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NATURE AND EXTENT OF DAMAGE OF CITRUS LEAF MINER, *Phyllocnistis citrella* Stainton

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ABSTRACT

Investigation was carried out in a citrus nursery at Bangladesh Agricultural University, Mymensingh, to determine the nature and extent of damage of citrus leaf miner (*Phyllocnistis citrella* Stainton) on three species of citrus viz. lime (*Citrus aurantifolia*), lemon (*C. limon*) and pummelo (*C. grandis*). The leaf miner larva prefers 4 to 6 days old leaves of citrus for infestation. The citrus leaves of all the species appeared to be tolerant against leaf miner when they are 10 to 14 days old. The larva after hatching penetrates through the adaxial and abaxial surface of new leaves by making irregular zigzag gallery. The mining action of larva damages leaf tissue, thus the leaves suffer badly, showing deformed, and curled shape, become defective in function for photosynthesis, and finally dry out and fall off. The zigzag gallery looks brown in lemon, reddish yellow in lime and white in pummelo. The highest percentage of leaf infestation and area of leaf damage were found in pummelo. The number of larva, mine, and length of mine were also higher in the leaves of pummelo followed by lemon and lime. Thus, pummelo appeared to be the susceptible species of citrus in Bangladesh.

Key words: Citrus, Leaf miner, *Phyllocnistis Citrella*, Nature and Damage extent

Introduction

Citrus leaf miner, *Phyllocnistis citrella* Stainton is a very destructive pests of citrus (Patel and Patel, 2001a). It inflicts considerable economic damage to various citrus plants in the south and South East Asian countries (Hill, 1987). It is found to attack citrus plant in different areas of Bangladesh (Ali, 1989). The leaf miner badly attacks citrus in the nursery and young plantations (Batra, 1998). It usually occurs on the tender leaves of new flushes but young shoots and fruits are also reported to be attacked (Beattie, 1989). The larva after hatching penetrates through the cuticle layer of the leaf tissue and mines the surface of newly formed leaves, which results in crumbling of leaf, reduction in plant vigor by making zigzag gallery and thereby reduce the photosynthetic activity and encourage the incidence of citrus canker, (Prodhan, 1992 and Muller, 1995). Heavy infestation may retard in growth of nursery and newly planted trees (Muller, 1995).Citrus leaf miner is difficult to control effectively as it is an internal feeder. Knowledge on the nature and extent of damage of the pest is important aspect for adopting appropriate management strategy. Seasonal incidence and extent of damage of *P. citrella* were studied by different authors (Pandey and Pandey, 1964, Pena 1998, Lara *et al.* 1998 and Patel and Patel, 2001b). But no in-depth studies in these regards have been made in Bangladesh. Therefore an attempt was undertaken to investigate the nature and extent of damage of citrus leaf miner, *P. citrella*.

Materials and Methods

The experiment was conducted in a citrus nursery at Bangladesh Agricultural University, Mymensingh, during February to April, 2003. Nature and extent of damage of leaf miner were investigated on lime (*Citrus aurantifolia*), lemon, (*C. limon*) and pummelo (*C. grandis*) as host plant. The layout of the

experiment was Randomized Complete Block Design (RCBD) with five replications considering a single plant as a replicate. One-year-old citrus saplings having uniform vigour were selected. The plants were free from insecticide application. Data were recorded on preference of leaf for infestation, number of larva, mine and length of mine per infested leaf. Percentage of leaf infestation and infested area per leaf were also determined.

Preference of leaf for infestation

The citrus plants were in new flush condition. Five newly sprouted leaves were selected and marked from each of the citrus plant. To identify the infestation observation was made daily at 8.00 a.m. The infestation was identified with the initiation of mining in leaf. The age of leaf at initial infestation was recorded, as the period required for starting mining activity by the *P. citrella*. The day of sprouting was considered as one-day-old leaf. The age of leaf for maximum infestation and for last infestation was also recorded.

Number of larva per infested leaf

Larva of different instar(s) of *P. citrlla* was observed carefully using magnifying glass. Total number of individuals was counted including the pre-pupal stage.

Number of mine per infested leaf

Since the mine is zigzag in pattern, so it is difficult to count the total number of mine per infested leaf. Here the total number of initial and terminal point of the mine was counted then it was divided by two to get the total number of mine. The initial point was marked as the minute hole and the terminal point was marked as pupal chamber or dead larval exuviae's.

Length of mine (cm) per leaf

The length of mine by the leaf miner in the infested leaf was measured in cm. As the mine is zigzag in shape and it is difficult to measure the mine length. Hence, a fine thread was placed on the tunnel and then the length of thread was measured as the length of mine by placing it on a scale.

Percentage of leaf infestation

Numbers of healthy and infested leaves were counted from each selected twig with 15 leaves (approximately) from the apex and percentage of leaf infestation was calculated.

