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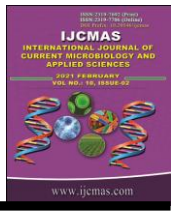

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Evaluation of Potential Biocontrol Agents on Root Knot Nematode *Meloidogyne incognita* Management in Carnation (*Dianthus caryophyllus* L.)

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A B S T R A C T

Field experiment on management of *Meloidogyne incognita* in Carnation var. Dona under poly house conditions was conducted to assess the efficacy of plant growth promoting rhizobacteria, single and combined application of *Pseudomonas fluorescens* and *Bacillus subtilis*. All the treatments were significantly increased the yield parameters *viz*., number of flowers per plant and total number of flowers per meter^2 and also observed the reduction of root knot nematode population. Fifty per cent increased yield was recorded in *P. fluorescens* (Pfbv 22) @ 10g/m^2 and combined application of *P. fluorescens* (Pfbv 22) + *B. subtilis* (Bbv57) each @ 5 g/m^2 treated bed respectively compared to untreated control. The single soil application of *P. fluorescens* (Pfbv 22) @ 10g/m^2 and combined application of *P. fluorescens* (Pfbv 22) + *B. subtilis* (Bbv57) each @ 5 g/m^2 recorded lowest root knot nematode population of 62.9 and 60.5 per cent respectively compared to untreated control. However, the reduction in galls index, number of egg masses and adult nematode population was higher in *P. fluorescens* (Pfbv 22) @ 10/m^2 alone treated bed.

Introduction

Carnation (*Dianthus caryophyllus* L.) is one among the most popular commercial cut flowers of the world, ranking second in commercial importance next only to rose. Carnation is preferred by several exporting countries, on account of its excellent keeping quality, wide range of forms, colours and ability to withstand long distance transportation. Carnation cultivation is popular in hilly regions of Tamil Nadu, India. It has become one of the most remunerative farming enterprises at present in lower pulney's of Dindigul district, Tamil Nadu, India. Frequently it was noticed that the growth of

carnation is adversely affected, leaves turn yellow, and slowly plants die. The soil and root samples of these areas on preliminary observations revealed that root-knot nematode, *Meloidogyne incognita* which was found to be responsible for growth decline. The root-knot nematode, *M. incognita* which causes 25 - 30 per cent yield loss in flower crops in Tamil Nadu is one of the major constraints of cut flower production. The nematodes cause reduced root system, stunted shoot growth and reduction in the number of blooms. The carbofuran 3G is a very good nematicide available for nematode management, but use of this nematicide is restricted due to nematicide residues in produce, environmental pollution and health hazards. So as to avoid these problems, alternatively use of biological agents were explored to manage root knot nematode *M. incognita*. The present study was undertaken to evaluate the biocontrol potential of talk formulation *viz., Pseudomonas fluorescens* and *Bacillus subtilis* on root-knot nematode under poly house cultivation.

Materials and Methods

The talk formulation of plant growth promoting rhizobacteria (PGPR) *P. fluorescens* and *B. subtilis* were tested for their antinemic potential against *M. incognita* on carnation under poly house condition at lower pulney hills, Thandikudi, Dindigul District. The talk formulation of PGPR consortium is the combination of two bacterial strain *P. fluorescens* (Pfbv 22) and *B. subtilis* (Bbv57) developed by Jonathan *et al.,* (2006) Department of Nematology, Tamil Nadu Agricultural University, Coimbatore was used in this experiment. Root knot nematode sick carnation growing medium was deeply tilled and added the organic matter to improve the aeration and fertility of soil. Beds are formed in the north–south direction. The bed width and height are 75 cm and 45 cm respectively. The bed length should not exceed 25 m. Before planting, drip lines and support netting are to be laid out. The bed should be moderately wet and drenched lightly with a fungicide (copper oxychloride @ 2 g/litre of water) to avoid fungal diseases. Planting were done at the time of evening with spacing of 15 x 15cm is followed. The plants should be removed from the rooting trays carefully without damaging the roots. Planting were done at shallow depth with part of the root zone exposed. Before planting the bed was treated as per the treatment schedule *viz*. Soil application of *P. fluorescens* (Pfbv 22) @ 10g /m^2, *B. subtilis* (Bbv57) @ 10 g/m^2, *P. fluorescens* (Pfbv 22) + *B. subtilis* (Bbv57) each @ 5 g/m^2, *P. fluorescens* (Pf 1) @ 10 g/m^2, Carbofuran 3G @ 1 kg a.i./ha, along with untreated control. The experiment was laid out in randomized block design with six treatments and four replications. Observation such as soil nematode population, root gall index, number of adult female/g of root, number of egg masses/g of root was recorded 180 days after planting. Yield parameters *viz.*, number of flowers/plant and total number of flowers/m^2 was also recorded.

