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Occurrence and seasonal incidence of sapota leaf webber, *Nephopteryx eugraphella* Ragonot on *Mimusops elengi* L. - A medicinal tree

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ABSTRACT: Studies on incidence and foliar damage by leaf webber, *Nephopteryx eugraphella* on Indian medlar, *Mimusops elengi* was carried out at ICAR- Directorate of Medicinal and Aromatic Plants Research at Anand, Gujarat during rainy season of 2019 and 2020. The identity of the pest was confirmed through morphological approach by dissecting the male and female genitalia of adult insects. The larvae of insect species were feed on younger leaves, apical shoots, flower buds and fruits of the host plant by making leaf folds. The incidence and foliar damage of leaf webber was ranged between 32-100 % and 4.86 to 32.53% during 2019, and it was 13.33-100 % and 5.80 to 42.07 % during 2020, respectively. The peak incidence and foliar damage was noticed during 36th Standard Metrological Week (SMW) in 2019 and 37th SMW in 2020. The correlation of leaf webber population with weather parameters showed that the per cent incidence and per cent leaf damage of *N. eugraphella* negatively correlated with maximum temperature and both the parameters positively correlated with minimum temperature, relative humidity (morning and evening) and rainfall during the study period.

Keywords: *Nephopteryx eugraphella*, *Mimusops elengi*, male genitalia, seasonal incidence, weather parameters

INTRODUCTION

Medicinal plants are chief source of phytochemicals for a number of human diseases since ancient times and are popular in tribal and rural areas because of their easy availability and low cost (Altemimi *et al*., 2017). Medlar wood or Bullet wood, *Mimusops elengi* L (Family; Sapotaceae), also known as Bakula (Sanskrit), Babhuli (Gujarati), is one such important medicinal plant that has been used for a long time in the history of medicine and is even mentioned in the ancient Ayurvedic scriptures such as Kalidas' Megduta (Gami *et al*., 2012). *M. elengi* is an evergreen tree commonly found in tropical forests of south Asia, Southeast Asia and northern Australia (Mitra, 1981; Kirtikar and Basu, 2001). Because of its therapeutic properties, the different parts of the tree including bark, flowers, seeds and roots has been used to prepare number of medicinal products (Mitra and Bakula, 1981; Gami *et al*., 2012). The medicines prepared from it are well known for anti-anxiety, antibacterial, anticariogenic, antifungal, antihyperglycemic, antinociceptive, diuretic effects, free radical scavenging and gastroprotective properties (Gami, 2007; Manjeshwar *et al*., 2011). Reports suggest that the fruits were a staple diet of the sages, hermits and people in the ancient Indian civilization (Kadam *et al*., 2012).

In India, the tree species infected with many insect pests and diseases, among which sapota leaf webber, *Nephopteryx eugraphella* Ragonot was assuming major pest in recent past. Leaf webber is a key pest of sapota in southern Gujarat and found active on sapota throughout the year. During 2019, Jaydeep *et al.* (2018) documented *M. elengi* as a new host of *N. eugraphella* from eastern region of Uttar Pradesh, India. The present study documents first report on feeding of *N. eugraphella* on *M. elengi* in Gujarat, which is one of major sapota growing regions in India. The study on incidence, field damage and population dynamics of *N. eugraphella* is essential for comprehensive management. Hence, the present study aims at documenting the incidence and population dynamics of *N. eugraphella* on *M. elengi* in relation to weather parameters during rainy season of 2019 and 2020.

MATERIALS AND METHODS

Morphology based identification

The larvae of *N. eugraphella* were collected from research plot and brought to laboratory of ICAR-DMAPR, Anand, Gujarat and reared on tender leaves of *M. elengi* till pupation. The collected pupae were sexed and kept separately. Immediately after emergence the

adults were killed using ethyl acetate and pinned via thorax using anticorrosive stainless insect pins (No.4). The specimens collected were described to generic and species level, based on the keys developed by Hampson in the Moths volumes of the Fauna of India (Hampson, 1896). Genitalia of male and female adults were dissected using the techniques described by (Kirti and Gill, 2005) and photographed with the help of SZX16 Stereozoome microscope.

Nature of damage and seasonal incidence

Present investigation was conducted to study the nature of damage, per cent leaf damage and seasonal incidence of *N. eugraphella* on *M. elengi* during rainy season of 2019 to 2020 at the ICAR- DMAPR, Anand, Gujarat, India. Twenty five trees of *M. elengi* were selected at random five locations containing five trees at each location to study the extent of damage. Assessment of leaf injury or damage was made on the basis of the percentage of leaf infested which was obtained from each tree plant by randomly selected hundred leaves from different direction of the plant.

