# FFECT OF CROP MIXING ON THE COCONUT RHIZOSPHERE

V. P. POTTY[1], MATHEW GEORGE[2] AND N. P. JAYASANKAR[3]

ot system of plants including tree crops har- vast population of micro-organisms. The dwelling on the root zone differs in num- ttern from those existing in the surrounding region of the soil which is close to the roots influence is defined as the 'rhizosphere' a d by Hiltner as early as in 1904. The rhizos- ion assumes importance as it has a direct n the growth and health of the plant, where ction between the soil micro-organisms and is implicated. The root exudates of culti- nts exert a profound influence on the rhizos- croflora. The dominant rhizosphere micro- normally consist of the bacteria, actino- and fungi. Microbiological studies on the oils have revealed certain important observa- ing to the microflora and the coconut palms.

ixing is one of the oldest cultivational prac- cientific investigations on the influence of ng in coconut gardens have gathered momen- ecent years. Efficient methods to check the ) disease are still obscure. The mixed far- the mixed cropping trials undertaken at this Station have recorded a beneficial influence ield of coconut in root (wilt) affected palms. rming facilitates organic recycling. This will the number and activity of the soil micro- he consequent alteration of the soil micro- s in the rhizosphere exerts an influence on

n fixing and phosphate solubilising micro- he root region of cultivated plants contribute lly to the uptake of these crop nutrients. l nitrogen fixation is the main mode of nitro- tion of agricultural crops particularly in the g nations. This is mainly because the pro- of nitrogenous fertilizers cannot meet the mand and the country needs the import of these fertilizers. Intensive agricultural practices accelerate the flow of available nitrogen in the soils. The atmosphere contains about 78 per cent of nitrogen which can be made useful to the living systems only when combined with either oxygen or hydrogen. Certain soil micro-organisms can convert the atmospheric nitrogen into ammonia and aminoacids which form the precursors of proteins to the plants. An approximate estimate indicates biological nitrogen fixation to the tune of 90 million metric tons. The classical free living bacteria capable of fixing atmospheric nitrogen are species of *Azotobacter* and *Clostridium*. More sensitive screening techniques have revealed this ability in other genera including heterotrophic, chemo-autotrophic and photosynthetic bacteria. They consist of *Achromobacter, Aerobacter, Azotomonas, Bacillus, Beijerinkia, Chromatium, Chlorobium; Derxia, Enterobacter, Klebsiella, Methanobacillus, Mycobacterium, Rhodomicrobium, Rhodopseudomonas* and *Rhodospirillum*. The biological constituent facilitating the nitrogen fixation is the enzyme nitrogenase. The chain of events leading to the assimilation of nitrogen can be summarised as the reduction of atmospheric nitrogen to ammonia followed by its conversion to organo nitrogen compounds.

Insoluble inorganic phosphorus compounds are not assimilated by the plant, but a variety of soil micro-organisms can solubilise the phosphate to a form assimilable to the plants. Generally the insoluble phosphorus compounds are mineralized by the production of organic acids with the exception of chemoautotrophic bacteria which produce nitric and sulphuric acids instead of organic acids. In the case of Ferric phosphate, the mechanism appears different. Certain micro-organisms possess the ability to produce hydrogen sulphide which combines with the Ferric phosphate forming Ferric sulphide and liberating the phosphates. The large reservoirs of organic phosphorus available in the soil get converted by certain fungi, bac-

ientist S. 2. Research Assistant 3. Plant Pathologist (Microbiology)
al Plantation Crops Research Institute, Regional Station, Krishnapuram—690533, Kayangulam, Kerala, India.

teria and actinomycetes possessing the ability to solubilise phosphorus. The bound phosphorus in the plant residues and soil organic matter are thus made available to the succeeding crop generations. The population of phosphate solubilising micro-organisms is normally abundant in the root zone of plants. The phosphate solubilising micro-flora in the root region therefore gain significance. Available phosphorus in the root zone can as well exert a favourable influence on the incidence of nitrogen fixing organisms.

Experiments conducted have provided certain positive indications on crop mixing. Cultivation of hybrid napier, as fodder grass, in root (wilt) affected coconut gardens results in favourable alteration in the soil microflora and the micro-organisms colonising on the coconut root surface.

