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Seasonal Incidence and Extent of Damage Caused by Citrus Leaf Miner, *Phyllocnistis citrella* Stainton Infesting Lemon

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Abstract. The seasonal incidence and extent of damage caused by citrus leaf miner, *Phyllocnistis citrella* Stainton (Lepidoptera : Gracillariidae) were investigated during a styudy carried out in a citrus orchard at Faridpur, Bangladesh. The leaf miner was active throughout the year, and its incidence and extent of damage varied significantly in different months. It was observed that the trend of rising and falling of the pest level occurred twice in a year, with two peak populations in the months of April and September. The minimum incidence was found in January and July. The extent of damage in respect of percentage of leaf infestation, area of leaf infestation and the mine length per leaf were, respectively, 80%, 60% and 12.8 cm in April, and 64.9%, 50.06% and 10.4 cm in September. The environmental temperature and relative humidity of spring and autumn influenced the incidence of citrus leaf miner resulting in higher pest population and plant damage. The low environmental temperature in the winter months and excessive rainfall in the monsoon season adversely affected the pest in the field. The moderate environmental conditions of spring and autumn were, therefore, the most favourable periods for *P. citrella* in Bangladesh.

Keywords: *Phyllocnistis citrella*, citrus damage, citrus leaf miner, lemon infestation

Introduction

The citrus leaf miner, *Phyllocnistis citrella* Stainton, is one of the most destructive microlepidopteran pests of citrus (Patel and Patel, 2001). It causes considerable economic damage to various citrus plants in the South and Southeast Asian countries (Hill, 1987; Atwal, 1976; Vevai, 1969; Alam, 1962). The leaf miner has been reported to attack citrus plants in different parts of Bangladesh (Ali, 1989). The larvae after hatching, penetrate through the cuticle layer of the leaf tissue and mine the adaxial and abaxial surface of the newly formed leaf causing the leaves to crumble. The zigzag silvery galleries made in the leaves reduce the photosynthetic activity and thus the crop vigour, which encourage the development of citrus cankers (Patel and Patel, 2001; Prodhan, 1992; Shevale and Pokharkar, 1992). The leaf miner, being an internal feeder, is difficult to control. Within this context, knowledge related to the peak periods of incidence of the pest is important for its successful management. Seasonal incidence of this pest has been studied by several authors in their respective native areas (Patel and Patel, 2001; Batra *et al.*, 1998; Lara *et al.*, 1998; Pena *et al.*, 1996; Shevale and Pokharkar, 1992). As the information in this regard is not available for Bangladesh, an attempt was made to study the seasonal incidence and the extent of damage caused by *P. citrella* during different months of the year.

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Materials and Methods

The study was conducted in a citrus orchard, located at Madhukhali, District Faridpur, Bangladesh, during January to December, 2002. The seasonal incidence and the damage caused by the leaf miner was investigated on lemon, *Citrus limon* Burm. Studies on the seasonal incidence of the pest were confined to the larval stage. The layout plan of the study was randomized complete block design, with five replications considering a single plant as a replicate. Four-year old lemon plants, having uniform vigour, were selected. The plants were free from any insecticide applications. Obser-vations were made in the middle of each month throughout the year. At each observation, tender twigs were randomly selected from all over the periphery of the plant canopy. Data were recorded in terms of the number of larvae per infested leaf, percentage of leaf infestation, percentage area of leaf infestation, and length of mine per leaf.

Larvae of different instar(s) of *P. citrella*, including the prepupal stage, were observed every month on 15 infested leaves per plant under a magnifying glass, and recorded as the mean number of larvae per infested leaf. The number of healthy (larvae-free) and infested leaves were counted from each selected twig (approx 15 leaves on the twig). The counting was done from the apex and percentage of leaf infestation was recorded. The percentage area of leaf infestation of 15 infested leaves per plant was recorded, which was measured graphically by considering a single leaf as 100% area. The

length of mine made by the leaf miner in the infested leaf was measured (cm). As the mines were zigzag in shape, the length was measured by placing a fine thread all along the tunnel and then measuring the length of the thread.

