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# Effect of *Pochonia chlamydosporia* formulations on root-knot nematode, *Meloidogyne incognita* infestation in medicinal coleus, *Coleus forskohlii*

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**ABSTRACT:** *Coleus forskohlii* is one of the valuable medicinal plants and is infected by the root-knot nematodes, *Meloidogyne* spp. Affected plants produce under sized and malformed tubers. Microbial based bioformulations are one of the best solutions to contain nematode damage. Native isolate of nematophagus fungus, *Pochonia chlamydosporia* (TNAU $PC_2$-NAIMCC0039) were tested in medicinal coleus under microplot and field conditions. The results showed that the soil application of talc based formulation of *P. chlamydosporia* (1 x $10^8$ CFU/g) @ 1g/$m^2$ mixed with 1 kg of FYM thrice at 30-day interval showed highest reduction of nematode (62.3%) with more number of tuberous root. The formulations of *P. chlamydosporia* were also validated under field conditions and the results showed that the soil application of oil based formulation of *P. chlamydosporia* @ 1 L /ha at the time of planting followed by 30 and 45 days after planting recorded highest reduction (67.8%) of nematode population.

**Keywords:** Medicinal coleus, *M. incognita, Pochonia chlamydosporia*, formulations

## INTRODUCTION

Medicinal coleus, *Coleus forskohlii* (Wild.) Briq. is one of the important a herbal plants of Indian Medicine and has the native of India (Valdes *et al*., 1987) and belongs to the family Lamiaceae. It is widely grown in India and other countries like Arabia, Brazil, Egypt, Ethiopia, Pakistan, Sri Lanka, and Tropical East Africa. In India, the crop is cultivated in Tamil Nadu, Gujarat, Karnataka, Maharashtra and Rajasthan. Medicinal coleus is infected by the root-knot nematode, *Meloidogyne* spp. Four different type of *Meloidoigyne* species are common: *M. javanica*, *M. incognita*, *M. hapla* and *M. arenaria*. Affected crops may show slow or stunted growth, yellowing of leaves, wilting of the plant despite of adequate soil water content and finally leading to collapse of individual plants. Heavy infection of older plants results in wilt and death of plants (Singh *et al*., 2011).Nematode infection also increases the susceptibility of the root system to soil borne pathogens such as *Macrophomina phaseolina* and *Fusarium* spp. *M. incognita* in were reported from *C. forskohlii* and cause a yield reduction of upto 86 per cent (Senthamarai *et al*., 2006), while severe looses also recorded because of *M. arenaria* infestations (Bhandari *et al*., 2007). Chemical methods have been mostly used to control nematodes but are not environment friendly.*Pochonia chlamydosporia* has been studied as bioagent due to its worldwide distribution. Endophytic behavior and root colonization of *Pochonia* species have been documented in some Graminae and Solanaceae crop species (Kerry and Hirsch, 2011). This fungus was reported to parasitize the eggs and females of economically important species of plant parasitic nematodes like root knot nematodes, *Meloidogyne* sp. and cyst nematodes like *Globodera* sp. and *Heterodera* sp. (Crump and Kerry, 1977; Hidalgo-Díaz *et al*., 2017).The present study was aimed to optimize dosage and period of application of *P. chlamydosporia* to suppress nematode infestation in medicinal coleus, *C. forskohlii*.

## MATERIALS AND METHODS

### Testing the effect of *P. chlamydosporia* on *M. incognita*

### Micro-plot experiment

A root-knot nematode, *M. incognita* infested micro-plot maintained in the Nematology glasshouse was used for this experiment. Initial nematode population was assessed using Cobb's wet sieving and Baermann funnel technique(Cobb,1918; Whitehead and Hemming,1965). The talc based formulation of *P. chlamydosporia* (TNAU$PC_2$ NAIMCC0039)with 1 x $10^8$ CFU/g was mixed with vermicompost and jaggery and incubated for one week with 20 per cent moisture. This mixture was applied to the micro-plot. Then, cuttings of medicinal coleus (*C. forskholii*) var. Co 1 was planted. The same mixture was applied at 30 and 60 days after planting (DAP).Observations on soil nematode population, number of galls/g of root and number of tubers per plant were recorded. There were five treatments and each one was replicated four times. The experiment was subjected to randomized block design.