Slips of Hybrid napier were planted in rows at 25 cm distance between plants and 80 cm between rows, leaving a basin of 2 m. radius around the coconut palms. The manurial schedule for the coconut was 0.5 kg. N; 0.32 kg. $P_2O_5$; 1.2 kg. $K_2O$; 0.75 kg. CaO and 0.5 kg. MgO/tree/year, applied to the basins in two split doses Fifty kg. $P_2O_5$ and 100 kg. $K_2O$/ha./year in two split doses and 150 kg. N (in eight split doses) were given to the Hybrid napier. The cultural operations consisted of weeding and earthing up of soil and irrigation by sprinkler three times a week. Cutting of the fodder was done at 10-15 cm height from the ground level at 40-45 days interval. Roots were collected from apparently healthy and root (wilt) affected coconut palms cultivated in the crop mixed plots and fallow check plots. The zone of sampling was one metre away from the bole of the palm at a depth of 50 cm. The soil adhering to the roots was shaken gently in sterile water and the different microflora were enumerated by soil dilution technique. Bacterial and fungi were counted using soil extract agar (Lochhead and Taxton, 1952) and Rose Bengal agar (Martin, 1950) respectively. The phosphate solubilising flora were estimated using the medium of Pilkoviskoya (1948) and the nitrogen fixing organisms in the nitrogen free mannitol agar (Harrigan and Mc Cance, 1966).

The relative incidence of the rhizosphere microfl in the experimental and control plots is given in Ta 1. In general, there was an increase in the numb different microflora in experimental samples comp to those from the control plots. Both the total b teria and nitrogen fixing bacteria were significantly m in the rhizosphere of experimental palms compared the control irrespective of the condition of the palm The phosphate solubilising bacteria were significan higher in the crop mixed area with root (wilt) affe ted palms harbouring significantly higher numbers. T incidence of phosphate solubilising fungi on the oth hand was significantly higher in the rhizosphere healthy palms in the experimental plot.

The objective of the investigation was to derive da as to how best an intercropping of Hybrid napier wi the coconut palm would influence the rhizosphere of the main crop. The significant increase in the number of bacterial population in the rhizosphere of th palms cultivated with the fodder grass might influen the pathogenic flora. The abundance of saprophyte in the rhizosphere normally exerts an adverse influen in pathogenic infection. Reports are conflicting on th occurrence of *Azobacter* in the rhizosphere of differen plants. General conclusions seem to suggest that plant roots do not favour the development of this genu Soil ecosystems with a pH lower than 6 are relativel free of this group. The higher number of nitrog fixing bacteria in the rhizosphere of the palms sug gests the possible occurrence of nitrogen fixing bacteria other than *Azotobacter*. The abundance of phosphate solubilising bacteria in the rhizosphere is in agreemen with numerous observations. Their increased numbe in experimental palms, and particularly in root (wilt affected palms can be attributed to the pattern of roo exudates in the environment that can act favourabl for colonization.

**REFERENCES**


1. Harrigan, W.F. and M.E. Mc Cance. Laboratory methods Microbiology 1966. Academic Press, London.
2. Lochhead, A.G. and R.H. Taxton. 1952. *J. Bacteriol*, 63, 21
3. Martin, J.P. 1950. *Soil Sci.* **69**, 215.
4. Pilkoviskoya, R.I. 1948. *Microbiologia*, **17**, 362.


**TABLE 1**

*Distribution of microflora in the rhizosphere of Coconut palm*

| Treatments: Organism/Condition of palm | Coconut & grass: Healthy | Coconut & grass: Root (wilt) affected | Coconut alone: Healthy | Coconut alone: Root (wilt) affected |
|---|---|---|---|---|
| Bacteria | $2.70 \times 10^6$ | $1.96 \times 10^6$ | $6.80 \times 10^5$ | $5.80 \times 10^5$ |
| | * | | | |
| Fungi | $1.23 \times 10^4$ | $1.20 \times 10^4$ | $1.00 \times 10^4$ | $6.80 \times 10^4$ |
| N2-fixing bacteria | $1.46 \times 10^4$ | $1.77 \times 10^4$ | $6.04 \times 10^3$ | $8.71 \times 10^3$ |
| | * | | | |
| Phosphate solubilizing: | | | | |
| Fungi | $6.51 \times 10^3$* | $5.26 \times 10^3$ | $2.40 \times 10^3$ | $1.00 \times 10^3$ |
| Bacteria | $4.82 \times 10^4$ | $4.61 \times 10^5$* | $2.93 \times 10^4$ | $4.00 \times 10^4$ |
| Actinomycetes | $4.87 \times 10^3$ | $2.40 \times 10$[illegible] | $6.48 \times 10^3$ | $2.00 \times 10^3$ |

*Significant at 5% level.