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# EVALUATION OF VARIOUS BIO-AGENTS FOR THEIR EFFICACY AGAINST *MELOIDOGYNE INCOGNITA* ON GROWTH AND DEVELOPMENT OF TUBEROSE (*POLIANTHES TUBEROSA* L.)

Preethi, D.M., Bommalinga, S., Pavithra, R.S., Ravichandra, N.G., Reddy, B.M.R. & Syeda Samina Anjum
Department of Plant Pathology, GKVK, University of Agricultural Sciences, Bengaluru - 560065

**ABSTRACT**
For the management of nematodes expensive and hazardous chemicals are being used which cause ecological imbalance in nature. In view of this, a study was taken up to evaluate the efficacy of different bio-agents against *Meloidogyne incognita* on Tuberose (*Polianthes tuberosa* L.) under green house condition. Though all the treatments were significantly differed over plant parameters and flower yield, in general the maximum weight of flowers was recorded in plants treated with *Paecillomyces lilacinus* followed by *Trichoderma viride*, *Pseudomonas fluorescens*, *Trichoderma harzianum*, *Pochonia chlamydosporia* and Carbofuran. The increased plant growth, yield and other parameters observed here could be attributed to the release of growth promoting substances by bio-agents or by producing toxic metabolites which inhibit nematodes and exclude other deleterious microorganisms.

**KEYWORDS:** Bio-agents, Meloidogyne incognita, Tuberose.

## INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is one of the most popular bulbous ornamental of tropical and sub- tropical areas and has considerable importance in the world market and crop has got a very good export potentiality. It is a native of Mexico and belongs to the family Amaryllidaceae. The flowers are a good source of essential oils that can be used for the preparation of various perfumes and cosmetics. It is commercially cultivated in many countries of the world like India, Hawaii, China, Brazil, Italy, Iran, UK, USA *etc.* Tuberose is susceptible to many diseases caused by fungi, bacteria and nematodes. Among fungal diseases, stem rot or tuber rot or sclerotial wilt (*Sclerotium rolfsii* Sacc.), Botrytis spot or blight (*Botrytis elliptica*) and leaf spot (*Alternaria polianthi* were important. Among bacterial diseases, the important one is flower bud rot (*Erwinia* sp.). Among nematodes, root-knot nematode (*Meloidogyne* spp.), reniform nematode (*Rotylenchulus reniformis*) and in some areas, greasy streak disease caused by a foliar nematode (*Aphelenchoides besseyi* Christie.) was important (Singh, 2006). Root-knot nematode (*Meloidogyne* spp.) is the major nematode pest on tuberose which causes a yield loss upto 13–14 %. Melis (1959) was first to report the infection of *Meloidogyne* spp. on *Polianthes tuberose*. Different *Meloidogyne* spp. are associated with *Polianthes tuberosa*. Plants infected by root-knot nematode show yellowing, stunted growth and moderate to severe galls on roots. Since, root-knot nematode causes severe yield losses, efforts in the recent past have been initiated on the management of this root-knot nematode through bio-agents and chemicals.

## MATERIALS & METHODS

Pot experiments were conducted in the glasshouse of AICRP (Nematodes) section, Department of Plant Pathology, University of Agricultural Sciences, GKVK campus, Bengaluru-65 to evaluate various bio-agents for their efficacy against *Meloidogyne incognita* on tuberose. Five bio-agents with Carbofuran 3G as treated check and another one maintained as control were evaluated for the management of *Meloidogyne incognita*.

The uniformly sized bulbs of commercially grown susceptible tuberose variety Vybhav was selected for sowing. Nematode free sterilized mixture of soil, vermicompost and sand was filled in 20cm diameter earthen pots with a capacity of 2.5 kg soil. After germination the seedlings were thinned off to maintain one seedling per pot. The pots were watered regularly whenever required. Three replications were maintained for each treatment with three plants in each replication. The pots were maintained at 25-30°C and plants were grown for 150 days under glasshouse conditions. After germination of tuberose bulbs the selected bio-agents were inoculated into the pots individually.

Treatments such as,

$T_1$ = *Trichoderma viride* @2g/Kg of soil ($1x10^8$ cfu/g of powder),
$T_2$ = *Trichoderma harzianum* @2g/Kg of soil ($1x10^8$ cfu/g of powder),
$T_3$ = *Paecillomyces lilacinus* @ 2g/Kg of soil ($2x10^8$ cfu/g of powder),
$T_4$ = *Pseudomonas fluorescens* @1g/Kg of soil ($1x10^6$ cfu/g of powder),
$T_5$ = *Pochonia chlamydosporia* @1.5g/ Kg of soil ($1x10^8$ cfu/g of powder),
$T_6$ = Carbofuran (chemical check) @3.5g/Kg of soil and
$T_7$= Untreated control were imposed following CRD with three replications.

