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# SLOW DECLINE OF BLACK PEPPER (*PIPER NIGRUM* L.) AND ROLE OF PLANT PARASITIC NEMATODES AND *PHYTOPHTHORA CAPSICI* IN THE DISEASE COMPLEX

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## ABSTRACT

A field trial on management of slow decline of black pepper (*Piper nigrum* L.) in arecanut-black pepper mixed cropping system was taken up with soil application of phorate, neem cake and bavistin. Application of nematicide and neem cake was highly effective in reducing the populations of *Meloidogyne incognita* and *Radopholus similis*. However, treatments did not show clear evidence of remission of slow decline symptoms. Moreover, during the course of three years of trial the vine death ranged from 16.6 to 50.3 per cent in different treatments. *Phytophthora capsici* was isolated from feeder roots of disease affected vines. This suggests that *P. capsici* also may be playing a role in the slow decline complex. High percentage of mortality in bavistin treated vines is another indirect supporting evidence for *Phytophthora* involvement in root rot since this fungus is insensitive to bavistin. There appears to be a lack of spatial segregation of plant parasitic nematodes and *Phytophthora* under field conditions. The studies strongly indicate the need for integrated disease management to check both plant parasitic nematodes and *Phytophthora* and to boost the vigour and productivity of the pepper vines.

## INTRODUCTION

Slow decline (slow wilt) and *Phytophthora* foot rot (quick wilt) of black pepper (*Piper nigrum* L.) are the major constraints in pepper production. These diseases are prevalent in all the pepper growing tracts in Kerala and Karnataka. Plant parasitic nematodes viz., *Meloidogyne incognita* and *Radopholus similis* were reported to be primarily responsible for slow decline (van der Vecht, 1950; Christie, 1957; Ichinohe, 1975 & 1976; Ting, 1975; Venkitesan and Setty, 1977; Mustika, 1978 and Ramana *et al.*, 1987). Pathogenicity tests conducted under simulated field conditions at National Research Centre for spices, Calicut, Kerala, have shown that both the nematode species caused significant damage to root system leading to foliar yellowing, defoliation and die back symptoms which are typical of slow decline syndrome (Mohandas & Ramana, Unpublished). In a pure plantation, application of phorate 10G @ 3 g a.i./vine, twice in a year significantly reduced the nematode population and improved the health of the vines (Anonymous, 1985). According to Hubert (1957) and Bridge (1978), *R. similis* was primarily responsible for the disease in Indonesia, but an association with fungus like *Fusarium* sp. was necessary to cause 'Yellows' disease. Nambiar and Sarma (1979) opined that the disease is complex in nature involving nematode fungal complex coupled with nutrient deficiency and soil moisture stress. Consistent association of *Fusarium* sp. with the roots of slow decline affected vines was reported (Nambiar and Sarma, 1977) though the role of the fungus in the disease was not understood then. In view of the known efficacy of bavistin in the control of *Fusarium* sp. and in order to get indirect information on the role of *Fusarium*, if any, field trial for disease management was undertaken to study the efficacy of phorate alone and in combination with bavistin in reducing the disease incidence in areca-pepper cropping system.

## MATERIALS AND METHODS

The trial was conducted in an arecanut based black pepper plantation at Central Plantation Crops Research Institute, Regional Station, Vittal (Karnataka) during 1985-88. A total of 216 pepper vines in a contiguous block were selected for the experiment with the following treatments. The experiment was

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replicated thrice with a plot size of 12 vines. Recommended package of practices were adopted throughout the trial. Treatments : $T_1$ - Control (No treatment), $T_2$ - Phorate 10 G @ 1.5 g a.i./vine, $T_3$ - Phorate 10 G @ 3 g a.i./vine, $T_4$ - Bavistin 0.2% soil drench @ 5 l/ vine, $T_5$ - Phorate 10 G @ 3 g a.i./vine + Bavistin 0.2% soil drench @ 5 l/vine and $T_6$ - Neem cake @ 2 kg/vine.

The treatments were given twice a year, first application during May/June and second application during September/October. Root samples were collected every year during September/October prior to second application of treatments. Populations of *M. incognita* and *R. similis* in the roots were estimated. The roots were also tested for the presence of *Phytophthora* using a selective medium PVPH. Disease symptoms such as foliar yellowing was recorded every year on the basis of visual scoring on 0-3 (0=Healthy, 1=Mild foliar yellowing, 2=Medium foliar yellowing, and 3=Severe foliar yellowing).

## RESULTS AND DISCUSSION

Population of plant parasitic nematodes viz., *M. incognita* and *R. similis* in the roots estimated during different years are given in Tables I and II respectively. Final population (pf) of root knot nematode was significantly reduced over initial population (pi) in the vines treated with phorate 10 G at both dosages alone or in combination with bavistin soil drenching and neem cake ranging from 47.8 to 69.8 per cent (Table I). Maximum reduction in the nematode population (69.8%) was observed in the vines treated with neem cake followed by phorate 10G 3 g a.i./vine. On the contrary, the population of root knot nematode had significantly increased in the vines treated with bavistin alone(68.4%) followed by untreated control (40.4%). Similar trend was observed with regard to the population of *R. similis* (Table II). Phorate at both the dosages significantly reduced the nematode populations. Nematode population has considerably increased in the vines treated with bavistin alone which was more than the population increase in the untreated control. However, neem cake showed less efficacy in suppressing the population of *R. similis*.