### Field trial

A nematode-sick field at Salaiyur village, Dindingul

**Table 1. Effect of *P. chlamydosporia* on *M. incognita* in *C. forskohlii* under micro-plot**

| | Treatments | Soil Nematode population (Number/ 250g soil) | Per cent decrease over control | Number of galls / g of root | Per cent decrease over control | Number of tubers/ plant | Per cent increase over control |
|---|---|---|---|---|---|---|---|
| T1 | *P.chlamydosporia* 1g @ Planting + 30 DAP | 269.5$^{c}$ (2.431) | 25.0 | 16.5$^{c}$ (1.217) | 44.0 | 6.5$^{b}$ (0.875) | 66.7 |
| T2 | *P.chlamydosporia* 1 g @ Planting + 30 DAP + 60 DAP | 177.5$^{a}$ (2.249) | 50.6 | 10.75$^{a}$ (1.031) | 63.0 | 8.75$^{a}$ (0.09) | 71.4 |
| T3 | *P.chlamydosporia* 2 g @ Planting + 30 DAP | 232.5$^{b}$ (2.366) | 35.3 | 13.0$^{b}$ (1.114) | 56.0 | 6.5$^{b}$ (0.875) | 66.7 |
| T4 | *P.chlamydosporia* 2 g @ Planting + 30 DAP + 60 DAP | 173.25$^{a}$ (2.299) | 51.8 | 10.0$^{a}$ (1.0) | 66.0 | 9.3$^{a}$ (1.088) | 73.6 |
| T5 | Untreated control | 359.25$^{d}$ (2.555) | - | 29.25$^{d}$ (1.466) | - | 2.5$^{c}$ (0.399) | - |
| | CD (p = 0.05) | 0.05 | - | 0.084 | - | 0.09 | - |
| | CV (%) | 1.382 | - | 4.878 | - | 6.795 | - |

Figures in parentheses are log transformed values. In a column means with common alphabets are not significantly different from each other by DMRT

**Table 2**. **Effect of *P. chlamydosporia* on *M. incognita* in *C. forskohlii* in field**

| | Treatments | Nematode population in soil | | Root-knot galls | | |
|---|---|---|---|---|---|---|
| | | No. of nematodes / g of soil | Per cent reduction over control | No. of galls/ 5g of root | Per cent reduction over control | Gall Index |
| T1 | Soil application of *P. chlamydosporia* 2.5kg/ha at the time of planting (Positive check) | 255.7$^{c}$ (2.408) | 28.9 | 76.3$^{e}$ (1.883) | 8.2 | 4 |
| T2 | *P. chlamydosporia* @ 2.5 kg + 100 kg of FYM on 30 and 45 DAP | 234.0$^{b}$ (2.408) | 31.2 | 59.3$^{d}$ (1.773) | 27.6 | 3 |
| T3 | *P. chlamydosporia* @ 5 kg/ha + 250 kg of FYM | 221.0$^{b}$ (2.408) | 35.5 | 44.3$^{c}$ (1.647) | 45.9 | 3 |
| T4 | *P. chlamydosporia* @ 5 kg/ha + 250 kg of FYM on 30 and 45 DAP | 185.3$^{a}$ (2.408) | 45.5 | 26.3$^{b}$ (1.421) | 67.8 | 2 |
| T5 | Oil based formulation of *P. chlamydosporia* @ 1 L/ha + Jaggery 2 kg at the time of planting and 30 & 45 DAP | 177.0$^{a}$ (2.408) | 47.9 | 25.3$^{a}$ (1.404) | 69.1 | 2 |
| T6 | Farmers practice - Application of carbofuran@1kg a.i / ha | 277.0$^{d}$ (2.408) | 28.6 | 76.0$^{e}$ (1.864) | 8.1 | 5 |
| T7 | Control (Untreated) | 340.3$^{e}$ (2.408) | - | 82.7$^{e}$ (1.917) | - | - |
| | CD (p = 0.05) | 0.026 | - | 0.081 | - | - |
| | CV (%) | 0.615 | - | 2.799 | - | - |

Figures in parentheses are log transformed values. In a column means with same alphabets are not significantly different from each other by DMRT

district of Tamil Nadu was selected to test the efficacy of *P. chlamydosporia* under field conditions. The field was planted with *C. forskholii* as previous crop with an initial nematode population of 215J2/250g of soil. *P. chlamydosporia* formulations of both talc and oil based were imposed to soil at different time intervals and observations on nematode infestation was recorded at the time of harvest. The talc based formulation was applied along with farm yard manure and oil based with jaggery. Treatments were arranged by applying randomized block design.

## RESULTS AND DISCUSSION

### Microplot

The results showed that the soil application talc based formulation of *P. chlamydosporia* 1 g / $m^2$ mixed with 100g of vermicompost at the time of planting followed by two applications at 30 day interval significantly reduced soil nematode population by 50.6 per centin soil and number of galls by 63 per cent (Table 1). Though the fourth treatment with 2 g / $m^2$ also reduced number of galls by 65 per cent which was on par with 1g. Hence, it was concluded that soil application of *P. chlamydosporia* at the rate of 1g / $m^2$ thrice is sufficient to reduce the nematode population below economic level with a tuber yield of 9.75 per plant. Besides increase in tuber yield, the treated plants showed better growth. As the tubers are used for the extraction of medicinal component from coleus harmful chemical could not be applied to soil. Hence the application of organic based solution is more suitable that includes biopesticides.

