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Pathogenicity and Reproductive Potential of Root-knot nematode, *Meloidogyne incognita* on Dragon Fruit (*Hylocereus* spp.)

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ABSTRACT: The effect of different initial population density of root-knot nematode and damage they cause to the plants (in terms of root-galling) in dragon fruit, and nematode multiplication rate in soil was studied. The initial population density of nematodes (200, 500, 1000 and 2000 J2s/ 200 cm^3 soil) caused significant number of galls on the dragon fruit root system after 90 days of inoculation. Significantly higher numbers of galls (85.00/plant) were observed in the initial population density of 2000 J2s/200 cm^3 soil compared to 52.50 galls/plant in initial population density of 200 J2s/200 cm^3 soil. Higher multiplication rate (8.77-fold increase) was observed at the initial population density of 500 J2s/200 cm^3 soil. The present study clearly indicated association of *M. incognita* with dragon fruit is pathogenic as significant number of galls/egg masses and high nematode population density in soil was observed at initial population density of 500 J2s/200 cm^3 soil.

Keywords: *Meloidogyne incognita*, dragon fruit, pathogenicity, multiplication.

INTRODUCTION

Dragon fruit (*Hylocereus* spp.), also known as pitahaya, is an important fruit crop mainly used for table consumption, medicinal and industrial uses (Le Bellec and Vaillant, 2011). In India, it is cultivated in an area of about 3,084.6 ha in several states with production of approximately 12,113.4 tonnes of fruit every year (Wakchaure *et al.*, 2021). Climate suitable regions for cultivation of dragon fruit in India were assessed by Srinivas Rao *et al.* (2021). Several fungal, bacterial and viral diseases are reported to attack the dragon fruit and affect both quality and quantity of the produce (Balendres and Bengoa, 2019). Diseases of dragon fruit, their etiology and current management options were reviewed by Balendres and Bengoa (2019) and reported recent increase in incidence of diseases worldwide.

Monitoring of new and emerging pathogens is necessary due to the increase in cultivation of dragon fruit. Very little information is available with respect to damage caused by plant parasitic nematodes on dragon fruit. Zhang *et al* (2018) reported the incidence of stunt nematode, *Tylenchorhynchus agri* from pitaya (*Hylocereus polyrhizus*) in Guangxi Province of China and observed the above-ground symptoms such as growth inhibition and fruit drop. The cactus cyst nematode, *Cactodera cacti*, is reported to parasitize the roots of dragon fruit in Taiwan (Chan *et al.*, 2016). Root-knot nematode, *Meloidogyne javanica*, parasitizing yellow dragon fruit plants, *H. megalanthus* in Brazil has also been reported (Nascimento *et al.*, 2020). The *M. javanica* caused root galls mainly on secondary roots and affected plants showed the symptoms of rickets, with chlorotic and thin branches without any fruit yield (Nascimento *et al.,* 2020). Root-knot nematodes are polyphagous and economically important nematodes, distributed worldwide, causing significant economic damage to several crop species, including fruit crops. Therefore, the present study was undertaken to study the pathogenicity and reproductive potential of root-knot nematode, *M. incognita* on dragon fruit (*Hylocereus* spp.).

MATERIALS AND METHODS

The stem cuttings of mother plants of dragon fruit (cv. Purple Pink) of eight months old plants were obtained from the experimental farm of Deccan Exotics India Producer Company, Hyderabad. The cuttings of 15 to 20 cm length were planted in a 15 cm diameter pot containing 1000 cm^3 sterilized soil. After 30 days of planting, plants were inoculated with freshly hatched second stage juveniles (J2s) of *M. incognita* that were obtained from pure culture of *M. incognita* maintained and multiplied on brinjal at ICAR-NBPGR, RS, Hyderabad. The initial population density of different inoculum levels was 0, 200, 500, 1000 and 2000 J2s/ 200 cm^3 soil. Each inoculum level was replicated six times. The plants were maintained under greenhouse conditions at temperatures ranging from 28-30±2°C. After 90 days of inoculation, plants were uprooted from the pots and their roots were washed separately with tap water to remove adhering soil particles. The number of galls and egg masses per root system was counted under a magnifying stand. The juveniles were extracted from the soil of each individual plant from their respective pots by Cobb's decanting and sieving technique. The reproductive factor was calculated by dividing the final population by the initial population.

