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LEAF DAMAGE IN JAMUN TREES ATTRIBUTED TO LEAF MINER INFESTATION

Himagirija B., Sowjanya M.G.S., and Ramesh B*

Department of Genetics & Genomics, Yogi Vemana University, Kadapa.

***Corresponding Author Email:** adenoramesh@gmail.com

ABSTRACT

The leaves of Jamun trees displayed symptoms such as oval or linear blisters, which later progressed into brown-colored blisters. Suspecting insect infestation, we conducted further investigation using a stereomicroscope and identified larvae within the affected areas of the leaves. To determine the insect species, the symptomatic leaves were placed in a test tube with moisture provided, and after 15 days, winged insects were observed and examined under the stereomicroscope. Based on their morphological characteristics, we identified the insect as *Heliozela anna* leaf miner, known to cause similar leaf damage in citrus and tomato plants.

Key words:
Abacavir, Hydroxypropyl methyl cellulose, sodium alginate, direct compression technique, *in- vitro* drug release studies.

INTRODUCTION

The *Syzygium cumini* Skeels (Jamun) is a medicinal as well as a nutritious fruit grown in many tropical and subtropical regions. It can be grown easily in muddy and wet areas where other crops cannot survive. The demand for Jamun fruit and seeds has increased in recent years due to their rich nutritional and medicinal values. The indigenous fruit is enriched with nutrients like iron, sugars, vitamins, protein, minerals, etc. Its seed has anti-diabetic properties and also controls diarrhoea. Three distinct growth stages in Jamun were observed, in which the rate of growth was slow in the first phase, growth was quite increased in the second phase, and slower growth rate with increased fruit moisture content, weight, total and reducing sugars in the third phase (Sukhla, 1979). Jamun fruit shows a sigmoidal growth pattern and confirmed that fruit length, weight, and moisture content increased during maturation (Geetha et al., 1992; Singh et al., 2006). Jamun can grow and survive better in low salinity and shallower water conditions (Hebbara et al., 2002). Jamun survived in alkali soils with pH 10.5 (Singh et al., 2006).

These fruits are highly perishable and can be kept under normal conditions for only two days. Pre-cooled jamun fruits packed in perforated polythene bags can be stored for up to 3 weeks at low temperatures of 8-10°C and 80-90% humidity (Sukhla, 1979). Fruits treated with ethanol and stored in polyethylene bags at 10°C can be stored for up to 9 days (Mohammed and Wickham, 1999).

Jamun fruit ripens in the months of June and July, and fully ripened fruit is deep purple or black in color. The average yield per tree per year is 80-100 kg. Ripe fruit can be eaten directly and is a main source of carbohydrates, proteins, sugars, minerals, iron, and vitamin C. They are also used in the preparation of many beverages, such as vinegar, wine, jelly, jams, and pickles. These fruits are used in the beverage industry because of the large amounts of tannins, acidity, and anthocyanins present in them in the early stages (Anonymous, 1986).

Jamun, with its medicinal properties, is used as medicine against diseases like heart, diabetes, and liver problems (Singh et al., 2001). Jamun seeds reduce the diastatic conversion of starch molecules into sugars due to the presence of jambosin and glycoside alkaloids. Treatment with Jamun seed extract for six weeks decreases fatty acids-lipids and increases levels of catalase and superoxide dismutase in the diabetic rat's brain (Prince et al., 2003). Jamun leaf extract also reduces radiation-induced DNA damage in cultured blood lymphocytes.

Insect pest management is critical against various pests like leaf-eating caterpillars, bark-eating caterpillars, white-fly, Jamun leaf miner, Jamun leaf roller, and leaf webbers to protect the crop yield. Although many major and minor pests infest leaves, flowers, fruits, seeds, and barks, there is no consolidated account available on the insects associated with Jamun in India, except for the major contribution made (Butani, 1979). Among the pests, fruit borers and leaf feeders such as leaf-eating caterpillars, chafer beetles, and leaf miners cause severe damage to trees. The leaf-eating caterpillar (*Carea subtillis*) infests the leaves and can defoliate the tree (Singh et al., 2009). The fruit borer (*Meridarchis scyrodes* M.) is a serious pest in southern states like Gujarat, Maharashtra, Andhra Pradesh, Karnataka, etc., causing up to 70% yield loss under severe infestation (Haldhar and Maheshwari, 2018). In the present study, we have observed swelling-like deformities on the leaves of Jamun plants, seemingly caused by the loss of leaf tissue between the abaxial epidermis. Approximately 15-20% of the leaves are affected by these symptoms. Suspecting insect feeding to be the cause of this leaf damage, our study aims to identify the insect species responsible for the damage.