The meteorological data was collected and correlated with insect population to understand the relationship between incidence of leaf webber and various weather parameters *viz.,* maximum temperature (X_1), minimum temperature (X_2), morning relative humidity (X_3), evening relative humidity (X_4), and total rain fall (X_5) considered for studying the seasonal incidence of *Nephopteryx eugraphella* on *Mimusops elengi.*

RESULTS AND DISCUSSION

Morphology based identification

The adults were taxonomically identified as *Nephopteryx eugraphella* Ragonot (Pyralidae: Lepidoptera) by the following morphological and genital characters. The results were confirm with (Nagaharish *et al.,* 2017)

Description

Head with the frons smoothly curved, covered with rough scales, labial palpi upturned, closely appressed to head, the 2nd joint normal and not hollowed; maxillary palpi filiform; antennae thickened in male, simple in female, more than two thirds the length of fore wing costa. Fore wings slightly suffused with brown and with black; some raised black scales at base in the cell; an ante-median band present edged by black lines; the inner of which with a ridge of raised scales, the band transverses by a fuscous line. Hind wings are whitish, semi-hyaline; the apical area, a marginal line and aline through the cilia fuscous.

Male genitalia

Uncus small, arch like; vulvae long and broad towards the basal 2/3 and narrow apically; dense hairs at costal margin; less hairs towards inner margin; vinculum broadly 'U-shaped, lateral arms slender and short; gnathos produced into median process; phallus narrowed towards apex, swollen towards base (Fig. 1 a & b).

Female genitalia

Anterior apophysis strongly developed than posterior apophysis; apophyses equal in size; bursae copulatrix bag like, oval towards distal extremity; ductus bursae thread like; bursae copulatrix with rows of spinules on both the sides with several minute oval sclerotized patches grouped together towards one side and covers 1/2 of the bursa copulatrix.

Nature of damage

Close observation on larval feeding shows that it feeds on the young leaves, apical shoots, flower buds and fruits of *M. elengi.* In case of leaves, larvae fed inside the leaf folds, which were made by joining the leaves with silken threads and excretal pellets were trapped inside the webs. The larvae of all age group damage the leaves by scrapping the chlorophyll content. Infested leaves dried up under extreme infestation and got detached at the pedicel base. The infested flowers and flower-buds dried up and bear no fruit. Once the larval stage is complete, pupation takes place is webbed part only by using silken threads and excretal pellets. During rainy season the incidence level reach up 100 per cent and with foliage damage up to 42.07 per cent. Finally plants from a distance show burning appearance (Fig. 2).

Seasonal incidence of *N. eugraphella*

Per cent plant incidence

During 2019, the activity of *N. eugraphella* on *M. elengi* was observed between of second week of July (28th Standard Metrological Week) to last week of October (44th SMW). The per cent plant incidence was 32 to 100. The larval activity was started from 28th SMW with 32 per cent plant incidence within two weeks of initial observation the per cent plant incidence reached to 100. Till 41st SMW the incidence was recorded on all observed trees, however started decreasing thereafter and becomes zero during 45th SMW. Whereas, during 2020 the incidence of leaf webber started earlier (27th

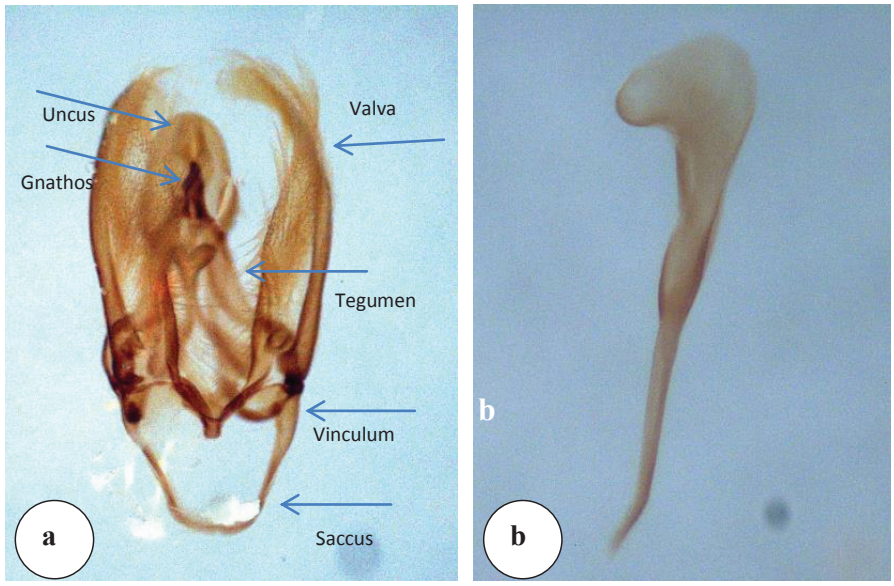

Fig 1. Morphological and genital characters of *Nephopterix eugraphella*
a) Male, b) Female adult, c) Male genitalia, d) Phallus

Fig 2. a. distant view of infested tree, b. infested shoot

SMW) and reached cent percent during 31st SMW. The incidence was noticed on all the observed trees till 40 SMW and thereafter started decreases and disappeared during 45th SMW.

