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Leafhopper (*Empoasca flavoscens* Fabricius): A Major Pest of Castor Affecting Ericulture in Northeast India

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ABSTRACT: Castor (*Ricinus communis*) is one of the primary food plants of eri silkworm (*Samia ricini* D.). The leaves of castor are economically important for ericulture due to their feeding of domesticated eri silkworm. Hence, the quality parameters of the leaves directly influences eri silkworm rearing. There are several factors which directly affect the cocoon quality of erisilk worm *viz.*, poor nutritional quality, dusted leaves, diseases infected leaves, pests infested leaves, etc. Among them, pest infested leaves significantly lower the yield and quality of castor leaves. Castor leafhopper, *Empoasca flavoscens*, is categorized under the seasonal sucking pest of castor (Mainly in winter and summer months). But, now a days this insect pest is becoming most devastating pest in Northeast India because of its behavior and incidence. Heavy infestation of leafhopper on castor impairs growth and reduces quality and number of leaves, which directly influences eri silkworm rearing. Till date, this pest is considered for low damage due to its seasonal nature and no systematic study has been carried out especially with reference to ericulture. Thus the present study was carried out with the main focus on the important diagnosis and its control measures including its life cycle.

Keywords: Leafhopper (*Empoasca flavoscens* F.), Castor (*Ricinus communis*), Eri silkworm (*Samia ricini* D.)

INTRODUCTION

Ericulture is an integral part of tradition and income generation occupation in tribal as well as rural population of northeastern states. Due to its labour intensive nature, ericulture can also reduce the unemployment and poverty (De and Das, 2007). Eri silkworm is polyphagous, semi-domesticated and multivoltinein nature and highly suitable for integrated farming and agroforestry model especially in rainfed regions (Mahesh and Arunkumar, 2020). On an average, four crops can be taken up against the single harvest in other dry land crops, which would be sufficient to maintain a family through additional income. Considering the advantages and return capacity of ericulture, many state governments especially in the northeastern and southern India have initiated steps to popularize ericulture (Ramalakshmi, 2012).

Traditionally ericulture has been practiced in north eastern states in India on uncultivated or wild plants of castor (*Ricinus communis*), kesseru (Hete *ropanaxfra* grans), tapioca (*Mainhot esculentum*), borpat (*Ailanthus grandis*), payam (*Evodia flaxinifolia*) and borkesseru (*Ailanthus excelsa*). However, castor is the most preferred food plant for eri silkworm due to its good palatability, good quality of cocoon, easy availability of castor leaf and also its commercial cultivation for non-edible oil. Besides, the farmers can be benefited with an additional income through ericulture which is a boon for rainfed castor growers. Further, eri pupae is relished by tribal people and is considered at par with mutton or chicken (Saratchandra, 2010).

India is the world leader in castor, producing nearly two-thirds of the total global production followed by Brazil and China. In the most parts of India, castor (*Ricinus communis*) is an important non-edible oilseed crop. Castor is being grown as oilseed crop and the seeds contain more than 50% oil. But, the eri farmers are utilizing castor leaves as a major food for eri silkworms. Castor leaves are large, succulent, green with pointed lobes and prominent veins, each develops on a long stalk often used as bunch for feeding eri silkworms. From the recent observations castor is infested by many pests right from sowing to harvesting. Castor is infested by insect pests right from sowing to harvesting. More than 60 species of insects and mites have been reported to cause damage to the castor crop

and their related yield loss has been estimated to be about 40-89% (Rai, 1976). The seed yield losses in castor due to insect pests varied with the season, the severity of the pest and the hybrid variety of the plant. The major insect pest problems in castor are the defoliators viz., semilooper, *Achaea janata* L., tobacco caterpillar *Spodopteralitura* Fab., capsule borer *Conogethes punctiferalis* Guen. and the sucking pests such as leafhopper, *Empoasca flavoscens* Fab., thrips, *Retithrips syriacus* Mayet and whitefly, *Trialeurodes ricini* Misra. The green leafhopper, *Empoasca flavescens* Fab. is one of the serious sucking pests at vegetative stage (Mounica *et al.,* 2018). The sucking pests such as leafhoppers, whiteflies and thrips have been known to be the most important pests attacking castor resulting in excessive loss of grain yield (Hegde, 2006). Around 30-35% of leaf yield loss caused by sucking pests was recorded in India. Leafhopper has become increasingly severe pest of castor, as well as some other agronomic crops and ornamental plants (Iqbal *et al.,* 2012). The nymphs and adults of the leafhopper suck sap from leaves and characteristic symptoms of hopper burn appear owing to the toxigenic nature of leafhopper.