METHODOLOGY

Sample collection

The affected leaves of jamun were collected from plants located at Yogi Vemana University around CV Raman block. The collected leaves were carefully transferred into a polyethylene bag and carried to the laboratory for further study.

Symptomatology

The collected leaves were carefully observed either by direct visualization or under a stereo microscope. The observed characteristics of the symptoms/damage were properly documented by photographs.

Microscopic observations

The affected leaves showed swelling-like appearance or symptom, which is probably near the mid-rib of the leaves. The swelling region was carefully dissected by a surgical blade and forceps and observed under a stereo microscope. The observations were properly documented.

Test tube experiment

To identify the adult fly, the test tube experiment was carried out. A total of nine sterilized boiling test tubes were taken and air-dried. The leaves with swelling-like symptom were properly placed inside the test tubes, and a small wet cotton ball was placed inside (bottom of) the test tube to provide sufficient moisture. The test tubes were then closed with muslin cloth and placed in a clean environment at laboratory conditions. After 15 days, flies were noticed in the test tubes. The test tubes were carefully opened, and the flies were collected with a fine brush and observed under a stereo microscope.

RESULTS AND DISCUSSION

Jamun is an indigenous plant with several nutritional and medicinal values, making it particularly popular in tropical countries. However, the crop is severely affected by various insects and pathogens, leading to significant yield loss. In this study, based on the deformities observed on the leaves of the Jamun plants, we suspected insect infestation might be involved. Affected Jamun leaves were collected from Yogi Vemana University in June and July 2021 around the CV Raman block. The collection comprised around 50 plants aged between 10 and 13 years, and we observed that approximately 15-20% of the leaves were affected. Similar leaf damage was also observed on some Jamun plants in Galiveedu village, located 80 km away from the campus. The affected leaves showed oval or linear-shaped blisters (fig.1). Similar symptoms were noticed in Jamun by Joshi et al. (1981), who identified these blisters as being caused by the infestation of *Antispila anna* Meyr. Subsequently, very limited work has been done in this area. Many miners cause similar damage to various plant species, including Jamun. For example, *Liriomyza sativae*, known as the Vegetable leaf miner, infests more than 40 different hosts belonging to 10 plant families, including vegetables such as tomatoes, peppers, melons, carrots, and lettuce (Via, 1984). *Liriomyza huidobrensis*, commonly known as the Serpentine leaf miner, affects a variety of plant families, such as beets, spinach, peas, beans, potatoes, and cut flowers (Foba et al., 2015). *Liriomyza trifolii*, the American serpentine leaf miner, infests a wide range of crops, including soybeans, cotton, peas, potatoes, and eggplants, targeting a total of 28 plant families (Foba et al., 2015). The Tomato leaf miner, scientifically known as *Liriomyza bryoniae*, mainly infests tomatoes but can also target other vegetables (Via, 1984). *Liriomyza cicerina*, commonly known as the Chickpea leaf miner, primarily infests chickpeas and other leguminous plants (Via, 1984). *Phyllocnistis citrella*, known as the Citrus leaf miner, attacks citrus plants. Therefore, in this study, we aim to confirm the insect responsible for causing blisters on the Jamun leaves using stereomicroscopy.

The affected leaves were carefully detached from the plant, collected into a polythene bag, and transported to the laboratory for further study. The leaves were observed under a stereo microscope, revealing larvae movement

inside the swelling-like symptoms. The larvae were found to feed on leaf tissue, specifically the mesophyll, causing damage by separating both ectoderm and endoderm, leading to oval or linear blisters or tunnels on leaves (fig.1b). This damage ultimately results in a reduction in chlorophyll and affects plant growth. The swollen blisters or tunnel-like regions were carefully dissected using a surgical blade and forceps, opening the upper layer of the leaf. The larvae were placed on a glass slide and observed under a stereo microscope. The larvae, measuring 1-2 mm in length, had pairs of eyes and a 13-segmented abdomen, and these observations were properly recorded (fig.1f).

