*Research Paper :*

# Studies of root-knot nematode, *Meloidogyne incognita* and leaf spot disease of okra and their management by *Pseudomonas fluorescens*

**UPMA DUTTA, J.N. SRIVASTAVA AND A.K. SINGH**

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See end of the article for authors' affiliations

Correspondence to :
**J.N. SRIVASTAVA**
Regional Horticultural Research Sub-Station, Gwari Bhaderwah, DODA (J&K) INDIA
Email : j.n.srivastava 1971@gmail.com

**SUMMARY**

***Pseudomonas fluorescens* an eco-friendly, bio control agent used for the management of phytonematodes and foliar disease and proved to be effective control over *Meloidogyne incognita* population and leaf spot disease of okra by its different treatments. The maximum value of growth parameters *viz.,* root length, shoot length, fresh root weight, fresh shoot weight and number of leaves were observed in plant grown in plots treated with *Pseudomonas fluorescens* @ 1 kg/20 kg of seeds. Root knot index was found to be maximum in $T_0$ (Control) minimum in $T_2$ (Seed treated with *Pseudomonas fluorescens* 1 kg/ 20 kg of seeds) followed by $T_1$ (Seed treated with *Pseudomonas fluorescens* @ 500 kg/20 kg of seeds). The leaf spot disease was found to be maximum in $T_0$ (Control) and minimum in $T_4$ (Foliar spray of *Pseudmonas fluorescens* @ 4 kg/ha) followed by $T_3$ (Foliar spray of *Pseudomonas fluorescens* @ 2 kg/ha).**

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Okra (*Abelmoschus esculentus*), an annual vegetable crop belongs to the family Malvaceae, a South African native, grown in tropical and sub tropical parts of world. Fruit of okra used as vegetable contain high iodine content which helps to control goiter and the fibrous parts are used in paper industries.

Infestation of root knot nematode (*Meloidogyne* spp.) is one of the major constraints in the production of okra. The most widely prevalent species are *M. javanica, M. incognita* and *M. arenaria*. They infest a large number of crops espically vegetables like tomato, chilli, okra, egg plant, carrot, beans etc. and cause direct damage to the root system of plant (Ibrahim and Massoud, 1974).

Okra is also affected by leaf spot disease caused by *Cercospora* spp. The mycelium of *Cercospora* spp. consists of multicellular septate and branched hypha (both inter and intracellular). An eco-friendly approach, a gram negative, *Pseudomonas fluorescens* has emerged as potential most promising rhizobacterium which manages plant parasitic nematodes by soil inoculants and also manages leaf spot disease by foliar application. *Pseudomonas fluorescens* is economical compatible with bio-fertilizer and acts as plant growth promoting rhizobacterium (PGPR). So, the present investigation was undertaken to study the efficacy of *Pseudomonas fluorescens* on root knot nematodes (*Meloidogyne incognita*) on leaf spot disease and growth parameters of okra.

## MATERIALS AND METHODS

The plant material used of okra cultivar was Arka Abey (seed rate 20 kg/ha) okra variety sponsored by unique seed co-operation with purity (98%) and germination (70%). Seeds were treated with *Pseudomonas fluorescens* talc based powder formulation. An experiment was conducted to evaluate its efficacy against root-knot nematode infestation and leaf spot disease. The experiment was conducted at the farm of Allahabad Agriculture Institute. The land was prepared well and all agronomical operations were done before sowing. The field was divided into 5 treatments with 4 replications. The plot size of each replicate was 2x2 $m^2$ having spacing of 30 cm row to row and 15 cm plant to plant. In each plot, FYM was applied @ 8 tonnes/ha. The presowing *M. incognita* population, before FYM application was calculated (Southey, 1986). The treatments were; $T_0$- Control, $T_1$- Seed treated with *Pseudomonas fluorescens* @ 500 g/ 20 kg of seeds, $T_2$- Seed treated with *Pseudomonas fluorescens* @ 1 kg/20kg of seeds, $T_3$- Foliar spray of *Pseudomonas Fluorescens* @ 2 kg/ha, $T_4$-Foliar spray of *Pseudomonas fluorescens* @ 4 kg/ha. The different treatments were allocated randomly in each replication. The observations taken were pre-sowing and 90 days after sowing larve populations were counted from soil sample. Root-knot index at 30, 60 and 90 dyas after sowing, disease intensity at 60 and 90 days after sowing while plant growth parameters *viz.,* root length, shoot length, fresh root weight, fresh shoot weight and number of leaves of randomly selected 2 plants were recorded at 30, 60 and 90 days after sowing. The data recorded during the course was subjected to statistical analysis of variance while significance and non-significance was judged and significant difference between the means were tested against the critical difference at 5 per cent level with standard procedures.

