Indian Journal of Natural Rubber Research, **14**(1) : 55 - 59, 2001

INFLUENCE OF INTERCROPPING ON THE RHIZOSPHERE MICROFLORA OF *HEVEA*

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Vimalakumari, T.G., Joseph, K., Jessy, M.D., Kothandaraman, R., Mathew, J. and Punnoose, K.I. (2001). Influence of intercropping on the rhizosphere microflora of *Hevea*. *Indian Journal of Natural Rubber Research*, **14**(1) : 55 - 59.

A comparative study of the rhizosphere microbial population of *Hevea* grown either as monocrop or along with other intercrops was carried out. Enumeration of soil samples for bacteria, fungi, actinomycetes and phosphobacteria indicated higher total microbial populations in rhizosphere of *Hevea* under intercropping but the count varied with the type of intercrop. The VAM colonization and the number of phosphobacteria harboured were more in the roots of Hevea under intercropping.

Key words : *Hevea*, Intercrop, Rhizosphere microflora.

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INTRODUCTION

Rhizosphere of plants consists of a consortium of microorganisms, which include symbionts and saprophytes capable of imparting beneficial effects on plants. They play a major role in the availability and uptake of nutrients, production of plant growth regulators, antibiotics, siderophores and also influence the growth and morphology of roots. Various organic substances and organic acids are excreted by plant roots into the rhizosphere and they form a rich source of nutrients for the microbial community. Nature and amount of substances excreted by the root is dependent on plant species, age, etc. (Bowen and Rovira, 1976). The practice of intercropping is being followed recently in *Hevea* plantations to get more income by utilising the vacant spaces between rows of standing trees. It has been observed that *Hevea* under intercropping registered a better growth than as monocrop (Jessy *et al.*, 1996). Intercropping with different types of crops might have altered the nutritional status of the rhizosphere of *Hevea*. A comparative study of rhizosphere microbial population of *Hevea* under different intercrops and as monocrop was carried out to acertain their role.

MATERIALS AND METHODS

Soil samples from rhizosphere of *Hevea* were collected from fields of an intercrop trial laid out at Central Experimental Station of the Rubber Research Institute of India at Chethackal. The experiment was laid out in 1993. Rubber was planted in paired rows at a spacing of 9.0 m with the distance within the paired row being 5.1 m. Black pepper on *Erythrina* standards, coffee, pineapple and a variety of annual crops were planted in the wider space and a legume cover *Pueraria phaseoloides* was established in the narrow interrow area. Teak and fodder grass were planted along the borders. The detailed description of the lay out of the experiment is given elsewhere (Jessy *et al.*, 1996). After cultivating banana for the first two years, tuber crops were planted in its place. The samples were collected from the treatment plots detailed in Table 1. Roots with adhering soil were collected and the roots separated from the block of soil with minimal tearing and used for the enumeration of microbial population.

Enumeration of total microbial population

Soil dilution and plate counts were employed to enumerate rhizosphere microflora. Bacterial, phosphobacterial, actinomycetes and fungal populations were enumerated using soil extract agar, apatite agar, Kenknight's agar and Martin's rose bengal agar respectively. The plates were incubated at 28±2°C. The microbial counts were expressed on oven dry weight of soil.

Mycorrhizal spore count and root infection

Vesicular arbuscular mycorrhizae (VAM) spores were collected by wet sieving and decanting method as described by

Table 1. **Microbial population (cfu per g of soil) in the rhizosphere of different intercrops and *Hevea***

Treatment	Bacteria (x 10^6)	Fungi (x 10^4)	Actinomycetes (x 10^3)	Phosphobacteria (x10^5)
Pineapple	17.2	255	64	28
Coleus	14.0	149	77	32
Yam	11.8	93	32	17
Sweet potato	11.3	100	58	25
Pueraria	10.9	185	50	34
Fodder grass	9.8	190	64	43
Arrowroot	5.6	68	38	9
Coffee	5.26	45	18	12
Pepper	5.4	67	45	8
Teak	8.2	7	27	7
Hevea in pineapple	39.3	124	42	29
in coleus	28.8	108	37	8
in yam	23.4	98	14	11
in sweet potato	17.7	94	40	19
in *Pueraria*	14.7	94	50	22
in fodder grass & teak	14.2	118	43	22
in arrowroot	9.1	75	36	3
in coffee	9.4	25	10	10
in pepper	13.3	46	46	6
Hevea monocrop	9.8	85	36	9
CD (P=0.05)	4.2	29.18	17.34	8.17

Gerdemann and Nicolson (1963) and counted using stereomicroscope. Percentage VAM colonization in the root samples was estimated using standard methodology (Phillips and Hayman, 1970).