To identify the mature insect stage, a test tube experiment was conducted in the laboratory (fig.1d). After four days, the wet affected leaves turned into dry, folded leaves due to decreased moisture in the test tubes. After seven days, white webs were observed in the middle of the folded leaves, and larvae movement was identified inside the white web (fig.1e). The white webs were carefully opened with a needle, and mature larvae were identified. In this stage, the antennae were more developed compared to the first stage, and the larvae had pairs of eyes, pairs of antennae, a 13-segmented abdomen, and mouthparts. After 15 days, flies were observed in the test tube. The test tube was carefully opened, and the flies were collected with a fine brush, placed on a glass slide, and observed under a stereo microscope. The mature insects were identified as *Heliozela anna* leaf miners, characterized by a head, thorax, pairs of eyes, pairs of antennae, pairs of wings, a 7-segmented abdomen, and whitish-grey colored lines on the surface of the wings (fig.g&h). Based on the morphological characteristics and available literature, it was determined that the insect was *Heliozela anna* leaf miner, belonging to the family *Heliozelidae*, genus *Antispila*, and species *Antispila anna*.

Only a few literature sources were found on the internet, and the insect was previously identified (Fletcher, 1920; Joshi et al., 1981). The larvae of the leaf miner burrow into the leaves, creating tunnels or mines, which can lead to reduced photosynthesis and yield. The insect's life cycle on guava was observed, with the larvae causing damage to the mesophyll tissue of guava leaves (Singh and Sinha, 2008). An infestation of Heliozela anna on guava in Uttarakhand, India, was reported, which reduced the crop yield (Khanna and Kumar, 2016). The insect was also reported to feed on papaya leaves, causing extensive damage to the plant (Zia-ul-Haq and Khan, 2012).

The *Heliozela anna* moth is a serious pest of several fruit trees, including guava, mango, papaya, and jamun in India. The larvae of this moth feed on the leaves, creating mines or tunnels, which reduce the photosynthetic efficiency of the plant and affect its growth and yield. In severe cases, the infestation can lead to complete defoliation of the tree, resulting in crop loss. *Heliozela anna* infestation is one of the major challenges faced by fruit growers in India, and several studies have been conducted to understand the biology, bionomics, and management of this pest. Control measures include the use of insecticides, cultural practices such as pruning and removal of infested leaves, and biological control agents such as parasitoids and predators. The impact of *Heliozela anna* on agriculture in India underscores the need for effective pest management strategies to ensure sustainable production of fruit crops.

A study on the biology and management of *Heliozela anna* infesting mango was conducted, recommending the use of insecticides to control the pest (Srivastava and Khare, 2013). The biology and bionomics of *Heliozela anna* on guava were examined, suggesting cultural and chemical methods for pest control (Akhtar and Khan, 1994). The first infestation of *Heliozela anna* on Jamun in India was reported, with recommendations for using insecticides to manage the pest (Sahoo et al., 2019).

CONCLUSION

The study confirmed that the blisters observed on the leaves of Jamun plants were caused by the larvae of *Heliozela anna* leaf miner. Through careful visual inspection, stereomicroscopic examination and test tube experiments, we identified the characteristic symptoms and developmental stages of the pest. This insect poses a significant threat to various fruit trees in India, including guava, mango, papaya, and Jamun, by reducing photosynthetic efficiency and potentially leading to severe crop loss. The findings underscore the importance of implementing effective pest management strategies, such as the use of insecticides, cultural practices, and biological control agents, to mitigate the impact of *Heliozela anna* on fruit production. Further research and awareness are essential to address this challenge and ensure the sustainable cultivation of these valuable crops.

Fig.1 Jamun leaves and microscopic observation of insect. a) Jamun fruit, b) healthy and infested leaves of jamun, c) browning of insect infested leaf, d) symptomatic leaves in test tube, e) larvae inside the white web, f) Mature larvae, g & h) mature insects.

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Conflict of Interests

The authors declare no conflict of interest.

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