## RESULTS AND DISCUSSION

It was found that the plots treated with *Pseudomonas fluorescens* showed better plant growth in comparison to control (untreated) plots. Plants from control plots were severely infected with *Meloidogyne incognita* and leaf spot disease resulting in reduction in plant growth parameters *viz.,* root length, shoot length, fresh root weight, fresh shoot weight and number of leaves (Mahajan and Sharma, 1979). The experiment showed that plots having seed treatments with *Pseudomonas fluorescens* bear lesser infestation of *Meloidogyne incognita* as compared to foliar application of *Pseudomonas fluorescens* but both have lesser number of root-knots than control and all the *Pseudomonas fluorescens* treated plots reduced the leaf spot of okra as compared to control but among the treatments foliar application of *Pseudomonas fluorescens* significantly reduced the leaf spot disease than other treatments. This is in agreement with findings of Rajeshwari *et al.* (1999) that the *Pseudomonas fluorescens* has emerged potentially most promising rhizobacterium which manages plant prarastic nematodes effectively and significantly reduces the population of roo-knot nematode (*M. incognita*) and also Hanna *et al.* (1999) that the decrease number of gall formation and nematicidal activity occur in *Pseudomonas flurescens* treated plots. Similar findings were also made by Meena *et al.* (2000) on groundnut and sunflower by Mathivanan *et al.* (2000) that foliar application of *Pseudomonas fluorescens* strain pf-1 significantly controlled leaf spot disease. In Table 1 larvae population of *M. incognita* between per sowing and 90 days after sowing significantly decreased in all the *Pseudomonas fluorescens* treated plots as compared to control (untreated) plot and among treatments $T_2$ have minimum number of larvae whereas treatments $T_1$ - $T_2$ and $T_3$ - $T_4$ did not show any difference. Root-knot index at 30 days after sowing, treatments $T_1$, $T_2$, $T_3$ and $T_4$ showed non-significant difference from each other but all decreased root-knot index over control plot and at 60 days after sowing, the maximum was found in $T_0$ and minimum in $T_2$ whereas, treatments ($T_1$, $T_2$, $T_3$) and ($T_1$, $T_3$, $T_4$) did not show any difference. At 90 days after sowing, the maximum value of root-knot index was found in $T_0$ and minimum in $T_2$ followed by $T_1$ (Table 1). It was found that at days after sowing, disease incidence was observed maximum in $T_0$ (control) plot and minimum in $T_4$ followed by $T_2$ whereas, among the treatments $T_4$, $T_2$ and $T_3$ did not show any difference. At 90 days after sowing, maximum disease was observed in control (untreated) plot and minimum in $T_4$ followed by $T_3$ whereas, among treatments $T_1$, $T_2$ and $T_3$ were statistically at par with each other (Table 1)

