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# INFLUENCE OF *MELOIDOGYNE INCOGNITA* ON YIELD COMPONENTS AND PHYSIOLOGICAL FUNCTIONS OF PAPAYA

by

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**Summary**. A pot experiment was carried out in a glasshouse on the effect of *Meloidogyne incognita* on yield components and physiological functions of papaya cv. Co 6. An initial inoculum level of *M. incognita* at one juvenile per g soil caused a reduction in growth parameters and adversely affected the vital physiological functions viz., photosynthesis, evaporation rate and diffusion resistance, as well as increasing leaf temperature. The adverse effect of *M. incognita* on plant growth and physiological functions was directly correlated with the nematode inoculum level.

The root-knot nematode *Meloidogyne incognita* is a severe pest to papaya (Prasad, 1960 and McSorley, 1992). Root-knot nematodes can also directly or indirectly affect host physiological processes and productivity (Wallace, 1987; Wilcox and Loria, 1987). However, information available on the effect of nematodes on physiological functions of their host in general is scarse. Therefore the present investigation were carried out to study the influence of *M. incognita* (Kofoid *et* White) Chitw. on yield components and physiological functions of papaya (*Carica papaya* L.).

## Materials and methods

Seeds of papaya cv. Co 6 were sown in 22.5 cm diam. clay pots filled with 5 kg sterilized pot mixture. The plants were thinned 30 days after sowing to maintain one seedling per pot. The seedlings were inoculated at the rhizosphere region with freshly hatched juveniles ($J_2$), 10, 100, 1000 and 10000 of *M. incognita* per kg of steam sterilized pot mixture. An uninoculated control was also maintained. The treatments were replicated five times and pots were arranged in a randomized block design in a glasshouse. The experiment was run twice and terminated at 90 days after inoculation.

Observations were made on number of leaves, leaf area, length and weight of shoot and root and number of root galls. A composite sample of 500 g soil, drawn from each pot at the time of termination of experiments, was processed for nematodes by modified Baermann's funnel technique and the population of nematodes in 5 kg of pot mixture filled in each pot was worked out (Darekar and Mhase, 1986). The third leaf of each plant plucked at the time of termination from the above experiments were immediately fed to Leaf Chamber Analyzer-3 of carbon-di-oxide leaf chamber analysis system to read leaf temperature and to estimate some physiological functions viz., photosynthesis, evaporation rate

and diffusion resistance (Sen *et al.*, 1989). The observations of growth parameters, nematode population and physiological functions recorded in both experiments were pooled.

## Results and discussion

Increased initial $J_2$ population of *M. incognita* in the soil had a direct effect in decreasing papaya plant growth. Regarding the number of leaves, a significant reduction (15.6%) was recorded at the highest initial inoculum level of 10000 J2 per kg of soil. Reduction in leaf area (7%) was significant at an initial inoculum level of 1000 J2. The regression equations of Y=1.354-0.0180 X (r=-0.6830) and Y=1.7992-0.0123X (r=-0.8030) derived for the reduction of number of leaves and leaf area with initial nematode population of *M. incognita* revealed negative correlation. Reduction in shoot length and shoot weight was observed at all the inoculum levels and were significant in pots with 1000 $J_2$ and 10000 $J_2$. There was a significant reduction of shoot length between the initial inoculum levels of 1000 $J_2$ (13.8%) and 10000 $J_2$ (25.1%) of *M. incognita* per kg of soil. However, the difference was not significant with shoot weight. The regression equation showed significant negative correlation between length (r=-0.8302) and weight (r=-0.6839) of shoot and initial nematode population. Similarly, there was a significant reduction in root length (25.9%) and weight (25.5%) with 1000 $J_2$, compared with the uninoculated, and it was on par with 10000 $J_2$ of *M. incognita* per kg of soil. The reduction in root length (r=-0.7070) and weight (r=-0.7828) was negatively correlated with the initial inoculum of *M. incognita* (Table I).