The data were analyzed statistically by following Gomez and Gomez (1984). The percentage data were transformed by arcsine transformation before analysis and mean values were separated using the Duncan's multiple range test.

Results and Discussion

The incidence of the leaf miner in *Citrus limon* and its extent of damage varied considerably during different months of the year. The pest was active throughout the year and had two peak periods, one in April and the other in September during which it caused greater damages to the plant, whereas minimum pest incidence and the extent of damage were noted during the periods from June to July, and December to January.

Seasonal incidence of *Phyllocnistis citrella*. The larvae of *P. citrella* were mostly confined to the lower surface of the leaves, though also found occasionally on the upper surface.

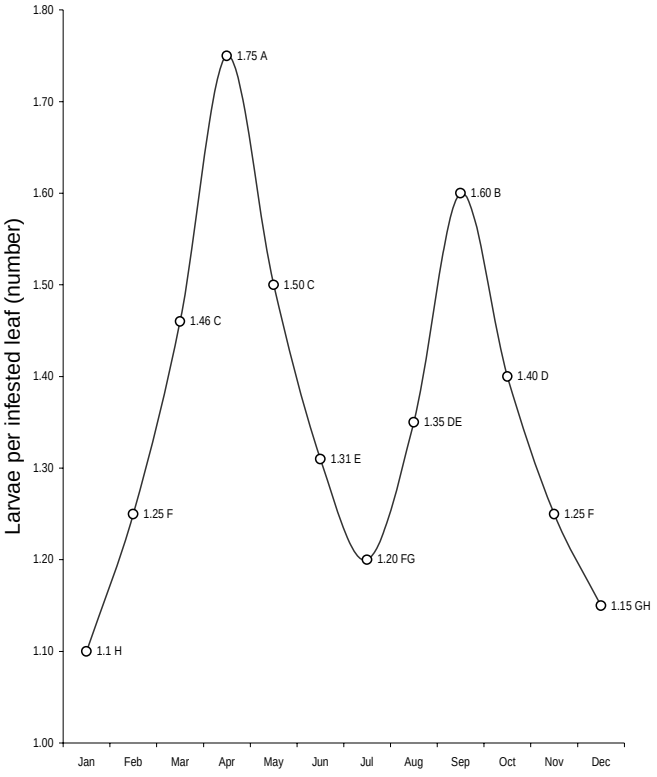

Fig. 1. Mean number of *Phyllocnistis citrella* larvae per infested citrus leaf during different months, 2002; the means of different months with common letter(s) are not significantly different.

The number of larvae per infested leaf during different months of the year is presented in Fig. 1. The larval count during different months showed a significant variation ($p < 0.01$). In January, the number of larvae per infested leaf was the lowest (1.1 per leaf), which increased consistently during February to April, reaching the peak (1.75 per leaf) in April. The number of pests started to decrease in May until July, when it reached the low value of 1.2 per leaf. A rise was again observed in August reaching its second peak (1.6 per leaf) in September.

The larval population of citrus leaf miner at any time of the year comprised of individuals representing different developmental stages, which is indicative of the presence of overlapping generations. Citrus plant develops new flush of leaves mainly during spring-summer (February/March-April/May), and autumn (September/October). Thus, the higher leaf infestation by *P. citrella* was obtained during these periods. The weather and climatic factors are also likely to play a vital role on the seasonal fluctuations of the leaf miner and the extent of damage that the pest causes, as the growth of the plant is related to climatic conditions.

In winter, the number of larvae were the lowest due to low temperature and non-availability of new leaf flushes. The heavy rainfall, in the rainy season, had a negative impact on the leaf miner incidence because of the destruction and washing out of eggs. Similar trends in the leaf miner incidence have been reported (Wu and Wu, 2000; Legaspi *et al.*, 1999; Pena *et al.*, 1996). Patel and Patel (2001) found higher and lower population of *P. citrella* on Kazi lime in the last week of September and the first week of January, respectively, which are very close to observations made during the present investigations.

