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# EFFECT OF CROP ROTATION ON THE POPULATION OF *RADOPHOLUS SIMILIS* COBB. AND YIELD OF BANANA (*MUSA* AAB cv. NENDRAN)

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**Abstract:** The population of burrowing nematode, *Radopholus similis* was reduced in a three year crop rotation involving banana-paddy-cowpea-paddy-elephant foot yam. The yield of banana crop in the second rotation cycle increased. In respect of output of banana the next best rotation was banana-tapioca-fallow sequence. Higher population build up of *R. similis* and low yield of banana were observed after mono-cropping with banana.

**Key words:** Banana, crop sequences, nematodes population, *Radopholus similis.*

## INTRODUCTION

The burrowing nematode, *R. similis* is one of the major nematode pests on banana. The population often reaches damaging level when banana is raised as a sole crop or retained as a ratoon crop. Eventhough chemical control measures are recommended for the control of this nematode on banana, high cost and toxic hazards necessitate non-chemical means of nematode management programme (Charles and Venkitesan, 1993). The influence of crop rotation on the population build up of the burrowing nematode has been investigated in the present study.

## MATERIALS AND METHODS

The experiment was conducted in a field infested with *R. similis* at the Banana Research Station, Kannara, Thrissur during 1987-1991. The initial average nematode population representing the entire field of 1280 nr was 28 per 100 ml soil. The five rotation treatments in a three year cycle (Table 1) were evaluated in randomised block design in plots each measuring 64 nr replicated four time.

The various crops were maintained as per the recommended agronomic practices of the Kerala Agricultural University (KAU, 1986). All plant protection measures were also followed as per the recommended practices. The banana crop was raised as the first crop in 1987 and repeated in 1991 in all the sequences after one rotation. The yields obtined from

Table 1. Details of the treatments

| Treat No. | I Year | II Year | III Year |
|---|---|---|---|
| 1 | Banana | Tapioca | Fallow |
| 2 | Banana | Vegetables (Bhindi and amaranth) | Banana |
| 3 | Banana | Banana + crotalaria | Tapioca |
| 4 | Banana | Paddy-cowpea-paddy | Elephant foot yam |
| 5 | Banana | Banana | Banana |

different cropping systems were recorded at the time of harvest. The yield of banana crop after one rotation was compared with banana monocrop. The population of *R. similis* in samples of 100 ml soil and 10 g roots drawn from each banana plant was estimated through modified sieving (Christie and Perry, 1951) and by the waring blender technique as modified by Taylor and Loegering (1959) respectively.

## RESULTS AND DISCUSSION

The data on the population counts of *R. similis* in soil/root and yield of crops in three year crop rotation and yield of banana after one rotation are given in Tables 2 and 3. After one rotation, there was significant differences

Table 2. Effect of crop rotation on the population of *Rodopholus similis*

| Tr. no. | First year | | | Second year | | | Third year | | | First year 2nd rotation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Crops | NPH | | Crops | NPH | | Crops | NPH | | Crops | NPH | |
| | | 100 ml soil | 10 g root | | 100 ml soil | 10 g root | | 100 ml soil | 10 g root | | 100 ml soil | 10 g root |
| T1 | Banana | 171 | 331 | Tapioca | 75 | - | Fallow | 97 | - | Banana | 95 | 777 |
| T2 | Banana | 173 | 348 | Vegetables (bhindi, amaranth) | 202 | - | Banana | 114 | 860 | Banana | 633 | 2792 |
| T3 | Banana | 156 | 350 | Banana-green manure | 293 | 248 | Tapioca | 225 | - | Banana | 442 | 1993 |
| T4 | Banana | 145 | 343 | Rice-cowpea-rice | 108 | - | Elephant foot yam | 45 | - | Banana | 210 | 325 |
| T5 | Banana | 170 | 342 | Banana | 216 | 821 | Banana | 175 | 962 | Banana | 185 | 3330 |
| CD (0.05) | | NS | NS | | 51 | - | - | 53 | - | - | 497 | 264 |