### Field trial

The results of field trial showed that the nematode population was significantly reduced by the application of oil based formulation of *P. chlamydosporia* thrice at the rate of 1L/ha followed by soil application of talc formulation at 5kg/ha thrice. The treatment with oil based formulation recorded with 73.6 per cent increase in yield besides the reduction nematode infestation on root. The same treatment resulted in highest reduction in nematode population in soil (82%) and root (67.8%) with a gall index of 2. The application of carbofuran did not show appreciable increase in nematode reduction. The biocontrol potential of native isolate of *P. chlamydosporia* (TNAUPc2)was well documented in cucumber under polyhouse condition (Swarnakumari *et al*., 2020). The roots of *C. forskholii* is succulent and texture is similar to cucumber roots. The endophytic nature of *P. chlamydosporia* might have helped in colonization of eggs inside the roots. In the current study, the formulation was mixed either with FYM or jaggery that helped to provide organic source for multiplication of fungal conidia. This statement is supported by the study of Das *et al*. (2001) who have reported that the incubation of *Trichoderma harzianum* with FYM for 10 days proliferated the growth. Based on findings, it is inferred that the application of nematophagus fungus, *P. chlamydosporia* is another option for the management of *M. incognita* in medicinal coleus. As this fungus possesses chlamydospore production, endophytic nature and growth promoting ability it is well suited for organic cultivation.

## REFERENCES

Bhandari, S., Harsh, N. S. K. and Singh, P. 2007. First report of *Meloidogynearenaria* on *Coleus forskohlii*. *Indian Forester*, **133**: 1709-1710.

Cobb, N. A. Estimating the nema population of the soil. Agricultural Technology Circular **1**.Bureau of Plant Industry, United States Department of Agriculture, Washington DC.

Crump, D. H. and Kerry, B. R. 1977. Observations on fungal parasites of females and eggs of the cereal cyst-nematode, *Heterodera avenae*, and other cyst nematodes. *Nematologica*, **23** (2):193-201.

Das, B. C., Das, B. K., Prabab Dutta, Begum, K. H. and Talukda, M. C. 2001. FYM: A source of growth and sporulation of *Trichoderma harzianum* for field application. *Pestology,* **25** (1): 28-30.

Hidalgo-Díaz., Leopoldo., Francisco Franco-Navarro. and Leandro Grassi de Freitas. 2017. "*Pochonia chlamydosporia* microbial products to manage plant-parasitic Nematodes: Case Studies from Cuba, Mexico and Brazil." In *Perspectives in Sustainable Nematode Management Through Pochonia chlamydosporia Applications for Root and Rhizosphere Health*, 311-342. Springer.

Kerry., Brian. R. and Penny.R. Hirsch. 2011. Ecology of *Pochonia chlamydosporia* in the rhizosphere at the population, whole organism and molecular scales. In: *Biological Control of Plant-Parasitic Nematodes,* 171-182.

Senthamarai, K. K., Poornima. K., Subramanian. and Sudheer J.2008. Nematode-Fungal Disease Complex involving Meloidogyne incognita and Macrophomina phaseolina on Medicinal Coleus, Coleus forskohlii Briq. Indian Journal of Nematology, 38 (1):30-33.

Senthamarai, M., Poornima, K. and Subramanian, S. 2006. Pathogenicity of *Meloidogyne incognita* on *Coleus forskohlii* Briq. *Indian Journal of Nematology*, **36**(1) : 123-125

Singh Rakshapal, Gangwar Surendera, Singh Deepmala, Singh Rachana, Pandey Rakesh, Kalra Alok. 2011. Medicinal plant *Coleus forskohii* Briq: Disease and management. Medicinal plant - *International Journal of Phytomedicines and related Industries*, **3** (1): 1-7.

Swarnakumari, N., Sindhu, R., Thiribhuvanamala, G. and Rajaswaminathan. 2020. Evaluation of oil dispersion formulation of nematophagus fungus, *Pochonia chlamydosporia* against root-knot nematode, *Meloidogyne incognita* in cucumber. *Journal of Asia-Pacific Entomology*, **23**:1283-1287.

Valdes.L.J., Mislankar, S.G. and Paul, A.G.1987. Coleus barbatus (*C. forskohlii*) (Lamiaceae) and the potential new drug forskolin (Coleonol). *Economic Botany*, **14**: 474.

Whitehead, A.G. and Hemming, J.R. 1965. A comparison of some quantitative methods of extracting small vermiform nematodes from soil. *Annals of Applied Biology*, **55**:25-38.

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