Among the different pests, a leafhopper is considered as a major pest which usually infests castor plants during summer and winter seasons. Leafhopper –*Empoasca flavescens* (Fabr) (Cicadellidae: Hemiptera) occurrence is widespread in Southern part of India with peak infestation during September-December in Andhra Pradesh and November-January in Tamil Nadu (Sujatha *et al.,* 2011). Meanwhile, it is found frequently in winter and summer months in Northeast India wherever the castor grows. Too hot, too cold and humid weather enhances the pest activity and its multiplication.

Taxonomy of leafhopper

Phylum - Arthropoda
Class - Insecta
Order- Hemiptera
Sub-Order - Homoptera
Family – Cicadellidae
Genus - *Empoasca*
Species - *Flavescens*

(i) Identification of the pest and its bionomics: Leafhoppers also called jassids are small and less than ¼ inches in length as adults. The adults are small, wedge-shaped and pale green. The nymphs are yellowish green in color found between the veins of leaves on the under surface. They have a prolongated head with a smooth, flat, triangular structure with an antenna possessing the sensorial parts. The thorax is simple and abdomen is a narrowing posterior. There are two parallel rows of spines which extend all along the tibiae at the hind legs (Agyenim-Boateng *et al.,* 2018).

Bionomics: Adult is green, wedge shaped hopper. It lays eggs within the leaf veins. A female lays 15-37 eggs during an oviposition period of 5-7 days. The egg period is 7-8 days. The nymphal period is 9 days.

Fig. 1. Leafhoppers incidence on lower leaf of castor.

(ii) Nature and Symptoms of castor leafhopper: Castor leafhopper lays eggs in the midrib of the undersurface of the leaves. The pale green nymphs and the adults feed on the undersides of the leaves. The nymphs can be easily identified because they tend to move sideways when they are disturbed. The adults fly readily. The castor leafhoppers have sucking type of mouth parts and feed on the juices in the castor leaves. During feeding, they damage phloem tubes. Tender leaves become yellow colour, the margin of the leaves start curling downward. In the case of severe infestation, leaves get a brown colour which is typical **"hopper burn"** symptom. The margin of leaves gets broken and crumbles into pieces when crushed. The leaves dry, shed and the crop growth gets retarded.

Fig. 2. Browning and curling of margin of the castor leaves.

Fig. 3. Hopper burn symptom of whole castor plant.

(iii) Influence of leafhopper on leaf quality and leaf yield of castor and subsequent problems in ericulture: Most of the literature available on Eri silkworm, *Samia ricini* is based on the comparative studies on the effect of castor food plants on the rearing performance, biochemical analysis and seasonal variations. The literature available on pest infestation and yield loss especially with respect to the ecriculture is meager. Increase in incidence of leafhoppers in the castor leads to reduction in availability of quality and quantity of leaves. Leafhoppers usually start infestation from 30 days after sowing because of the plant succulence. The pest continues the infestation throughout the crop cycle if proper crop protection measures are not taken. The reduced leaf yield directly influences the rearing due to the shortage of leaves leading to less income for the farmers. Also the poor quality of leaves impacts the eri silkworm nutrition leading to various secondary problems including poor quality of cocoons.

(iv) Population of leafhopper is higher in non-bloomy castor accessions than bloomy castor accessions: Leafhopper population will start infestation from 30 days and continues throughout the crop cycle in the field. The leafhopper population increases gradually based on the number of succulent leaves available in the plant. From the present study, it was observed that the hopper burn scorings were higher in the zero bloom accessions apparently due to absence of wax bloom on the leaf lamina, therefore the leafhopper population on zero bloom accessions was higher as there was no barrier/deterrence for the insects feeding on leaves. But bloomy castor accessions are more tolerant to leafhopper compared to zero bloom accessions because of the bloomy character of lower surface and branches of the castor plant. Theeri silkworms also prefer the non-bloomy castor leaves when compared to bloomy castor leaves. So, there is an urgent requirement for more systematic work to be done to control this sucking pest in the non bloomy castor varieties to utilize more quality leaves for the rearing.

(v) Influence of weather parameters on incidence of leafhopper, *Empoasca flavescens*: Leafhopper population is mostly found in summer and winter season due to the favorable climatic conditions. It prefers both summer and winter season. Leafhopper population is found more in both maximum temperature hours with maximum humid hours and minimum temperature with minimum humid hours. Northeast India is having favourable climatic condition for this pest, so the attack of this pest is higher in the above mentioned climatic conditions. During rainy season, the leafhopper will vanish and no incidence has been found.