Per cent leaf damage

Leaf damage due to *N. eugraphella* on *M. elengi* was observed only during rainy season of the year and ranging from 4.86 to 32.53 per cent (Fig. 3). The initial leaf damage due to larvae was at 4.86 per cent during the 28th SMW and then reached a peak of 32.53 per cent during the 36th SMW. However thereafter leaf foliage damage was decreased to 5.80 percent during the 44th SMW. The leaf damage due to *N. eugraphella* becomes zero during 45th SMW. The trend in activity of leaf webber remains same with the previous year; however the intensity varied during 2020. The maximum leaf damage due to *N. eugraphella* was recorded during 37th SMW (Fig. 4).

Correlation with weather parameters

The correlation analysis (Table 1) indicated that the per cent incidence (r= -0.32 and -0.42) and per cent leaf damage (r= -0.46 and -0.43) of *N. eugraphella* negatively

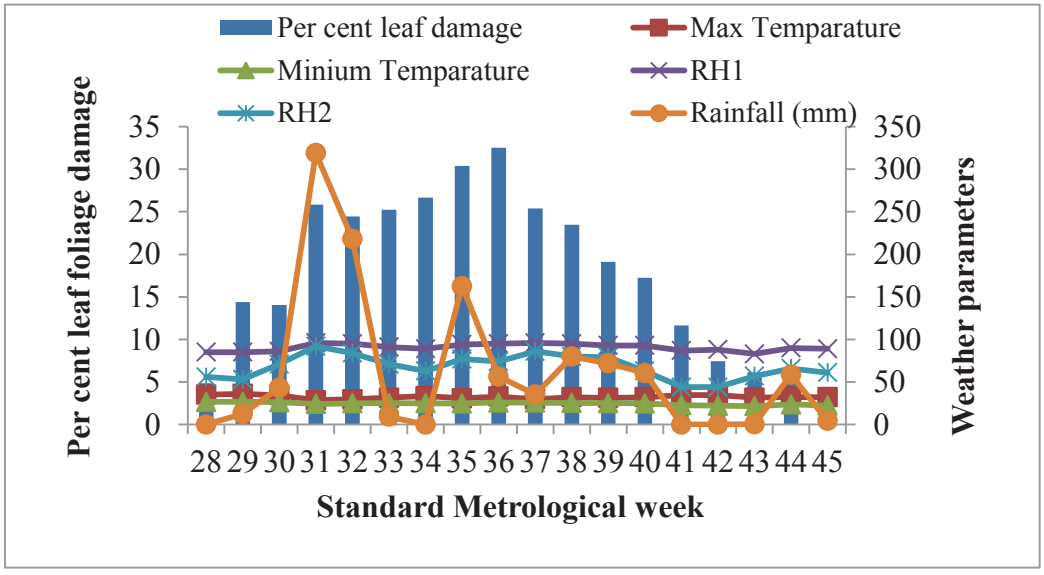

Fig 3. Per cent leaf foliage damage by *Nephopterix eugraphella* on *Mimusops elengi* during 2019.

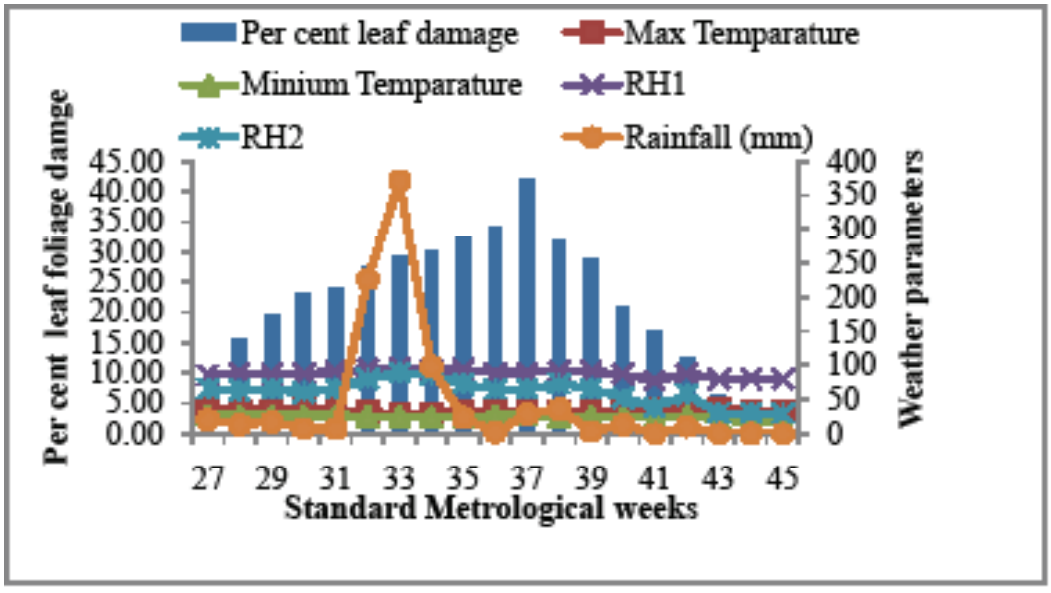

Fig 4. Per cent leaf foliage damage by *Nephopterix eugraphella* on *Mimusops elengi* during 2020.