In Table 2, the analysis of data on growth parameters

**Table 1 : Effect of Pseudomonas fluorescens on larval populations, root-knot index leaf spot disease intensity**

| Treatments | Larval populations | | Root-knot index | | | Leaf spot disease intensity | |
|---|---|---|---|---|---|---|---|
| | Pre-sowing | 90 DAS | 30 DAS | 60 DAS | 90 DAS | 60 DAS | 90 DAS |
| $T_0$ | 500 | 628 | 1.5 | 2.5 | 3.25 | 46.5 | 52.7 |
| $T_1$ | 460 | 256 | 0.5 | 1.0 | 1.5 | 25.6 | 3.6 |
| $T_2$ | 428 | 244 | 0.25 | 0.5 | 1.0 | 17.11 | 28.4 |
| $T_3$ | 481 | 300 | 0.75 | 1.25 | 2.25 | 20.4 | 24.2 |
| $T_4$ | 413 | 310 | 0.75 | 1.5 | 2.0 | 16.8 | 20.3 |
| C.D. (P=0.05) | 143.59 | 35.12 | 1.07 | 0.96 | 1.26 | 5.75 | 6.50 |

DAS- days after sowing

**Table 2 : Effect of Pseudomonas fluorescens of growth parameters of okra**

| Treatments | Root length | | | Root weight | | | Shoot length | | | Shoot weight | | | No. of leaves | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DAS (Days after sowing) | | | | | | | | | | | | | | |
| | 30 | 60 | 90 | 30 | 60 | 90 | 30 | 60 | 90 | 30 | 60 | 90 | 30 | 60 | 90 |
| $T_0$ | 5.4 | 7.2 | 11.9 | 1.5 | 1.9 | 2.6 | 15.6 | 22.7 | 58.6 | 2.6 | 8.7 | 10.2 | 6.9 | 9.9 | 12.6 |
| $T_1$ | 6.9 | 9.3 | 19.9 | 2.3 | 2.6 | 4.9 | 27.5 | 57.2 | 91.9 | 5.9 | 17.9 | 27.0 | 12.6 | 13.6 | 19.6 |
| $T_2$ | 8.1 | 10.7 | 21.3 | 2.8 | 3.6 | 5.1 | 31.5 | 62.4 | 99.6 | 6.4 | 18.7 | 30.1 | 11.8 | 16.9 | 23.5 |
| $T_3$ | 6.5 | 9.9 | 19.4 | 2.1 | 3.3 | 4.7 | 25.7 | 51.6 | 82.6 | 5.6 | 17.3 | 24.3 | 10.3 | 11.9 | 20.5 |
| $T_4$ | 7.2 | 10.3 | 16.4 | 2.1 | 3.4 | 3.8 | 28.2 | 49.7 | 84.2 | 5.8 | 17.4 | 25.6 | 10.9 | 13.3 | 21.5 |
| C.D. (P=0.05) | 1.39 | 1.50 | 2.01 | 0.46 | 0.62 | 0.64 | 5.08 | 5.50 | 11.55 | 0.82 | 1.65 | 2.63 | 2.65 | 4.07 | 4.13 |

*viz.,* root length, shoot length, fresh root weight, fresh shoot weight and number of leaves were recorded at 30, 60 and 90 days after sowing (DAS). Root and shoot length showed highest growth in $T_2$ plots at 30, 60 and 90 days after sowing (DAS) while lowest being found in $T_0$ (untreated) plot and $T_1$, $T_3$ and $T_4$ were statistically at per with each other. It was found that 30, 60 and 90 days after sowing (DAS) root and shoot weight showed maximum value in $T_2$ and lowest in $T_0$ whereas, $T_1$, $T_2$, $T_3$ and $T_4$ are statistically at par with each other. Number of leaves showed significant difference under different treatments. At 30 days after sowing, the maximum growth in plot $T_1$ followed by $T_2$ and minimum in control whereas, among the treatments $T_1$, $T_2$, $T_3$ and $T_4$ were statistically at par with each other. Similar findings were reported by Santhi and Sivakumar, (1995) that *Pseudomonas fluorescens* increased the plant growth parameter and also in agreement with findings of Johri *et al.* (1995) that several strains on *Pseudomonas fluorescens* were found to significantly increase the plant growth vigour.

Authors' affiliations:
**UPMA DUTTA,** Regional Horticultural Research Sub-Station, Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, DODA (J&K) INDIA
**A.K. SINGH,** Regional Agricultural Research Station, Sher-e-Kashmir University of Agricultural Science and Technology of Jammu, DODA (J&K) INDIA

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