Percentage area of leaf infestation

Percentage area of leaf infestation was studied with the infested leaves only. The percentage area of leaf infestation was measured by using transparent graph paper considering a single leaf as hundred percent areas.The data were analyzed statistically following Gomez and Gomez (1984). The percentage data were transformed by aresine transformation before analysis and mean values were separated using Duncan's Multiple Range Test.

Results and Discussions

Citrus leaf miner *P. citrella* posses chewing type of mouthparts in its larval stage and siphoning type of mouthparts in its acult stage. The damage is caused by the larva only. The nature and extent of damage of citrus leaf miner on food plant varied considerably.

a) Nature of damage

P. citrella is an internal leaf feeder which attacks only the younger and tender leaves of citrus causing them distorted and curled by making zigzag gallery. The nature of damage of *P. citrella* observed in this study is described below.

Preference of leaf age:

The citrus leaf miner prefers newly sprouted soft and succulent leaves for infestation. The age of different citrus leaves play a vital role for leaf miner infestation. The data regarding the age of leaf for infestation are presented in table 1. The first infestation was noticed after 2.2, 2.0 and 1.8 days in lemon, lime and pumello leaf respectively, which are statistically insignificant. The infestation was continued up to 10, 11 and 14 days in lime, lemon and pummelo leaf respectively. But after this period no leaf was found to be attacked by *P. citrella*

Table 1. Age of different citrus leaf for P. citrella infestation.

Citrus species	Age of leaf for infestation (in days)		
	Initial infestation	Maximum infestation	Last infestation
Lime	2.20	4.00[a]	10.00[a]
Lemon	2.00	4.80[b]	11.00[b]
Pummelo	1.80	6.00[c]	14.00[c]
L.S.D.	-	1.20	2.21
S.E. (±)	-	0.25	0.47
Level of significance	NS	P< 0.001	P< 0.001

Means with different letter in a column are significantly different.

After 4.0, 4.8 and 5.6 days the highest number of leaf was infested by *P. citrella* in lime, lemon and pummelo respectively. In this investigation it was found that lime leaves was infested last of all and its liability to be attacked is less, whereas pummelo leaf was infested before others and its liability to be attacked by *P. citrella* is high. The citrus leaf miner attacks leaves of 2.2 to 10.0 days in lime, 2.0 to 11.0 days in lemon and 1.8 to 14.0days in pummelo. Besides it prefers to infest the leaves of 4.0 to 6.0 days old. Mogahed (1999) reported that the leaves of 1 to 5 days old were mostly infested and that of 11 to 15 days old leaves were appeared to be tolerant against *P. citrella*.

Nature of leaf mining

The female lays eggs singly, in the lower surface of leaves, particularly in the midrib region. After hatching, the larva penetrates through the epidermal layer by making irregular serpentine mine. Major findings reported by several workers (Pandey and Pandey 1964, Prodhan 1992 and Muller: 1995) indicate that the larva mines only the adaxial surface but in this investigation it was found that the larva mines both adaxial and abaxial surface of leaves. Primarily the larva mines in the adaxial surface but when the infesting area in this surface is finished then it migrates to the abaxial surface through the junction between leaf wing and leaf lamina. On encountering of any type of barrier in the way of tunneling, the larva changes its direction in making gallery. The barrier includes hard rib, leaf margin, leaf spot and any hard particles attached to the leaf surface. The mining action of larva caused deformed and curled shape of leaf, reduction of photosynthetic area and finally, leaf drying and dropping off.

Symptom of mine:

Most of the time the larva starts it feeding from mid rib region and proceeds toward the margin of leaf. When the larva reached to the margin then finding no straight way, it turns back and proceeds towards the midrib. Thus, it makes a zigzag gallery. As the larva feeds and moves about, the leaf part behind it along with the middle gallery, a narrow line of semi-liquid excrement was found which was whitish at first but turned brown with age in lemon (Plate 1), reddish-yellow in lime (Plate 2) and pure white in pummelo leaves (Plate 3). Similar notes were also reported by Pandey and Pandey (1964).

b) Extent of damage

The extent of damage of *P. citrella* was determined on the basis of percentage of leaf infestation, area of leaf infestation and number of larva, mine and total length of mine per infested plant.

Percentage of leaf infestation

A significant (P<0.001) difference in percentage of leaf infestation was found in the three citrus species (Fig.1). The highest infestation (80.42%) and the lowest (57.46) of leaf infestation were observed in pummelo and lime respectively. The moderate infestation was found in lemon. None of the three citrus species were found resistant to the *P. citrella*. Lara *et al.* (1998) found the range from 12.0 to 86.60% and Boughdad *et al.* reported 07.0 to 52.0%.

