Outbreak of Leaf Miner and Root Knot Nematode-wilt Disease Complex on Cucumber- A New Threat under Protected Cultivation in District Gurugram Haryana

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ABSTRACT

Background: Crops are constantly exposed to various organisms feeding on above and belowground parts under both natural and protected conditions. As compare to open field, the warm and humid conditions besides abundant food under protected conditions provide a stable environment for pest and disease development either alone or together. However, the natural enemies i.e. predators, parasites and parasitoids that keep pests and pathogens under control naturally are not present under protected environment. For these possible reasons, pest and pathogens often develop in polyhouses more rapidly and with greater severity than open fields.

Methods: A polyhouses study was carried out during last two months June and July in Patudi block of district Gurugram, Haryana where growers are facing failure of cucumber crop due to outbreak of insect pests- disease complexes on common host cucumber. On closer observation, symptoms of leaf miner as mining lines on leaves and galls or knots on roots the symptoms of root knot nematode were encountered. Further detailed lab based investigation were carried out on affected cucumber plant and root samples with the objective for isolation and identification of both pests and pathogens. For leaf miner morphological identification, the pattern of the feeding tunnel and the layer of the leaf being mined by leaf miner is one of the diagnostic key are useful to determine the species and instar of the leaf miner. However, Sieving and decantation method for nematode isolation and soil dilution method for fungal isolation were carried out and followed by morphological identification.

Result: Two types of herbivore i.e. leaf miner Liriomyza trifolii (Burgess) on aerial parts while root knot nematode, Meloidogyne javanica and wilt causing fungus Fusarium oxysporum f. sp. cucumerinum were identified on the basis of their specific morphological characters. Galled roots of cucumber were affected by combined attack of vascular bundle feeders, root knot nematode, Meloidogyne javanica and wilt causing fungus Fusarium oxysporum f. sp. cucumerinum identified in both soil and root samples. This kind of field report on cucumber crop under protected cultivation has not been reported so far in which three type s of pest and pathogens are feeding on the same host. Poly houses or ‘hot spots’ are selected for detailed investigation especially for growers’ friendly management in addition to interaction studies of upper and lower ground herbivores on cucumber crops.

Key words: Liriomyza trifolii, Meloidogyne javanica, Fusarium oxysporum f. sp. cucumerinum.

INTRODUCTION

Green house crops are highly prone to a number of pests and diseases under protected cultivation due to lack of natural enemies which are abundantly found in open fields and for these reasons, usually pest and disease development under poly houses are more rapid with greater severity than fields Sharma et al. (2009). Under the ages of National Horticulture Mission, a large numbers of polyhouses are being erected in Gurugram district of Haryana for growing short duration horticultural crops. Cucumber (Cucumis sativus L.), member of the gourd family, Cucurbitaceae is widely grown crop under protected cultivation due to primary source of vitamins, mineral and fiber for human body Patil et al. (2017).

Most recently, an investigation was carried out in Pataudi block of district Gurugram, Haryana where farmers were facing serious yield loss due to insect pest and disease-complex outbreak in cucumber (Cucumis sativus L.) crop under polyhouses which on closer examination showed foliar wilting with heavy infestation of serpentine leaf miner Liriomyza trifolii Burgess (Lepidoptera: Agromyzidae) when uprooted, severe root galling were observed due to root knot nematode (Fig1,2). Further examination of soil of infested cucumber plants showed the presence of second stage J2 larvae or infective stage of root-knot nematodes in large

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numbers i.e. 10-12 l/g soil much higher than economic threshold level of 2 l/g soil and the species was identified *Meloidogyne javanica* (Treub) Chitwood. Mycoflora studies revealed that *Fusarium oxysporum* f. sp. *cucumerinum* was consistently occurring fungi in most of the soil and root samples collected from root knot affected cucumber plants. However, among pest and diseases insect pests, serpentine leaf miner and root-knot nematode (*Meloidogyne* spp.)/ wilt (*Fusarium* spp.) fungus are serious maladies under polyhouses but alone or independently (Viraktamath et al 1993; Ananthakrishnan, et al 2009; Sabir and Singh, 2013). This kind of association of two groups of spatially separated shoot and root feeder on the same host cucumber associated with wilt fungus under protected cultivation has not been reported so far. These identified poly houses or ‘hot spots’ are selected for further IPM studies.

**MATERIAL AND METHODS**

The preliminary investigation was carried out in cucumber growing polyhouses of villages viz. Pachgaon, Bhorakalan, Uncha Majara and Lanagra of Patudi block of district Gurugram, Haryana from June to July 2020. The cucumber crop of cultivars, Multistar star and Captain star was found badly affected with aerial pest leaf miner, soil borne root knot nematode/ wilt alone and together as insect pest-disease complex. Three sampling points were taken for collection of plant samples viz front (4m from poly house entrance), middle (15m from the entrance) and rear (30m from the entrance). The affected 30 plants/ locality and their soil samples were collected for isolation, identification and severity of pest and diseases.

