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Interaction of *Meloidogyne incognita* and *Colletotrichum lagenarium* complex in ivy gourd (*Coccinia indica* L.)

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Abstract

A pot experiment was carried out during the *rabi* season of 2015-2016 to study the interaction of *Meloidogyne incognita* and *Colletotrichum lagenarium* on ivy gourd. Experimental study revealed that, the dual inoculation treatments significantly decreased plant growth parameters were the treatment with *M. incognita* @ 1000J2/kg of soil and *C. lagenarium* @ 2% (w/w). The treatment with *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) simultaneous inoculation was statistically superior in decreasing the plant growth parameters of ivy gourd. The number of galls, eggmasses and final nematode population were maximum in the treatment with *M. incognita* @ 1000 J2/kg of soil. The maximum disease incidence was observed in the treatments with *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) after 15 days of inoculation and simultaneous inoculation of *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w).

Keywords: *Meloidogyne incognita*, *Colletotrichum lagenarium*, ivy gourd, plant growth parameters, interaction

1. Introduction

Ivy gourd, (*Coccinea indica* L.) is one of the most important nutritious vegetable and medicinal plants belong to the family Cucurbitaceae that has been recognized as a rich source of Beta-carotene, a major vitamin A precursor^[10, 12]. It is also considered as a good source of iron, vitamin C, protein and fiber^[13]. A hundred grams (100 gm) of ivy gourd fruit has a number of essential nutrients and 75KJ of energy. The root, stem, leaves and fruits of ivy gourds are used as medicine for controlling blood glucose levels in hyperglycemia. The leaves are very effective for treating diabetes as well as keeping sugar under control. It is also used for skin diseases such as ring worm, psoriasis itch, skin eruptions of small pox, small lesions of scabies etc. Fruits are effective for hypoglycemia, analgesia (reduces pain), tuberculosis, eczema, antipyretic, anti-inflammatory and hepatoprotective (liver protective) condition. Stems are effective for treating expectorant, antispasmodic, asthma, bronchitis, GIT disturbances, urinary tract infection and skin diseases. Roots are effective against hypoglycemic, antidiabetic, skin diseases and joint pain. In India, a number of major and minor cucurbits are cultivated in several commercial cropping systems and they share about 5.6 per cent of the total vegetable production of India. According to an FAO estimate, cucurbits were cultivated on about 4,290,000 ha with the productivity of 10.52t/ha.

Cucurbitaceous crops suffer from a number of pests and diseases which are caused by fungi, bacteria, virus and nematodes. Almost all cucurbitaceous crops may host of anthracnose disease. The infection was observed on leaves, stems, fruits and tendrils of snakegourd (*Tricho- santhes anguina* L.), ashgourd (*Benincasa hispida* Thunb. and Cogn), tinda or round-melon (*Citrullus vulgaris* var. *fistulosus* L.), watermelon (*Citrullus lanatus* Thunb. and Mansf.), bottlegourd (*Lagenaria siceraria* Mol and Standi.), muskmelon (*Cucumis melo* L.) and cucumber (*C. sativus* L.)^[9]. Anthracnose caused 90 per cent losses in yield of bitter gourd and water melon^[11]. Among the different pests causing damage to cucurbit crops, plant parasitic root-knot nematodes (*Meloidogyne* spp.) are considered major limiting factors of successful crop cultivation. Besides causing direct damage to the plant as pathogens, nematodes play important and destructive roles in disease complexes, where they either act as incitants, aggravators or vectors. The importance of disease complexes has been a matter of serious concern from the time of first report by Atkinson^[1] when wilt resistant cotton became

susceptible in the presence of root-knot nematode. In Konkan region, every year, this anthracnose-nematode complex caused very heavy losses in yield of bitter gourd; yield losses to the tune of 58.86 per cent due to the combined attack of anthracnose and root-knot nematode [5]. While yield losses in the range of 22.90 to 42.80 per cent due to root-knot nematode infestation in bitter gourd alone [7]. The presence of single pathogen may cause little damage while more than one may account for serious crop loss. Since fungal infection (*C. lagenarium*) was frequently encountered with most of the Cucurbitaceous crops [9]. Therefore an attempt was made to know the interrelationship, if any, between *M. incognita* and *C. lagenarium* of ivy gourd.