correlated with maximum temperature during 2019 and 2020, respectively. The remaining weather parameters *viz*., minimum temperature, mean relative humidity morning, mean relative humidity evening and rainfall have positive effect on both incidence and leaf damage of *N. eugraphella* on *M. elengi* during 2019 and 2020. On the other hand, the regression studies revealed that weather factors influenced 29.00 and 64.00 per cent on incidence and leaf foliage damage during 2019. Similarly, during 2020 the weather parameters influenced 47.00 and 61.00 percent on incidence and damage of *N. eugraphella* on *M. elengi* (Table 2).

The sapota leaf webber, *Nephopteryx eugraphella,* assumed to a status of major pest of sapota throughout India and active around the year. However, the insect feeding on the closely related plants of Sapotaceae also reported. We observed the incidence of *N eugraphella* on *Mimopsis elengi* only during rainy season of the year Jayadeep *et al*. (2018). Even though the pest was reported for the first on Bakula, but listed as minor pest, however we report the incidence of leaf webber on *M. elengi* assuming major pest status. Interestingly the incidence restricted only to rainy season. Many workers reported similar correlation results where minimum temperature, rainfall and relative humidity (morning and evening)

Table 1. Correlation of *Nephopterix eugraphella* incidance with weather parameters on *Mimusops elengi* tree plant

Weather parameter	Year 2019		Year 2020	
	Plant incidence	Leaf damage	Plant incidence	leaf damage
Maximum temperature (°C)	-0.32	-0.46	-0.42	-0.43
Minimum temperature (°C)	0.21	0.48*	0.53*	0.63*
Relative humidity morning (%)	0.52*	0.73*	0.65*	0.74*
Relative humidity evening (%)	0.42	0.67*	0.63*	0.73*
Rainfall (mm)	0.35	0.48*	0.33	0.30

* significant at p = 0.05

Table 2. Multiple regression analysis between abiotic factors and *Nephopterix eugraphella* incidence on *Mimusops elengi* tree plant

Year		Regression analysis	R^2
2019	Plant incidence	Y=-358.369+ 1.738 Tmax + 1.284 Tmin + 3.938 RH_1 – 0.076 RH_2 + 0.032 RF +25.55	0.29
	Leaf damage	Y=-135.404 – 0.099 Tmax + 2.820 Tmin + 1.36 RH_1 – 0.12 RH_2 + 0.005 RF +6.989	0.64
2020	Plant incidence	Y=10.286 – 9.22 Tmax + 7.12 Tmin + 3.00 RH_1 – 1.15 RH_2 – 0.030 RF +31.28	0.47
	Leaf damage	Y=-9.416 – 2.23 Tmax + 1.50 Tmin + 0.800 RH_1 - 0.01 RH_2 – 0.033 RF + 8.52	0.61

Tmax (Maximum temperature), Tmin (Minimum temperature), RH_1 (Relative humidity morning), RH_2 (Relative humidity evening), RF (Rainfall)

positively correlated with the incidence and damage (Shukla and Patel, 2011; Chaudary *et al*., 2017; Hajare *et al*., 2012). Similarly, maximum temperature negatively correlated with the incidence and plant damage (Shukla and Patel, 2011; Chaudary *et al*., 2017; Hajare *et al*., 2012).

CONCLUSION

The Medlar wood, *M. elengi* is a medium sized, evergreen tree, economically paramount because each part of the tree used in traditional medicine to treat variety of human diseases. Even though *M. elengi* was recorded as host plant of *N. eugraphella* since 1896 (Hampson, 1896), the insect was not causing significant economic damage to the tree. However, due to its stenophagous feeding behaviour on Sapotaceae members, *N. eugraphella* remains active throughout the year and causing damage up to 80 per cent on *M. elengi* assuming major pest status Jayadeep *et al*. (2018). The incidence and damage reached to 100 and 32.53 per cent, respectively during 36th SMW in eastern part of Gujarat during 2019 and 100 and 42.07 percent during 2020. However, possibility of further increase is evident because of wide scale monoculturing of sapota in Gujarat. In this regard, the current study will be useful in understanding agro- ecosystem information and could be utilized in developing forecast models and sound technology for management.

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