Statistical analysis of data was carried out by a single factor ANOVA (Gomez and Gomez, 1984). The data on no. of galls, no. of egg masses, and soil population (J2s) were square root transformed before analysis. Analyses of variance were carried out using DSAASTAT, version, 1.1 statistical package (Onofri, 2007) available at http://www.unipg.it/~onofri/ DSAASTAT/ DSAASTAT.htm. The Least Significant Difference (LSD) values at P = 0.05 were used to determine the significance of treatment mean differences.

RESULTS AND DISCUSSION

The results revealed that *M. incognita* caused galling on the roots of dragon fruit irrespective of inoculation level (Fig. 1, Table 1). The increase in initial population density resulted in an increase in the number of galls on the dragon fruit root system. Significantly higher numbers of galls (85.00/plant) were observed in the initial population density of 2000 J2s/200 cm^3 soil followed by 1000 J2s/200 cm^3 soil (82.67 galls/plant) and 500 J2s/200cm^3 soil (72.67 galls/plant) compared to 52.50 galls/plant in initial population density of 200 J2s/200 cm^3 soil. The number of egg masses at initial population density of 2000 and 1000 J2/200 cm^3 soil are at par with each other but significantly differ from the initial population density of 500 and 200 J2s/200 cm^3 soil. Observation on soil population revealed that increase in initial population density resulted in increase in soil nematode population. However, an inverse relation was found between initial population density and nematode multiplication rate. Higher multiplication rate (8.77-fold increase) was observed at the initial population density of 500 J2s/200 cm^3 soil followed by 1000 J2s/200 cm^3 (6.42-fold increase). Minimum multiplication rate (4.02-fold increase) was observed at the initial population density of 2000 J2s/200 cm^3 soil (Table 1).

Fig. 1. (a) Healthy roots of dragon fruit (b) Root-knot or root gall symptoms on dragon fruit due to *Meloidogyne incognita.*

Table 1: Effect of different inoculum levels of *Meloidogyne incognita* on root galling and nematode reproduction in dragon fruit.

Nematode inoculum level	No. of galls/root system	No. of egg masses/root system	Nematode soil population (No./200 cc soil)	Reproductive factor (*Pf*/*Pi*)
0	0	0	0	0
200	52.50±6.42* (7.25) **	59.17±4.14 (7.69)	1230.43±138.12 (35.08)	6.15±0.69
500	72.67±5.94 (8.52)	65.00±3.73 (8.06)	4386.70±158.98 (66.23)	8.77±0.32
1000	82.67±7.38 (9.09)	87.00±5.02 (9.33)	6030.27±216.83 (77.65)	6.42±0.22
2000	85.00±6.79 (9.22)	94.83±6.23 (9.74)	8030.23±139.50 (89.61)	4.02±0.07
LSD ($P < 0.05$)	1.18	0.81	4.03	--

* Value ± Standard error ** Values in parentheses are square root-transformed values

The dragon fruit plants did not exhibit above ground symptoms and nematode inoculated plants were similar to uninoculated plants. However, the root system exhibited a significant number of galls due to *M. incognita* at the initial nematode inoculation level (500 J2s/200cm^3 soil) with 8.77-fold increase in soil population. Root-knot nematodes are sedentary endoparasites that infect the vascular tissue of plants and induce metabolically active specialized structure called "giant cells" for source of nutrients. In the process, hyperplasia of surrounding cells of the nematode feeding site leads to the formation of root-knots or galls. The formation of giant cells and root galls modify the root architecture and affect the nutrient and water uptake by the host plant resulting in poor plant growth and reduction in yield (Favery *et al.*, 2016; Kihika *et al.*, 2017).

The dragon fruit is a hardy plant and highly tolerant to drought stress (Nie *et al.*, 2019; Wang *et al.*, 2021). Therefore, during the initial period, plants might have tolerated the nematode infection. However, possibility of showing above-ground symptoms in dragon fruit due to *M. incognita* in a year-old crop cannot be ruled out due to infection by secondary inocula. Nascimento *et al.* (2020) and Zhang *et al.* (2018) found the above ground symptoms in dragon fruit due to *M. javanica* and *T. agri* six months after nematode inoculation.

CONCLUSION

The *M. incognita* is an obligate plant parasite responsible for reduction in fruit-yield in several fruit crops. The present study clearly indicated association of *M. incognita* with dragon fruit is pathogenic as significant number of galls/egg masses and high soil nematode population observed at initial population density of 500 J2s/200 cm^3 soil. Further studies on survey and surveillance of root-knot nematodes in dragon fruit fields, symptomatology and losses caused by nematodes will greatly help in understanding the nematode behavior in dragon fruit and timely implementation of nematode management strategies.

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Conflict of Interest. None.

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