2. Materials and Methods

The experiment was carried out in the net house of Department of Nematology, Assam Agricultural University, Jorhat during the *rabi* season of 2015-2016. A pure culture of the fungus (*Colletotrichum lagenarium*) was collected from the culture collection, Department of Plant Pathology, AAU, Jorhat. This culture of the fungus was maintained throughout the period of experimentation on PDA by periodically sub-culturing on fresh media and stored at 4 °C. The purified *C. lagenarium* was multiplied on wheat-bran medium. For mass culture of fungus wheat-bran was soaked overnight and the water was allowed to drain out. About 200 g of wheat bran was put in to polypropylene bags. The bags were plugged with non-absorbent cotton. The medium was then autoclaved at 121 °C and 15 lb pressure per square inch for 30 minutes. Sterilized media was inoculated with two mycelial discs (5 mm) cut out from the 5-6 days old culture of *C. lagenarium* and inoculated bags were incubated at 28 °C±1 °C for 20 days. Mass culture of *C. lagenarium* was inoculated @ 2% (w/w) and mixed with the soil before planting or as per treatment combination. Local variety of ivy gourd terminal cuttings (semi hardwood cuttings) 15-20 cm long were planted at a depth of 5-6 cm deep in a 3kg capacity pot filled with sterilized pot mixture. After establishment of cuttings, freshly hatched 2nd stage juveniles of *M. incognita* were inoculated @ 1J2/g of soil. The treatments included were: T1- *Colletotrichum lagenarium* @ 2% (w/w); T2- *Meloidogyne incognita* @ 1000 J2/kg of soil; T3- *Meloidogyne incognita* @ 1000 J2/kg of soil + *Colletotrichum lagenarium* @ 2% (w/w) after 15 days of inoculation; T4- *Colletotrichum lagenarium* @ 2% (w/w) + *Meloidogyne incognita* @ 1000 J2/kg of soil after 15 days of inoculation; T5- *Meloidogyne incognita* @ 1000 J2/kg of soil + *Colletotrichum lagenarium* @ 2% (w/w) simultaneous inoculation; T6- Uninoculated control. Each treatment was replicated ten times and pots were arranged in a completely randomized design. The experiments were terminated 60 days after inoculation. Observations were recorded on plant growth parameters (Shoot length, dry and fresh weight of shoot and root), number of galls, eggmasses per root system, nematode population in soil and disease incidence. The disease incidence per cent was calculated by using the following formula:

$$\text{Disease incidence (DI \%)} = \frac{\text{No. of infected plant units}}{\text{Total number (healthy and infected) of units assessed}} \times 100$$

3. Results

The result revealed that there was a significant reduction in

the plant growth characters *viz.*, shoot length, fresh weight of shoot, dry weight of shoot. These features were noticed in all treatments compared to uninoculated controls (Table 1). Maximum percent reduction in shoot length (45.24), fresh weight of shoot (44.89), and dry weight of shoot (59.83) were recorded in the simultaneous inoculation of *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) (T5), followed by *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) after 15 days of inoculation (T3), *M. incognita* @ 1000J2/kg of soil (T2), *C. lagenarium* @ 2% (w/w) + *M. incognita* @ 1000J2/kg of soil after 15 days of inoculation (T4) and *C. lagenarium* @ 2% (w/w) (T1). Maximum per cent reduction in fresh weight of root and dry weight of root were recorded in the treatment *C. lagenarium* @ 2% (w/w) and maximum root weight (fresh and dry weight) was found in *M. incognita* @ 1000 J2/kg of soil followed by *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) after 15 days of inoculation, simultaneous inoculation of *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) and *C. lagenarium* @ 2% (w/w) + *M. incognita* @ 1000J2/kg of soil after 15 days of inoculation compared to uninoculated control. It was concluded that the number of galls (69.30) and eggmasses (33.80) and the final population of *M. incognita* (413.24) was significantly higher in plants inoculated with *M. incognita* @ 1000J2/kg of soil (T2). Fewer galls (34.10), eggmasses (16.70) and final population of *M. incognita* (262.67) were recorded in the plants inoculated with *C. lagenarium* @ 2% (w/w) + *M. incognita* @ 1000J2/kg of soil after 15 days of inoculation (T4) (Table 2). And the maximum disease incidence was recorded in simultaneous inoculation of *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) (T5) and *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) after 15 days of inoculation (T3). Both the treatments were statistically *at par*.

4. Discussion

Studies on the interrelationship between *M. incognita* and *C. lagenarium* on plant growth parameters, number of gall, number of eggmasses, final population of *M. incognita* and disease incidence of ivy gourd were recorded. The maximum percent reduction in the plant growth parameters were recorded in the simultaneous inoculation of *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) followed by *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) after 15 days of inoculation, which was in accordance with the reports of earlier studies by Chandra *et al.* [3] who reported that a decrease in shoot length (53%) in bottle gourd was observed with a population of 10 nematodes per 500g of soil due to *M. incognita* alone. Maximum root weight (fresh and dry weight) was found in the treatment (T2) followed by the treatment (T3) compared to uninoculated control. Cucurbits develop much larger galls due to spongy nature of the roots as a result root weight increased [4]. The results are in agreement with the findings of Catibog and Castillo [2] on mungbean (*Phaseolus aureus*) who reported that with increase in inoculum levels of *M. javanica*, root weight of mungbean increases. The number of galls, eggmasses and nematode population was significantly higher in plants inoculated with the treatment T2 and fewer in the plants inoculated with the treatment T4. The findings are in agreement with Kakati and Mahanta [6] who

reported that maximum nematode population was observed in control plots of cucumber. And in the present study, the maximum disease incidence was recorded in the treatment with simultaneous inoculation of *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) and *M. incognita* @ 1000J2/kg of soil + *C. lagenarium* @ 2% (w/w) after 15 days of inoculation, where both the treatments were statistically *at par*. This was in accordance with the reports of earlier studies by Jadhav *et al.* [5] who reported that in the control plot of

bitter gourd (anthracnose + root-knot infested plot) there was very high disease intensity (*i.e.* 72.21%). Anthracnose incidence caused by the fungus was maximum when inoculated either simultaneously or when nematodes were followed by fungus. It is evident that the prior invasion of nematode in to the roots made the host more suitable for fungal infection by providing a metabolically rich substrate. Alternatively or in addition nematodes might modify the rhizosphere to favour the fungal growth [8].