Though there was significant reduction in the population levels of both the nematode species in the roots of pepper vines treated with phorate/neem

Table I. Populations of root knot nematode, *Meloidogyne incognita* in black pepper (per 5 g root)

| Treatment | 1985 (pi) | 1986 | 1987 | 1988 (pf) | % age reduction (-) or increase (+) in the pf over pi |
|---|---|---|---|---|---|
| Control (untreated) | 788.9 | 1251.4 | 1334.9 | 1107.4 | +40.4 |
| Phorate 10 G @ 1.5 g a.i/vine | 815.8 | 927.6 (-25.9) | 531.1 (60.2) | 296.7 (-73.2) | -63.6 |
| Phorate 10 G @ 3.0 g a.i/vine | 903.9 | 596.2 (-52.3) | 440.6 (-67.0) | 381.1 (-65.6) | -57.8 |
| Bavistin 0.2% @ 5l/vine | 908.6 | 1298.0 (+3.7) | 1451.8 (+8.8) | 1530.0 (+38.2) | +68.4 |
| Phorate 10 G @ 3 g a.i/+ Bavistin 0.2% @ 5l/vine | 728.9 | 627.1 (-49.9) | 449.4 (-65.3) | 380.2 (-65.7) | -47.8 |
| Neemcake @ 2 kg/vine | 760.7 | 477.3 (-61.9) | 284.7 (-78.7) | 229.8 (-79.3) | -69.8 |
| C.D. at 5% | NS | 576 | 570 | 625 | |

pi = Initial population, pf = Final population
Figures in parentheses denote percent reduction (-) or increase (+) over untreated control

cake, there was no corresponding decrease in the foliar yellowing indices (Table III) and subsequent improvement in the health of the vines. Further the disease manifested severely during the course of three years of experimentation leading to death of vines ranging from 16.6 to 58.3 per cent in different treatments. The highest mortality of the vines was observed in the bavistin-treated vines alone with the highest percentage of positive isolation of *P. capsici* from the roots. This might be due to the fact that bavistin

Table II. Population of burrowing nematode, *Radopholus similis* in black pepper (per 5g of root)

| Treatment | 1985 (pi) | 1986 | 1987 | 1988 (pf) | % reduction (-) or increase (+) in the pf over pi |
|---|---|---|---|---|---|
| Control (untreated) | 462.2 | 797.3 | 889.6 | 682.7 | + 71.0 |
| Phorate 10 G @ 1.5 g a.i/vine | 351.2 | 270.8 | 143.7 | 162.8 | - 45.0 |
| | | (-66.0) | (-88.8) | (-76.2) | |
| Phorate 10 G @ 3 g a.i/vine | 413.3 | 236.1 | 49.6 | 94.5 | - 69.7 |
| | | (-70.4) | (-94.4) | (-86.2) | |
| Bavistin 0.2% @ 5l/vine | 312.8 | 535.3 | 603.9 | 1107.6 | + 139.3 |
| | | (-32.9) | (-32.1) | (+62.2) | |
| Phorate 10 G @ 3 g a.i. + Bavistin 0.2% @ 5l/vine | 248.9 | 246.8 | 179.5 | 181.5 | - 18.5 |
| | | (-69.1) | (-79.8) | (-73.4) | |
| Neemcake @ 2 kg/vine | 343.7 | 388.7 | 201.4 | 396.5 | - 4.1 |
| | | (-51.3) | (-77.0) | (-41.9) | |
| C.D. at 5% | N.S. | 280 | 349 | 377 | |

pi = Initial population, pf = Final population
Figures in parentheses denote percent reduction (-) or increase (+) over untreated control

Table III. Foliar yellowing and mortality of black pepper in the experimental plot

| Treatments | Foliar yellowing index | | | | Mortality of the vines | | % isolation of *P. capsici* (out of 50 root bits tested) |
|---|---|---|---|---|---|---|---|
| | 1985 | 1986 | 1987 | 1988 | No. | % | |
| Control (Untreated) | 1.64 | 1.42 | 1.89 | 1.92 | 10 | 27.7 | 48 |
| Phorate 10G @ 1.5 g a.i./vine | 1.67 | 1.39 | 1.28 | 1.66 | 6 | 16.6 | 40 |
| Phorate 10G @ 3 g a.i/vine | 1.64 | 1.11 | 1.19 | 1.69 | 16 | 44.4 | 76 |
| Bavistin 0.2% @ 5l/vine | 1.61 | 1.18 | 1.81 | 2.24 | 21 | 58.3 | 60 |
| Phorate 10G @ 3g a.i. + Bavistin 0.2% @ 5l/vine | 1.61 | 1.31 | 1.16 | 1.51 | 10 | 27.7 | 36 |
| Neemcake @ 2 kg/vine | 1.53 | 1.22 | 1.45 | 1.42 | 7 | 19.4 | 48 |

Foliar yellow on 0-3 scale (0=Healthy; 1=mild; 2=medium & 3=severe)

is known to suppress fungi like *Fusarium* sp. only and not *Phytophthora*. This also indirectly indicates that *Fusarium* sp. has no role in root rot and death of vines. The increased vine death in bavistin-treated vines might be due to its ineffectiveness to control *Phytophthora*. Further studies are needed to understand the microbiological changes in the soil in relation to *Phytophthora* population to see whether there is any disturbance in the native population of natural antagonists of *Phytophthora* present in bavistin-treated plots. All the vines irrespective of treatment gave positive isolation of *Phytophthora* indicating its role in causing root damage and subsequent expression of symptoms. Anandaraj *et al.* (1988) indicated that when the infection of *P. capsici* is restricted to certain portion of the root system, initially the vines express symptoms such as foliar yellowing and defoliation. These studies indicated that infection by plant parasitic nematodes and fungi could result in root degeneration leading to slow decline. Since spatial segregation of plant parasitic nematodes and *Phytophthora* cannot exist under field condition, the study strongly suggests for an integrated disease management to check plant parasitic nematodes and *P. capsici* and to boost up the health and vigour of black pepper vine.

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