NPH = Nematode population at harvest

due to treatment effect in respect of the nematode population and banana yield. The nematode population recorded at the harvest of banana during the first year did not show any significant treatment differences. During second year, in banana-tapioca ($T_1$) and banana-paddy-cowpea-paddy ($T_4$) plots the population of *R. similis in* soil was reduced. But, *R. similis* increased in rotations involving banana. When banana was raised again during second year, along with *Crotalaria juncea* (green manure) in the interspace, which was later incorporated into the soil resulted in low population in banana roots compared to banana following banana. Data presented in Table 3 further revealed that banana + *C. juncea* ($T_3$) gave the highest yield (24.4 t $ha^{-1}$) compared to banana alone ($T_5$) which was 23.0 t $ha^{-1}$. It has been reported from Kerala (Charles *et al.* 1985) and Tamil Nadu (Naganathan *et al.*, 1988) that low population of *R. similis* in roots along with better vegetative and yield characters was realised when banana was intercropped with *C. juncea.* Ternisien and Melin (1989) tested various crops for one year after banana and found that the grasses *Brachiaria decumbens* and *Macroptilium citropurpureum* improved soil fertility and satisfactorily removed *R. similis.* During third year of rotation with elephant foot yam ($T_4$) the lowest nematode population in soil (45.0) was observed followed by one year fallowing (97.5). Sarah *et al.* (1983) found good control of *R. similis* in banana field trials in the Ivory Coast by bare fallow for 9 months. The population of *R. similis* in banana monocrop was more (174.8) when compared to banana preceded by vegetables (113.8). The nematode population in treatment rotating with tapioca ($T_3$) was also high (225.3) as banana monocrop.

The yield of banana plants after the first rotation in the cropping sequence banana-rice-cowpea-rice-elephant foot yam ($T_4$) was 25.9 t $ha^{-1}$ recording 43% more than that of plants in monocrop, 18.1 t $ha^{-1}$ ($T_5$). The next best yield of banana (23.7 t $ha^{-1}$) was obtained in

Table 3. Yield of crops in 3 year crop rotation and yield of banana in next rotation (t $ha^{-1}$)

| Tr. no. | First year | | Second year | | Third year | | First year of 2nd rotation | |
|---|---|---|---|---|---|---|---|---|
| | Crops | Yield | Crops | Yield | Crops | Yield | Crops | Yield |
| T1 | Banana | 22800 | Tapioca | 20.0 | Fallow | - | Banana | 23.7 |
| T2 | Banana | 20525 | Vegetables (bhindi, amaranth) | 16.3<br>10.4 | Banana | 28.6 | Banana | 21.2 |
| T3 | Banana | 20125 | Banana-Green manure | 24.3 | Tapioca | 25.4 | Banana | 20.3 |
| T4 | Banana | 20875 | Paddy grain (2 crops)<br>Paddy straw (2 crops)<br>Cowpea | 6.5<br>5.5<br>0.8 | Elephant foot yam | 53.0 | Banana | 25.9 |
| T5 | . Banana | 22300 | Banana | 23.0 | Banana | 27.9 | Banana | 18.1 |
| CD(0.05) | | | | | | | | 3.5 |

the banana-tapioca-fallow sequence in treatment ($T_1$), where the yield was on par with yield of banana in treatment ($T_4$). The banana yields of 21.2 t $ha^{1}$ and 20.3 t $ha^{-1}$ obtained in treatments banana-vegetables-banana ($T_2$) and banana-banana + green manure-tapioca ($T_3$) respectively were not significantly different from banana-banana-banana ($T_5$). The reduction of banana yield after 3 years of continuous cultivation was 35% when compared to preceding year. It showed that the monocropping of banana cultivar Nendran could lead to steep yield reduction.

It could be concluded that among the different cropping sequence tested, banana-paddy-cowpea-paddy-elephant foot yam and banana-tapioca-fallow were the best crop rotations. In Martinique, it has been found that a fallow or crop rotation in banana cultivation with sorghum *Brachiaria decumbens*, sweet potato, *Crotalaria juncea, Desmodium distortium, Canavalia ensformis* and *Mucuna pruriens* reduces the population of *R. similis* (Ternisien and Ganry, 1990). The population of *R. similis* associated with banana was statistically higher in monocrop. After the rotation, the population of *R. similis* in root and soil of the banana monocrop were 10 and 8.6 times respectively more than banana-paddy-cowpea-paddy-elephant foot yam cropping sequence. The treatment where the banana-tapioca-fallow system was followed ($T_1$) was most effective in reducing the nematode population in soil. The number of soil and root population of *R. similis* in the monocrop banana rhizosphere were 19 and 4 times respectively more than those in the banana preceded by fallow and tapioca ($T_1$). Trials done in Bahia, Brazil have found that banana-cassava rotation reduced *R. similis* on banana. The *R. similis* in soil in banana-vegetables-banana system ($T_2$) was on par with that of banana-banana + green manure-tapioca system ($T_3$), but higher with respect to root population. Ternisien (1989) also reported poor yields of banana in plots that had become infested with the nematode, *R. similis* under monoculture.

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