Extent of damage caused by *P. citrella*. The extent of damage caused by *P. citrella* to lemon is presented in Table 1. A significant ($p < 0.01$) difference in the percentage of leaf infestation was found during different months of the year. The highest (80%) and the lowest (10.8%) leaf infestation by the leaf miner were observed in April and January, respectively. Lara *et al.* (1998) found these values to range from 12.0 to 86.6%, while Boughdad *et al.* (1999) reported these to range between 17.00 and 52.00%. The two peaks of leaf infestation as found during April and September were observed to be statistically different.

Percentage area of leaf infestation. The percentage area of leaf infestation varied significantly ($p < 0.01\%$) during different periods of the year, following similar pattern to that noted for the percentage of leaf infestation. The highest (60%) area of leaf infestation was observed in April but it was reduced

Table 1. The extent of damage caused by *Phyllocnistis citrella* to lemon leaves, based on percentage of leaf infestation and the area of leaf infestation*

Month	Percentage of leaf infestation		Percentage area of leaf infestation	
	actual value	transformed value	actual value	transformed value
January	10.80h	18.99	6.40h	14.42
February	25.34e	30.16	24.16ef	29.31
March	53.18c	46.81	40.00c	39.18
April	80.00a	63.59	60.00a	50.79
May	50.12c	45.10	37.68cd	37.81
June	22.40ef	28.18	22.10f	27.97
July	20.00ef	26.48	12.06g	20.18
August	38.10d	38.10	30.38de	33.38
September	64.94b	53.70	50.06b	45.01
October	33.20d	35.18	32.52cd	34.73
November	17.64fg	24.74	18.72f	25.49
December	12.01gh	20.15	7.20h	15.38
LSD	7.00	4.69	7.30	4.77
SE(±)	1.84	1.23	1.92	1.25

*means with the same letter(s) in each column are not significantly different ($p > 0.01$; Duncan's multiple range test); LSD = least significant difference; SE(±) = standard error

to the minimum (12.06%) in July. An increase in the area of leaf infestation was again observed from August, which reached the peak in September (50.06%), decreasing to the lowest level (6.4%) in January. Batra *et al.* (1998) reported a similar trend in the extent of damage in the area of infested leaves.

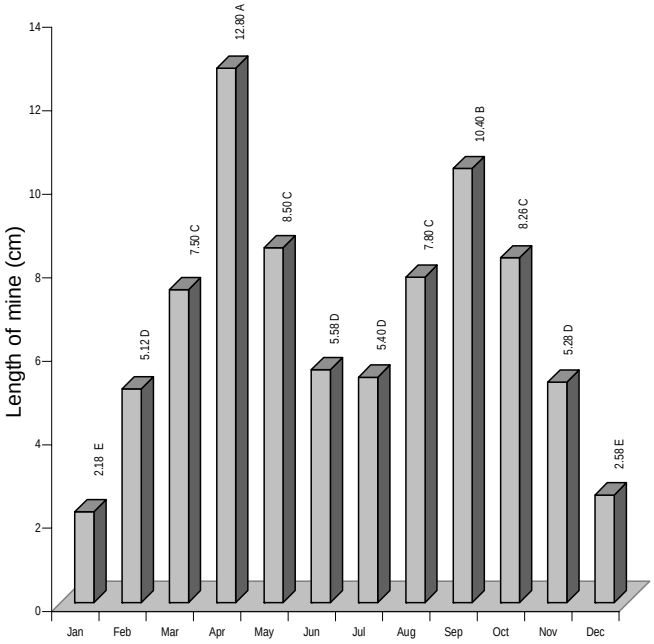

Fig. 2. The extent of damage caused by *Phyllocnistis citrella* based on length of mine made in the leaves of lemon; the means of different months with common letter(s) are not significantly different.

Length of mine. The larvae made long irregular serpentine mines within the leaf lamina. The data on the mine length of citrus leaf miner are presented in Fig. 2, which show significant differences ($p < 0.01$) during different months of the year. The mean length of mines was greater (12.8 cm) in April followed by September (10.4 cm). The shortest length of mines was observed in the month of January (2.18 cm).

It is concluded from the foregoing presentation that different seasons had marked influence on the incidence and extent of damage caused by *P. citrella* on lemon leaves. The periods of moderate climatic conditions were favourable for the incidence of citrus leaf miner, causing higher damage to the leaves of citrus plants during such conditions.

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