Papaya plants infested with *M. incognita* remained stunted with smaller leaves and this was related to inoculum levels of the nematode, as found by Babatola (1985) and Gupta and Yadav (1988). The results of the present study indicated a noticeable reduction in plant growth characters viz., length and weight of shoot and root as reported by Rajendran *et al.* (1984) and Nath and Singh (1992). In addition, the number of

TABLE I - *Effect of* Meloidogyne incognita *on growth of papaya.*

| Inoculum level/kg soil ($J_2$) | Growth parameters* | | | | | | Nem. multiplication | | |
|---|---|---|---|---|---|---|---|---|---|
| | Leaves | | Shoot | | Root | | No. of galls/ plant | Final** pop. (/kg soil) | RF (Pf/Pi) |
| | No. | Area ($cm^2$) | Length (cm) | Weight (g) | Length (cm) | Weight (g) | | | |
| 0 | 11.50 | 59.57 | 31.39 | 23.60 | 15.44 | 19.45 | – | – | – |
| 10 | 11.00 (4.35) | 59.50 (0.12) | 30.85 (1.72) | 23.20 (1.69) | 14.73 (4.60) | 19.32 (0.67) | 2.73 | 163 (2.217) | 16.4 |
| 100 | 10.90 (5.21) | 58.35 (2.05) | 30.77 (1.98) | 23.10 (2.12) | 13.79 (10.69) | 17.20 (11.5)) | 13.37 | 767 (2.878) | 7.7 |
| 1000 | 9.80 (14.78) | 55.40 (7.00) | 27.07 (13.76) | 20.50 (13.14) | 11.44 (25.91) | 14.49 (25.50) | 193.35 | 4260 (3.629) | 4.3 |
| 10000 | 9.70 (15.56) | 53.50 (10.18) | 23.52 (25.07) | 19.60 (16.95) | 10.00 (35.23) | 14.39 (26.02) | 310.21 | 12644 (4.102) | 1.3 |
| CD (0.05) | 1.70 | 2.20 | 2.38 | 2.57 | 2.84 | 3.42 | 12.68 | 0.07 | |

* Figures in parantheses are percentage reduction over control.
** Figures in parantheses are transformed values of log x + 2.

TABLE II - *Effect of* M. incognita *on physiological functions of papaya.*

| Inoculum level/kg soil ($J_2$) | Leaf temperature* (°C) | Physiological functions* | | |
|---|---|---|---|---|
| | | Evaporation rate (mol/$m^2$/s) | Diffusion resistance (sec $cm^{-1}$) | Photosynthesis (mg $Co_2/dm^{-2}$ leaf/hr) |
| 0 | 25.86 | 8.02 | 8.68 | 24.85 |
| 10 | 26.00 (+0.50) | 8.06 (+0.50) | 9.91 (+5.89) | 24.24 (+2.45) |
| 100 | 26.06 (+0.77) | 8.38 (+4.49) | 10.25 (+18.09) | 24.12 (-2.93) |
| 1000 | 26.54 (+2.62) | 9.50 (+18.45) | 11.44 (+31.80) | 19.34 (-22.17) |
| 10000 | 26.42 (+2.17) | 9.80 (+22.19) | 11.74 (+35.25) | 18.85 (-24.14) |
| CD (0.05) | 0.46 | 0.49 | 2.37 | 3.48 |

* Figures in parantheses are percentage of increase or decrease over control.

leaves and leaf area were reduced, which is in accordance with the findings of Prasad (1960). Further, the leaves were distinctly yellowish at the higher inoculum levels (Darekar and Mhase, 1986).

In the present study the pathogenic level for *M. incognita* to affect the growth of papaya was 1000 $J_2$ per kg of soil which is in line with the findings of Darekar and Mhase (1986).

*M. incognita*, independently of the initial population density, increased leaf temperature, evaporation rate and diffusion resistance and lowered the photosynthesis at 90 days after inoculation compared to the control and it was significant at 1000 $J_2$ per kg of soil (Table II).

The number of root galls increased with the increase in inoculum levels. The number of galls at 14, 193.3 and 310.2 per root system, caused by an initial inoculum level of *M. incognita* at 100, 1000 and 10000 $J_2$ per kg of soil, at 90 days after inoculation differed significantly among each other. Gupta and Yadav (1988) also recorded a similar effect with *M. incognita* in papaya. The final soil nematode population of *M. incognita* was highest at the initial inoculum level of 10000 $J_2$ (12644) and significantly differed from the lower inoculum levels. However, the reproduction factor (RF) was highest at the lowest initial inoculum of 10 $J_2$ (16.4) and decreased with increase in initial inoculum of *M. incognita* (Table I). This might be due to variation in the growth rate of *M. incognita* and subsequent retarded development due to competition for food and space at high inoculum levels (Triantaphyllou and Hirschmann, 1960).

The present study clearly indicated that *M. incognita* is highly effective in reducing yield components of papaya. Regular physiological functions of photosynthesis, evaporation and diffusion resistance are also disturbed. The pathogenic level of *M. incognita* was one juvenile per g of soil for reducing plant growth parameters and to alter the physiological functions of papaya.

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