**Occurrence and frequency of leaf miner, root knot nematode and/or root wilt disease complex incidences.**

The affected cucumber plant samples collected from the hot spots were categorized, in four types on the basis of occurrence of insect- pest and diseases both alone and together viz. a) leaf miner b) root knot nematode c) root wilt and d) distinct appearance of leaf miner and root knot nematode -wilt fungus causing disease-complex incidence on common host cucumber.

The frequency percentage of occurrence of leaf miner/ root knot nematode and/or wilt diseases were calculated by using formula:-

\[
\text{No. of infected plant samples } \times 100 \\
\text{Total number of plant samples}
\]

**Isolation, Identification of leaf miner, root knot nematode and wilt fungus through in vitro studies**

Leaf blades infested with mature larvae or pupae of leaf miner were collected and placed in petri dishes until the emergence of adults at constant room temperature (25 to 30°C) for identification besides the pattern of the feeding tunnel is one of the diagnostic key to determine the species and instar of the leaf miner. In present investigation, leaf miner, *Liriomyza trifolii* Burgess (Lepidoptera: Agromyzidae) was identified. The isolation of root knot nematode from soil samples was carried out by following Cobb’s sieving and secantation method with modified Baermann Funnel technique (Southey, 1986) for its soil population. Correspondingly, the roots were examined in terms of no. of galls and no. of egg masses per gram roots. The cucumber roots were immersed in an aqueous solution of Phloxin B (0.15g/litre tap water) for 15 minutes to stain the egg masses in Acid Fuchsins (Byrd,1983). Number of galls/egg mass/root system was then counted for recording root population. Gall index (G.I) and egg mass index (E.M.I) rating. (Tylor and Sasser, 1978): based on G.I and E.M.I, diseases intensity grades were made as follows:- 0= disease free; 1 (very mild); 2(mild); 3(moderate); 4(severe) and 5(very severe).

The rhizospheric soil was subjected to soil dilution method (Martin, 1950) through which several fungi appeared on potato dextrose agar (PDA) medium at 22±2°C in BOD incubator. Among the consistently occurring mycoflora, *Aspergillus niger*, *A.terreus*, *Trichoderma harzianum*, *T.viride*, *Cladosporium oxysporum*, *Fusarium oxysporum*, *Claviceps purpurea*, *Alternaria alternata*, and others, *Fusarium oxysporum* was consistently identified throughout the investigation.

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**Fig 1:** Insect pest-disease complexon cucumber.

**Fig 2:** cucumber plant showing symptoms of leaf miner and root knot nematode-wilt disease complex.
Rhizoctonia solani, Alternaria alternata, Penicillium crysogenum were isolated, sub cultured and identified on the basis of morphological and spores characteristics (Barnett and Hunter, 1987).

Assessment of damage or severity caused by leaf miner, root knot nematode and/or wilt

The severity of damage assessment was scored on the basis of damaged leaf area caused by leaf miner L. trifolii i.e. low (20-40%), moderate (40-60%), high (60-80%) and severe (80-100%) Lopez et al. (2010). However, severity of root damage by nematode was evaluated on the number of galls/roots according to root knot index (Anon, 1993) in which 1(0), 2(1-10), 3(11-30), 4(31-100), 5 (100-above). Severity of fungal wilt was assessed by using 1-5 scoring scale Yang et al. (2007) i.e. 1 (visible symptoms); 2 (symptoms less than 25%); 3 (symptoms on entire leaf/root area and 5 (stunting of plant).