Table 1: Effect of interaction of *Meloidogyne incognita* and *Colletotrichum lagenarium* alone and in combinations on plant growth parameters of ivy gourd (Mean of 10 replications)

Treatments	Shoot length (cm)	Fresh weight of shoot (g)	Dry weight of shoot (g)	Fresh weight of root (g)	Dry weight of root (g)
T1 : <i>Colletotrichum lagenarium</i> @ 2% w/w	98.20b (-11.85)	15.41b (- 14.81)	1.95b (- 16.67)	24.39d (- 9.19)	2.37e (- 12.87)
T2 : <i>Meloidogyne incognita</i> @ 1000 J2/kg of soil	75.50cd (- 32.23)	11.83cb (- 34.60)	1.20d (- 48.72)	38.81a (+ 44.49)	3.89a (+ 43.01)
T3 : <i>M. incognita</i> @ 1000 J2/kg of soil + <i>C. lagenarium</i> @ 2% w/w after 15 days of inoculation	70.60de (- 36.62)	11.08d (- 38.75)	1.19de (- 49.14)	36.75a (+ 36.82)	3.36b (+ 23.53)
T4 : <i>C. lagenarium</i> @ 2% w/w + <i>M. incognita</i> @ 1000 J2/kg of soil after 15 days of inoculation	87.40b (- 21.54)	12.74c (- 29.57)	1.56c (- 33.33)	29.51bc (+ 9.86)	3.02cd (+ 11.03)
T5 : <i>M. incognita</i> @ 1000 J2/kg of soil and <i>C. lagenarium</i> @ 2% w/w simultaneous inoculation	61.00e (- 45.24)	9.97e (- 44.89)	0.94e (- 59.83)	31.65b (+ 17.83)	3.24bc (+ 19.12)
T6 : Check (UC)	111.40a	18.09a	2.34a	26.86c	2.72d
S.Ed.±	5.85	0.53	0.13	1.34	0.15
CD0.05	11.71	1.06	0.25	2.68	0.31

Figures in parentheses are per cent decrease (-) or increase (+) over uninoculated control Means followed by the same letter in the superscript(s) are not significantly different Check (UC) = Check (Uninoculated Control)

Table 2: Effect of *Meloidogyne incognita* and *Colletotrichum lagenarium* alone and in combinations on host infection, nematode multiplication and disease incidence on ivy gourd (Mean of 10 replications)

Treatments	No. of galls	No. of egg masses	Final nematode population / 250 cc soil	Disease incidence (%)
T1 : <i>Colletotrichum lagenarium</i> @ 2% w/w	0.00 (0.71)e	0.00 (0.71)e	0.00 (0.71)e	70.00 (56.79)b
T2 : <i>Meloidogyne incognita</i> @ 1000 J2/kg of soil	69.30 (8.35)a	33.80 (5.85)a	413.24 (20.34)a	0.00 (0.57)d
T3 : <i>M. incognita</i> @ 1000 J2/kg of soil + <i>C. lagenarium</i> @ 2% w/w after 15 days of inoculation	47.80 (6.94)b	25.20 (5.07)b	382.61 (19.57)b	80.00 (63.44)a
T4 : <i>C. lagenarium</i> @ 2% w/w + <i>M. incognita</i> @ 1000 J2/kg of soil after 15 days of inoculation	34.10 (5.88)d	16.70 (4.13)d	262.67 (16.22)d	60.00 (50.77)c
T5 : <i>M. incognita</i> @ 1000 J2/kg of soil and <i>C. lagenarium</i> @ 2% w/w simultaneous inoculation	40.30 (6.38)c	21.80 (4.71)c	369.06 (19.22)c	80.00 (63.44)a
T6 : Check (UC)	0.00 (0.71)e	0.00 (0.71)e	0.00 (0.71)e	0.00 (0.57)d
S.Ed.±	0.09	0.11	0.14	0.87
CD0.05	0.18	0.22	0.28	1.74

Values of number of galls, egg masses and final nematode population within parentheses are square root ($\sqrt{x + 0.5}$) transformed data

Values of disease incidence percentage are angular transformed values

Means followed by the same letter in the superscript(s) are not significantly different

5. Conclusion

The present study demonstrates the interrelationship between *M. incognita* and *C. lagenarium* of ivy gourd. The development of a successful strategy to manage root-knot nematode and anthracnose fungus disease complex should depend primarily on integrated disease management including methods to suppress the population of both pathogens in field soils.

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