Week after application of bio-agents into the pots, an average of 2000 freshly hatched $J_2$ of *M. incognita* per Kg of soil were inoculated into individual pot.

**RESULTS & DISCUSSION**

The results of the trial on efficacy of bio-agents on plant parameters *viz.*, plant height, root length, fresh and dry root weight, number of days taken for spike emergence, length of spike and flower yield of tuberose infected by *M. incognita* were analyzed and presented in Table 1, 2and 3.

**TABLE 1:** Effect of bio-agents on plant height of tuberose infected with *M. incognita*

| Treatments | Plant height (cm) | | | | |
|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | 120 DAS | AT the time of harvest |
| T1: *Trichoderma viride* @ 2 g/Kg of soil | 22.20 | 35.80 | 45.20 | 57.07 | 118.87 |
| T2: *Trichoderma harzianum* @ 2 g/ Kg of soil | 21.77 | 33.13 | 43.77 | 55.17 | 115.77 |
| T3: *Paecilomyces lilacinus* @ 2 g/ Kg of soil | 22.63 | 36.17 | 46.17 | 57.40 | 120.37 |
| T4: *Pseudomonas fluorescens* @ 1 g/ Kg of soil | 22.03 | 34.67 | 44.73 | 57.00 | 117.27 |
| T5: *Pochonia chlamydosporia* @1.5 g/ Kg of soil | 20.33 | 32.13 | 42.90 | 54.77 | 114.57 |
| T6: Carbofuran 3G @ 3.5 g/ Kg of soil | 24.13 | 36.83 | 47.13 | 57.77 | 122.17 |
| Control (Untreated) | 13.23 | 22.57 | 37.57 | 46.93 | 98.48 |
| S. Em ± | 1.19 | 1.27 | 0.64 | 0.07 | 1.09 |
| C.D. at 5% | 3.66 | 3.94 | 1.98 | 2.19 | 3.30 |

**TABLE 2:** Effect of bio-agents on root growth and development of tuberose plant at the time of harvest

| Treatments | Root length (cm) | Roots weight | |
|---|---|---|---|
| | | Fresh weight (g) | Dry weight (g) |
| T1: *Trichoderma viride* @ 2 g/Kg of soil | 34.37 | 3.30 | 1.37 |
| T2: *Trichoderma harzianum* @ 2 g/ Kg of soil | 33.67 | 3.22 | 1.28 |
| T3: *Paecilomyces lilacinus* @ 2 g/ Kg of soil | 35.27 | 3.41 | 1.50 |
| T4:*Pseudomonas fluorescens* @ 1 g/Kg of soil | 34.13 | 3.23 | 1.31 |
| T5:*Pochonia chlamydosporia* @1.5 g/Kg of soil | 33.03 | 3.20 | 1.11 |
| T6: Carbofuran 3G @ 3.5 g/ Kg of soil | 31.90 | 2.34 | 1.00 |
| T7: Control (Untreated) | 24.40 | 1.67 | 0.77 |
| SEm ± | 0.90 | 0.09 | 0.07 |
| CD at 5% | 2.72 | 0.27 | 0.22 |

**TABLE 3:** Effect of bio-agents on flower yield of tuberose infected by *M. incognita*

| Treatments | Days taken for spike emergence | Spike length (cm) | % Increase Over control | Number of flowers / spike | % Increase Over control | Weight of 10 flowers (g) | Flower yield (g/plant |
|---|---|---|---|---|---|---|---|
| T1 | 102.00 | 81.00 | 24.30 | 42.67 | 33.34 | 15.06 | 64.43 |
| T2 | 109.00 | 77.80 | 19.40 | 41.67 | 30.21 | 14.83 | 61.67 |
| T3 | 100.33 | 81.53 | 25.10 | 43.33 | 35.40 | 15.07 | 65.43 |
| T4 | 105.00 | 78.20.0 | 20.00 | 42.00 | 31.25 | 15.00 | 63.00 |
| T5 | 111.00 | 75.00 | 15.10 | 41.33 | 29.15 | 14.74 | 60.75 |
| T6 | 98.00 | 84.37 | 29.46 | 46.00 | 43.75 | 14.78 | 68.08 |
| T7 | 125.00 | 65.17 | _ | 32.00 | _ | 12.09 | 38.72 |
| S. Em ± | 1.46 | 1.64 | _ | 1.14 | _ | 0.073 | |
| C.D. at 5% | 4.52 | 5.04 | _ | 3.51 | _ | 0.226 | |

Note: T1 – *T. viride*, T2 – *T. harzianum*, T3 – *P. lilacinus*, T4 – *P. fluorescens*, T5 – *P. chlamydosporia*, T6 - Carbofuran and T7

