *Bacillus anthracis* (EKM 5A)	*Streptomyces albus* (EKM 5A)
	Betal vine	*Bacillus* sp. (EKM 6BV)	*Streptomyces griseus* (EKM 6BV)
	Banana	*Bacillus* sp. (EKM 6B), *Bacillus* sp. (EKM 5B), *Pseudomonas* sp. (EKM 2GG), *Bacillus* sp. (EKM 3B), *Bacillus* sp. (EKM 2N), *Paenibacillus* sp.(EKM 3B), *Paenibacillus* sp. (EKM 4B2)	*Streptomyces griseus* (EKM 2B), *Streptomyces albus* (EKM 3B), *Streptomyces albus* (EKM 4p), *Streptomyces griseus* (EKM 1B)
	Teak	*Bacillus* sp. (EKM 8T), *Bacillus* sp. (EKM 1T)	*Streptomyces albus* (EKM 8T)
	Mango	*Bacillus* sp. (EKM 5MG)	Not obtained
	Mangosteen	*Lysinibacillus* sp. (EKM 5MS)	*Streptomyces albus* (EKM 1MS)
	Pepper	*Bacillus* sp. (EKM 6P), *Brevibacillus fluminis* (EKM1P)	*Streptomyces griseus* (EKM 1p), *Streptomyces griseus* (EKM 6P)
	Sappota	*Lysinibacillus* (EKM 5S)	*Streptomyces albus* (EKM 5S)
	Rubber	*Brevibacterium* sp. (EKM 4RB)	*Streptomyces griseus* (EKM 4RB)
	Gummigutta	*Bacillus* sp. (EKM 7G2)	*Streptomyces albus* (EKM 2GG)
	Mahagony	*Bacillus* sp. (EKM 3M)	Not obtained
	Ginger	*Bacillus acidiceler* (EKM 7G-2), *Bacillus korlesis* (EKM 7G-1)	Not obtained
	Jacktree	Not obtained	*Streptomyces griseus* (EKM 4R)
Wayanad	Coconut	*Bacillus* sp. (WYD 11-1), *Bacillus* sp. (WYD 11-2), *Alcaligenes faecalis* subsp. *Parafaecalis* (WYD 5-1), *Bacillus* sp. (WYD 5-2), *Bacillus* sp. (WYD 2-3), *Bacillus* sp. (WYD 2-2)	Not obtained
	Arecanut	*Bacillus* sp. (WYD 10-1), *Bacillus anthracis* (WYD 3-1)	Not obtained
	Coffee	*Bacillus* sp. (WYD 9-1), *Bacillus* sp. (WYD 8-2), *Bacillus anthracis* (WYD 8-3), *Acinetobacter* sp. (WYD 1-1)	Not obtained
	Pepper	*Bacillus* sp. (WYD 7-2), *Bacillus* sp. (WYD 4-1), *Bacillus* sp. (WYD 13-2), *Bacillus anthracis* (WYD 7-1), *Bacillus aryabhattai* (WYD 8-1), *Bacillus anthracis* (WYD 13-1)	Not obtained
	Cocoa	*Bacillus cereus* (WYD 16-1)	Not obtained
	Banana	*Bacillus mycoids* (WYD 9-2), *Bacillus* sp. (WYD 6-2)	Not obtained
	Cardamom	*Bacillus* sp. (WYD 14-1)	Not obtained
	Banana	Not identified (WYD 6-1)	Not obtained

the actinomycetes, only *Streptomyces griseus* were found in the homesteads of Wayanad district and that too in coffee and banana. In the dry region (Palakkad district), *Bacillus* sp. was most common.

Bacillus sp. was predominant in most of the soil samples collected particularly in high range region (Wayanad district). Nandhini and Mary Josephine (6) also reported the predominance of *Bacillus* sp. and *Pseudomonas* sp. in the potting soil for plants in pots and flower boxes. *Bacillus* is one of the most potential PGPR due to their spore forming ability and better adaptation to stress conditions. In a similar study, Joshi and Bhatt (4) reported that in the rhizosphere of wheat, 44% were *Bacillus* sp. and 24% belonged to *Pseudomonas* sp. Sometimes, the changes in composition or species diversity of above-ground communities can also effect the composition and function of below-ground communities and *vice versa* (Van der Heijden, 7). The present studies revealed the presence of *Bacillus* sp. in majority of the regions and horticultural crops. Actinomycetes diversity was less in the present studies. Only *Streptomyces griseus* and *S. albus* were found in the coastal region of Ernakulam district whereas, *S. griseus* was the only species of actinomycetes found in Wayanad and Palakkad districts, that too in coconut, arecanut (Palakkad district),coffee, banana (Wayanad district) teak and banana, coconut, mangosteen, sapota, *gummi gutta* and betel vine (Ernakulam district). Li-hua *et al*. (5) reported *Streptomyces* to be the most important genus in ecological function. He also found *Streptomyces* strains, which represented 88% of the total actinomycetes in eight vegetable farmland areas of Yunnan, China, which is in agreement with the present studies. The results of the microflora in homesteads of Ernakulum clearly showed species richness and diversity with respect to the host plants.

The association and diversity of bacteria in the horticultural crops of tropical homesteads have been explored and the most predominant bacteria and actinomycetes found in the rhizosphere of horticultural crops were *Bacillus* sp. and *Streptomyces* sp. respectively. Both these isolates are well known as potential antagonists for effective plant disease management and *Bacillus* sp. is already exploited in plant growth promotion for different crops but needs to be exploited in the horticultural crops. Future line of work is to screen the efficiency of these bacteria and actinomycetes so that a suitable bio-inoculant can be developed for the horticultural crops under homesteads.

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