Plate 1. Infested leaf of lemon

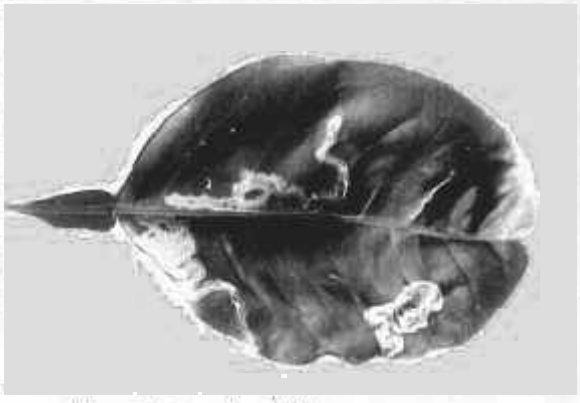

Plate 2. Infested leaf of lime

Plate 3. Infested leaf of pummelo

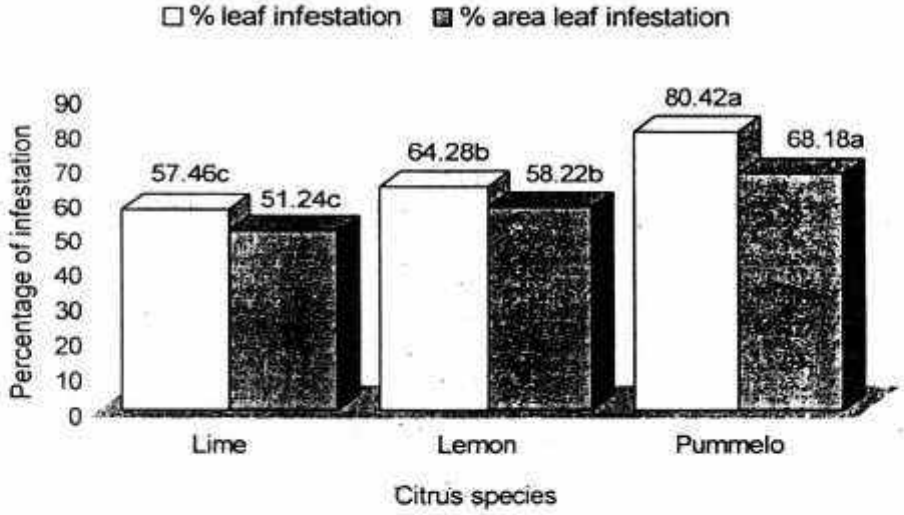

Fig. 1 Extent of damage of citrus leaf miner, *P. citrella* based on percentag of leaf and area of leaf infestation

Percentage area of leaf infestation

Percentage of area of leaf infestation also varied significantly in the different species and followed similar pattern (Fig. 1) to that percentage of leaf infestation. The highest (68.18%) area of leaf infestation was found in pummelo, which is followed, by lemon (58.22%) and lime (51.24). Batra *et al.* (1998) reported a similar trend of extent of damage in respect of area of leaf infestation.

Number of larva per infested leaf

The larva of *P. citrella* is mostly confined in the lower surface of the leaves but occasionally they are found in the upper surface. Average member of larva per infested in the citrus species is presented in the Table 2. Larval count in the citrus species showed a significant difference ($P<0.001$). The maximum number of larva (2.08) per infested leaf was found in pummelo leaf and that of the lowest (1.40) was in lime. Mean number of leaf miner larvae per lemon leaf was1.68. The number of larva per infested leaf depends on the surface area of leaf. The surface area of leaves of lime, lemon and pummelo is different at equal age. In the three citrus species pummelo had the maximum leaf surface followed lemon and lime. The highest number of larvae was found in pummelo and the lowest was in lime. It was also found that higher larval infestation was in the leaf having maximum leaf surface.

Number of mine per infested leaf

Number of mine per infested leaf was varied significantly ($P<0.01$) and followed the similar pattern to that of number of larva per infested leaf (Table 2). Number of mine was higher (2.40) in pummelo leaf and lower (1.40) in lime leaf.

Table 2. Average number of larva, mine and total length of mine of P. citrella per infested leaf.

Citrus species	No. of larva/infested leaf	No. of mine/infested leaf	Total length of larva/infested leaf
Lime	1.22[c]	1.40[c]	12.00[c]
Lemon	1.68[b]	2.16[b]	15.00[b]
Pummelo	2.08[a]	2.40[a]	25.00[a]
L.S.D.	0.20	0.11	0.867
S.E. (±)	0.04	0.02	0.182
Level of significance	P< 0.001	P< 0.01	P< 0.01

Means in different letters in a column are significantly different.

Total length of mine

The data regarding length of mine are presented in table 1. The larva made irregular serpentine mine with in the leaf lamina. The length of mine was significantly different among the three citrus species. The length of mine was found higher (25 cm) in pummelo leaf followed by lemon (15 cm) and lime (12 cm). This is also might be due to the variation in size of leaf of different citrus plant.

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