(vi) Management practices for leafhopper: In view of safety precautions for silkworm rearing, there is very limited option for the management of this pest through chemical mode. The cultural and mechanical practices are more efficient to control than chemical based management. The silkworms are sensitive to the chemicals sprayed on leaves. If the chemicals are ingested, the silkworm starts vomiting and ultimately the whole crop will get affected. However, chemical provides the quick solution but cocoon yield may be compromised due to the toxic effect of the harsh chemicals. Therefore, the investigation towards the assessment of the efficacy and efficiency with the less toxicity needs to be carried out on priority. The biological controls can also provide the sufficient protection but need to apply at early stage of the infestation. Presently no biological control measures are available against this pest, which also needs to be developed. The mechanical separation of the infested plants at early stage can provide the sufficient protection but only for low infestation condition. In this regard the complete package of Integrated Pest Management towards the control of this emerging pest infestation in ericulture needs to be worked out. The details of cultural and mechanical methods which can be taken up as prevention measures to control the leafhoppers in the field are provided below:

(a) Destroy old castor plot clearly and promptly to reduce pest populations that are dormant until next season. However, if there are no major insect pests or diseases in your crop, then leave residues to improve the soil and reduce water loss.

(b) Scout the castor fields once per week to monitor leafhoppers at young plant stage. Search for the leafhoppers near the bases of leaf veins and on the underside of leaves. They can be very small (like aphids) but up to ½ a cm, and jump away when plants are shaken or when they are touched.

(c) Plot should be clean and free from weeds to avoid more leafhopper population because many weeds serve as a reservoir for leafhoppers.

(d) Use of recommended local green bloom (waxy coat) varieties of castor which are quite resistant to the leafhoppers as compared to the most of the non-bloomy varieties. Bloom character of castor crop played a major role in determining the resistance or susceptibility to sucking pests.

Chemical measure:

Direct control can be done when few leafhoppers are seen on the majority of plants, by chemical spray at the time of first appearance of yellowing and curling along margins of leaves but before leaf margins get dry. Before spraying chemicals, decide which chemical is suitable and have less residual effect on leaves. Use only recommended chemicals for spraying because safety period for eri silkworm rearing is very important; otherwise entire rearing will be affected.

(i) Spray 5% neem seed kernel oil extract (NSKE) mixed in water. Give two to three sprays at fortnightly intervals for effective control of leafhoppers.

(b) Spray systemic insecticide like dimethoate 30 EC @ 2ml per litre of water – Safety period for rearing is 12 days.
(c) Prepare a suspension of 1/2 teaspoon of soap powder in 1 litre water and spray onto and below leaves to reach all leafhoppers (Safety period for rearing is 1 week).
(d) Soil application of neem cake 250 kg/ha followed by sprays of NSPE 4% or neem soap 1% at 10 days interval.

Future strategies for control of leafhopper infestation:

(i) Population dynamics (Season wise) and economic threshold level of leafhopper should be studied in the view of ericulture.
(b) Yield loss assessment and leaf quality assessment should be studied.
(c) Identify the pheromone traps or sticky trap for control of leafhoppers.
(d) Rain gun or sprinkler irrigation can be adopted in the castor field during early stage of the crop.
(e) Study can be taken up to recommend more chemicals with safety period for the rearing to quickly control the pest infestation.
(f) Encourage biological control or identify the natural enemies for field release to control the leafhoppers.
(g) Resistant castor cultivar or varieties can be identified.
(h) Alternative hosts should be identified and studied nearby the castor field to reduce the pest incidence.
(i) IPM strategies should be prepared for effective control.

CONCLUSION

Not much has been studied about leafhopper (*Empoasca flavoscens*) since it is considered as a seasonal pest in castor eco-system in Northeast India. The information on its taxonomy, distribution, life history, symptoms and recommended control measures discussed in this article is not sufficient to prepare an integrated pest management strategy for leafhopper. Therefore, in view of the importance of ericulture more studies should be conducted on pest population, yield loss assessment, quality of damaged leaves assessment, alternative hosts, cultural control measures, mechanical control measures, biological control measures and chemical control measures without affecting ericulture and environment. Such an effort will be definitely useful in the future to efficiently manage leafhopper from the castor ecosystem.

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Conflict of Interest: The authors declare no conflict of interest.

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