RESULTS AND DISCUSSION

Crops are constantly exposed to various pests and pathogens feeding on above and belowground parts under both natural and protected conditions. As compare to open field, the warm and humid environment besides abundance of food under protected cultivation provide a stable environment for pest and disease development either alone or together. However, natural enemies i.e. predators, parasites and parasitoids that keep pests and pathogens under control naturally are not present under protected environment of polyhouses. Due to which, pest and pathogens often develop more rapidly with greater severity in polyhouses than open fields Patil et al. (2017). It was noticed during our preliminary investigation of polyhouses of Patudi block of Gurugram district, Haryana that most of the cucumber plants infested with pest, leaf miner Liriomyza trifolii Burgess on aerial parts and roots were affected by combined attack of vascular bundle feeders, root knot nematode, Meloidogyne javanica and wilt causing fungus Fusarium oxysporum f. sp. cucumerinum (Owen, 1955) consistently occurring fungus almost pure culture in most of the soil and root samples collected from root knot affected cucumber plants. Leaf miner, L. trifolii, is a polyphagous pest that feed on nearly 80 plants in India (Srinivasan et al., 2005; Ratheey and Dalal 2018). The leaf miners can cause 11 percent to 62 percent in reducing the photosynthetic activities as per the leaf area damage Yang et al., 2007; Sinclair and Hughes, 2010). In protected cultivation, an overall average annual yield loss in major horticultural crops due to plant parasitic nematodes reported up to 60 percent and 19.6 percent under open fields respectively in India Gowda et al. (2017). The damage becomes very severe and goes up to 80 percent in case of ‘disease-complexes‘ in which the role of root knot nematode as primary pathogen while other invited pathogens termed as secondary pathogen (Powell, 1971). Though, yield loss due to synergistic effects on the common host has been estimated from 35 percent to 75 percent under protected cultivation Patil et al 2017.

In the present investigation, four types of maladies were recorded in which frequency percentage of most dominant type constituting leaf miner and nematode- wilt disease complex was recorded high i.e. 50.6, 54.1, 49.3 and 49.1 in four villages viz. Pachgaon, Bhorakalan, Uncha Majara and Langara respectively as compare to alone.. In case of leaf miner, 22.7, 23.1, 24.5 and 21.8 while 11.3, 10.5, 12.7 and 17.4 in case of wilt besides frequency percentage of root knot nematode occurrence 11.3, 10.5, 12.7 and 17.4 were recorded in above villages respectively (Table1).

In addition to occurrence of diseases, their severity of leaf miner, root knot nematode and/or wilt were scored on the basis of leaf damage, root gall and root wilt index. The scores were very high for leaf miner severe (70-90 percent) and ranges 3-5 for root knot nematode and wilt diseases recorded as per the scale in all identified polyhouses of four villages (Table1). The average population of root knot nematode inoculum (J2) larvae was encountered 10-12 l/g soil which was much above economic threshold level (ETL) value i.e. 2 l/g soil.

Soil mycoflora studies revealed that Fusarium oxysporum f. sp. cucumerinum was dominant over other fungi in samples collected from root knot and/or wilt affected ones while other consistently occurring fungi, Aspergillus niger, A. terreus, Trichoderma harzianum, Cladosporium oxysporum, Fusarium oxysporum, Alternaria alternata, Penicillium crysogenum were isolated, sub cultured and identified on the basis of morphological and spores characteristics (Barnett and Hunter, 1987). However, serpentine leaf miner and root-knot nematode (Meloidogyne spp.) are the most damaging pests under polyhouse conditions but alone or independently,

| Villages     | Leaf miner | Root wilt fungus | Root knot nematode | Leaf miner and Root knot nematode disease complex | (J2) l/g soil | SI index | G.I. /EMI | RW index |
|--------------|------------|------------------|-------------------|-----------------------------------------------|--------------|----------|----------|----------|
| Pachgaon     | 22.7       | 11.3             | 15.4              | 50.6                                           | 12           | 90       | 4-5/3-4  | 4-5      |
| Bhorakalan   | 23.1       | 10.5             | 12.3              | 54.1                                           | 12           | 85       | 3-4/2-3  | 2-3      |
| Uncha Majara | 24.5       | 12.7             | 13.5              | 49.3                                           | 11           | 77       | 3-5/3-4  | 3-4      |
| Langara      | 21.8       | 17.4             | 11.7              | 49.1                                           | 9            | 73       | 3-4/2-3  | 2-3      |

Table 1: Frequency of disease incidences caused by leaf miner, root knot nematode and/or root wilt fungus from affected cucumber plants under protected cultivation in district Gurugram.
This kind of field report on cucumber crop under protected cultivation has not been reported so far in which three types of pest and pathogens are feeding on the same host.

CONCLUSION

A number of insect-pests and diseases including soil borne plant parasitic nematodes and wilt/rot fungi which interfere with the successful cultivation of cucumber under polyhouses. Among the insect pest, serpentine leaf miner (Liriomyza spp.), root-knot nematode (Meloidogyne spp.) and the wilt causing fungus, Fusarium oxysporum f. sp. cucumerinum among soil borne pathogens are the most damaging pathogens for cucumber and other vegetable crops under protected cultivation, parasitizing almost all the polyhouses crops but independently in most of the cases. However, all three maladies were recorded in form of leaf miner-root knot and wilt disease complex on common host cucumber. These identified poly houses or 'hot spots' are selected for further IPM studies especially for management of emerging issue of insect-pest and disease-complex on cucumber crops.

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