**Plant height**

Effects of bio-agents on the plant height of tuberose under glass house conditions was recorded with an different intervals *viz.,* 30 days, 60 days, 90 days, 120 days after sowing and at harvest stage, the results are presented in Table 1. At 30 and 60 days after sowing, all the treatments showed significant difference over control. Higher plant height was observed in Carbofuran (24.13 cm and 36.83 cm) when compared to untreated check (13.23 cm and 22.57). Among the bio-agents, the plants treated with *P. lilacinus* was recorded maximum plant height (22.63 cm and 36.17 cm) compared to *T. viride* (22.20 cm and 35.80 cm), *P. fluorescens* (22.03 cm and 34.67 cm), *T. harzianum* (21.77 cm and 33.13 cm) and *P. chlamydosporia* (20.33 cm and 32.13 cm) at 30 and 60 days after sowing respectively. At 90, 120 DAS and at the time of harvesting also there was a significant difference in plant height among the treatments and untreated check. The maximum plant height was observed in Carbofuran (47.13 cm, 57.77 cm and 122.17 cm) compared to untreated check (37.57 cm, 46.93 cm and 98.48 cm). Among bio-agents, the maximum plant height was observed in *P. lilacinus* followed by *T. viride*, *P. fluorescens*, *T. harzianum* and *P. chlamydosporia*. The treatments *P. lilacinus* and carbofuran; *T. viride*, *T. harzianum*, *P. lilacinus* and *P. fluorescens*; *T. viride*, *T. harzianum*, *P. fluorescens* and *P. chlamydosporia* were on

par with one another but significantly superior over untreated check.

**Root length**

Effect of bio-agents on the root length of tuberose plants under glass house condition were recorded at the time of harvest (Table 2) and showed that, all the treatments recorded significantly better root length over untreated check (24.40 cm). In general, *P. lilacinus* treated plants were recorded significantly higher root length compared to other treatments (35.27 cm) followed by *T. viride* (34.37 cm), *P. fluorescens* (34.13 cm), *T. harzianum* (33.67 cm), *P. chlamydosporia* (33.03 cm) and carbofuran (31.90 cm).

**Fresh and dry root weight**

The effect of bio-agents on the fresh and dry root weight of tuberose was recorded at the time of harvest and data presented in Table 2. All the treatments compared to untreated check (1.67g and 0.77 g). The maximum weight was recorded in *P. lilacinus* (3.41g and 1.50g) followed by *T. viride* (3.30g and 1.37 g), *P. fluorescens* (3.23g and 1.31 g), *T. harzianum* (3.22 g), *P. chlamydosporia* (3.20 g and 1.11 g) and carbofuran (2.34g and 1.00g). Similar results were observed by Phani Kumar, (1997) who reported that *P. lilacinus* treated tuberose plants recorded better plant growth parameters. The reason for increased plant growth, yield and other parameters observed here could be attributed to the release of growth promoting substances by bio-agents (Baker *et al*., 1986) or by producing toxic metabolites which inhibit nematodes and exclude other deleterious microorganisms.

**Days taken for spike emergence and spike length**

The number of days taken for spike emergence was recorded during the emergence of spike and the data on length of spike were recorded at the time of harvest under glass house condition (Table 3). In general, all the treatments were significantly superior over untreated check which took 120 days for spike emergence and recorded spike length of 65.17 cm. However, early emergence of spike was seen in Carbofuran (98 days) and which recorded spike length of 84.37cm. Among bio-agents the treatment which receives *P. lilacinus* showed the spike emergence at early 100.33 days and recorded maximum spike length of 81.53cm compare to other bio-agents. The results are in accordance with Rao *et al.* (2004) who observed increased number of florets/spike, spike /plot and floral characteristics in bio-agent treated plots.

**Number of flowers and Flower yield**

The effect of bio-agents on number of flowers per spike and yield of tuberose were recorded at the time of harvest under glass house conditions and data presented in Table 3. In general maximum flowers (46.00 flowers/spike) which received Carbofuran. The result with respect to Carbofuran is in accordance with the findings of Rahman (1991). The high yields obtained from the Carbofuran treated plants might be due to the direct activity of Carbofuran on the nematodes in soil thereby preventing or limiting the hatching of eggs and the movement of larvae into roots which enhanced the plant growth and yield. Weight of ten flowers was significantly higher in all the treatments compared to untreated check (12.09 g). The maximum weight of ten flowers (15.07g) was recorded in plants treated with *P. lilacinus* followed by *T. viride*, *P. fluorescens*, *T. harzianum*, carbofuran and *P. chlamydosporia* with 15.06 g, 15.00 g, 14.83 g, 14.78 g and 14.74 g respectively. These results with respect to bio-agents in increasing floral characteristics and flower yield are in conformity with the findings of Rao *et al.* (2003). The result obtained in current investigation were also uphold the results observed by Nirmal Johnson (2000), Rao and Shaylaja (2003) and Rao (2007) who observed increased growth and yield of carnation and crossandra in polyhouse and field experiments by the inoculation of *Paecilomyces lilacinus*, *Pseudomonas fluorescens* and *Pochonia chlamydosporia.*

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