Results and Discussion

The results revealed that the root knot nematode population, plant growth and flower yield were increased considerably in all the treatments compared to untreated control. Among the treatments soil application of *P. fluorescens* (Pfbv 22) @ 10g/m^2 and combined application of *P. fluorescens* (Pfbv 22) + *B. subtilis* (Bbv57) each @ 5 g/m^2 recorded lowest root knot nematode population of 62.9 and 60.5 per cent respectively compared to untreated control. Consortium of both *P. fluorescens* and *B. subtilis* found to reduce the number of root galls and number of egg masses per gram of root. *P. fluorescens* (Pfbv 22) @ 10g/m^2 application was recorded the number of adult

female nematode, egg mass in one gram of root and root gall index with a reduction of 63, 65 per cent & index 2 respectively over untreated control. Maximum number of flower per plant and flower yield per sq.m were recorded in *P. fluorescens* (Pfbv 22) + *B. subtilis* (Bbv57) each 5 g/m^2 treated bed when compared to untreated control. Whereas application of *B. subtilis* (Bbv57) @ 10 g/m^2, *P. fluorescens* (Pf 1) @ 10 g/m^2, and Carbofuran 3G @ 1 kg a.i./ha were found to observe significantly increased flower yield compared to untreated control (Table 1).

Table.1 Management of root knot nematode *Meloidogyne incognita* in carnation through PGPR consortium

Treatments	Nematode population (250g soil)	No. of female /g of root	No. of egg mass/g of root	Gall Index	Yield (No. of flower/Plant)	Yield (No. of flower /m2)
T1 – SA Pf (Pfbv 22) @ 10 g/m^2	148	12	8	2	4	112
T2 – SA Bs (Bbv57) @ 10 g/m^2	171	17	10	3	3	90
T3 –SA Pf (Pfbv 22) + Bs (Bbv 57) each @ 5 g/m^2	139	10	8	2	4	120
T4 – SA Pf (Pf 1) @ 10 g/m^2	207	18	14	3	3	90
T5 – Carbofuran @ 1 kg a.i./ha	137	8	7	2	3	90
T6 – Untreated control	375	27	20	4	2	60
CD (0.05)	14.88	1.43	1.79		0.67	20.22

***** Pf – *Pseudomonas fluorescens*, Bs– *Bacillus subtilis*, SA = Soil application

The present study was designed to determine the biocontrol potential of consortium *P. fluorescens* (Pfbv 22) + *B. subtilis* (Bbv57) on root knot nematode in carnation. In general, all the bio agents are capable of reducing the root knot nematode *M. incognita* population in soil. The results of this study showed that combined application of *P. fluorescens* and *B. subtilis* was found to be more effective on reduction of nematode population. The population of *M. incognita* juveniles was suppressed by *Pseudomonas* spp. due to its nematicidal action against juveniles (Keuken and Sikora, 1995), and alteration of root exudates, which affect the hatching and mortality of juveniles (Oostendorp and Sikora, 1990) finally nematode population were reduced. Reduction of root knot nematode *M. incognita* and increased the plant growth significantly due to its plant growth promoting hormones and the bacterium was suited for both seed as well as soil application, because of their potential for rapid and aggressive root colonization (Santhi and Sivakumar, 1995). The PGPR consortium was used as soil application in black pepper reduced the population of *M. incogntia* and *Radopholus similis* significantly (Senthilkumar *et al.*, 2011).

Number of flowers per plant and total number of flowers harvested from one square meter area was significantly increased in each treatment compared to untreated control. Fifty

per cent highest yield was recorded in combined application of *P. fluorescens* (Pfbv 22) + *B. subtilis* (Bbv 57) each @ 5 g/m^2 compared to untreated control. The single and combined application of *P. fluorescens* and *B. subtilis* significantly improved the yield parameters *viz*., number of flowers per plant and total number of flowers harvested from one square meter area. This was due to the plant growth promoting activity and high biocontrol potential of fluorescent pseudomonads and *Bacillus* sp. (Shekhar Varshney and Chaube, 1999). The plant growth promoting rhizobacteria may promote growth by secreting plant hormones (Lifshits *et al.*, 1987).

The *P. fluorescens* and *P. aeruginosa* producing gibberellic acid (Katznelson and Cole, 1965) and the production of Indole Acetic Acid by *P. fluorescens* (Dubeikovsky *et al.*, 1993) was responsible for plant growth. Senthil Kumar and Rajendran (2003) also recorded increase in the yield by soil application of *P. fluorescens* with consequent management of nematode fungal disease complex in grapevine. Hence it was concluded that the consortium of *P. fluorescens* (Pfbv 22) + *B. subtilis* (Bbv 57) may be a promising practice in management of root knot nematode in carnation under poly house cultivation.

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