RESULTS

The population of different groups of microorganisms in the rhizosphere of the intercrops and *Hevea* under intercropping are presented in Table 1. A wide variation in microbial population was observed with respect to *Hevea* and intercrops. In general, rhizosphere of *Hevea* under intercropping harboured higher bacterial population than *Hevea* as monocrop. *Hevea* roots in pineapple intercropped plot recorded significantly higher bacterial population while arrowroot intercropped plot recorded lesser number. There was also a wide variation in rhizosphere bacterial population among different intercrops. Pineapple harboured highest rhizosphere bacterial population (17.2 x 10^6). Fungal microflora for different treatments varied from 255 x 10^4 cfu per g of soil for pineapple to 45 x 10^4 cfu per g of soil for coffee. *Hevea* under different intercropping had higher fungal population than *Hevea* as monocrop. *Hevea* intercropped with pineapple, grass and teak harboured comparatively higher fungal population, whereas with coffee it had a lower. The count of actinomycetes, ranged from 10 – 77 x 10^4 cfu per g of soil. More actinomycetes population was recorded in rhizosphere samples of *Hevea* under intercropping than as monocrop. *Hevea* in c grass, teak and pineapple intercropping showed significantly higher phosphobacterial population. VAM colonization of *Hevea* roots under different intercrops varied from 64 to 94 per cent (Table 2). *Hevea* intercropped with grass and teak had higher VAM colonization followed by *Hevea* with yam. VAM spore count in rhizosphere of different crops ranged from 158 to 296 spores per 20 g of soil. *Hevea* intercropped with pineapple showed comparatively higher spore count and *Hevea* with coffee had a lower spore count.

Table 2. **Mycorrhizal colonization (%) and spore count (per 20 g of soil) in the rhizosphere of different intercrops and *Hevea***

Treatment	Colonization	No. of spores
Pineapple	91	264
Coleus	82	258
Yam	88	248
Sweet potato	66	200
Pueraria	70	212
Fodder grass	94	296
Arrowroot	77	234
Coffee	50	158
Pepper	51	182
Teak	68	168
Hevea in pineapple	80	248
in coleus	78	222
in yam	82	232
in sweet potato	79	228
in *Pueraria*	74	210
in fodder grass & teak	84	262
in arrowroot	74	224
in coffee	64	175
in pepper	69	182
Hevea monocrop	65	20
CD (P=0.05)	18.36	45

DISCUSSION

The present study shows that rhizosphere of *Hevea* harboured all groups of microbes including beneficial microbes like phosphobacteria and VAM fungi. Due to intercropping in *Hevea*, there was a general increase in rhizosphere microflora and the population varied depending upon the type of intercrop. *Hevea* intercropped with pineapple harboured significantly higher bacterial and fungal population whereas

Hevea with coffee had lesser population. This might be due to the qualitative difference in the root exudates of these intercrops and their impact on the rhizosphere microflora.

Similarly, intercrops harbouring more number of rhizosphere microflora had a positive influence on rhizosphere microflora of *Hevea*. This correlation was found for most of the intercrops. These results are in corroboration with findings of Nair and Rao (1977), who reported that cocoa rhizosphere harbouring more microflora, when grown as intercrop with coconut possibly influenced the coconut rhizosphere microflora. Actinomycetes are the group of microbes whose enrichment in soil could have a role in maintenance of soil health, because many of these organisms show antagonism against soil borne pathogens (Waksman and Woodruff, 1940). In our study, *Hevea* in different intercrops generally harboured higher actinomycetes population than *Hevea* as monocrop. In particular, *Hevea* with pineapple and *Pueraria* harboured more number of actinomycetes and *Hevea* with coffee harboured lesser number. The enhanced microbial activity under the intercropped situation may be one of the factors contributing to increased growth of rubber as reported by Jessy *et al.* (1996). Even though the microorganisms are small, they exert large effects – neutral, beneficial or antagonistic on macro system (Bopaiah and Shekarshetty, 1991). This is true with reference to beneficial microbes like phosphobacteria and VAM fungi. An increase in the available P content of the soil under intercropped conditions of *Hevea* was reported. (Zainol *et al.*, 1993; Jessy *et al.*, 1996). The increased activity of phosphorus solubilising microorganisms and vesicular arbuscular mycorrhizal fungi under intercropped situation might be one of the factors contributing to the increase in the available P content under intercropping.

Hevea intercropped with pineapple, grass and *Pueraria* showed significant increase in phosphobacterial population. A correlation was observed between phosphobacteria and VAM colonization also. *Hevea* rhizosphere harbouring more phosphobacterial population also had higher spore numbers and VAM root colonization. In the intercropped area, there was increased application of rock phosphate. Phosphorus solubilising microorganisms would have acted on the applied rock phosphate to release soluble P and mycorrhizae would have enhanced the P uptake. This is in accordance with Barea *et al.* (1975) who had reported that maize seedlings inoculated with phosphate solubilising bacteria harboured higher VAM population and the two organisms had a synergistic effect on availability of P in soil.

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