



Seasonal incidence of insect pest of banana (*Musa paradisiaca*) from Gangetic basin of West Bengal, India

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ABSTRACT

Present study was carried out during 2018–23 at Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal with a view to ascertain the seasonal incidence of major insect pests and occurrence of new emerging pests of banana (*Musa paradisiaca* L.) crop. The study revealed that leaf and fruit scarring beetle *Basilepta subcostata* (Jacoby) was most dominating insect-pest followed by rugose spiralling whitefly (*Aleurodicus rugioperculatus* Martin). All the studied weather parameters collectively influenced 90, 87, 87 and 77% of variations in the incidence of *B. subcostata* (Jacoby), *Odioporus longicollis* (Olivier), *A. rugioperculatus* (Martin) and *Oligonychus sapienticolus* (Gupta), respectively. Barring *Oligonychus sapienticolus* (Gupta), all other studied insects had significant positive correlation with different weather parameters except sunshine hours that showed positive correlation with the spider mite. Besides, few insects were recorded as emerging problem of banana crop in this state like banana lace wing bug *Stephanitis typica* (Distant), sucking pest of banana foliage and brown tussock moth *Olene mendosa* (Hubner) feeding on the unfurled leaf of the seedling suckers and thus causing considerable damage.

Keywords: Banana, Correlation, Insect pests, Multiple regression, *Olene mendosa*, *Stephanitis typica*

Banana (*Musa paradisiaca* L.) belonging to family Musaceae is one of the most preferred fruit crops in the tropical regions of the world because of its high nutritive value, year round availability and low price. India is one of the leading banana producing country with 884 thousand ha area under banana cultivation and 30808 thousand million tonnes annual production (Anonymous 2018). The states like Maharashtra, Gujarat, Tamil Nadu, Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Orissa and West Bengal are the major contributors (Bauri *et al.* 2014, Warshini *et al.* 2022). Globally, the banana production is declining due to various factors. One of the important factor is the interference of disease, insects and vertebrate pests (Blomme *et al.* 2020). Padmanaban *et al.* (2002) reported 19 insect pests associated with banana in India from planting to harvesting. Chowdhury (2015) reported 6 insect pests namely thrips, aphids, corm weevil, pseudostem weevil, hard scale and tinged bug from Malda district of West Bengal. Mahalanobish *et al.* (2020) reported leaf and fruit scarring beetle as one of the most economically important pests in eastern India including West Bengal. In addition to the major insect pests causing

economic damage to banana, few insects are now a days seeking attention to the researchers as emerging problem in different states of India. The brown tussock caterpillar, *Olene mendosa* Hubner (Lepidoptera: Erebidae) is polyphagous and feeds on a diverse range of plant species. In India, this caterpillar has been recorded on crops such as *Solanum tuberosum*, *Tamarindus indica*, *Citrus* spp., *Cedrus deodara*, *Acacia nilotica*, *Mangifera indica*, *Camellia sinensis*, *Ricinus communis* and *Salmalia malabarica* (Kalia *et al.* 1995, Sasidharan *et al.* 1995, Manjunatha *et al.* 2019). Gopika *et al.* (2022) reported the pest attacking cabbage in Maharashtra while National Research Centre for Banana, Trichy, Tamil Nadu reported this pest as most common pest of banana foliage (Anonymous 2023). However, the incidence of this insect on banana has not been reported from West Bengal so far and a very scanty literature is available on its incidence. Hence, the present investigation was carried out to study the insect pests of banana and their seasonal occurrence. The study also focused on the occurrence of new and emerging insect pest problem of banana in the region.

MATERIALS AND METHODS

Present study was carried out during 2018–23 at Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. 39 roving surveys were undertaken in different banana growing areas, viz. Nadia, Hoogly, Howrah, North and

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South 24 Pargana and Murshidabad districts of West Bengal. The insect pests observed were recorded and subsequently identified based on the damage symptoms, immature and mature insect stages. Specimens which could not be identified were brought in the laboratory and observed under stereo zoom microscope and subsequently identified.

To study the seasonal incidence of the insect-pests, a fixed plot was selected with 144 numbers of plants under ICAR-AICRP on Fruits, Mandouri, Bidhan Chandra Krishi Viswavidyalaya and were kept under unsprayed conditions during the study period. The data on incidence of pseudostem weevil; and new and emerging insects were taken from all the plants while leaf and scarring beetle, rugose spiraling whitefly and spider mite data were taken from ten randomly selected plants. Pseudostem weevil incidence was studied by recording number of infested plants from total number of plants and the number of grubs/adults/infested plant. Incidence of leaf and fruit scarring beetle was recorded by counting number of adult beetle in 20 cm² leaf area (Sah *et al.* 2022) while the rugose spiralling whitefly populations were recorded by counting number of adults/spiral and mite population was recorded from number of mites/3 cm². To study the effect of weather parameters on population fluctuation of various pests, the data of environmental factors, viz. maximum (T_{max}) and minimum (T_{min}) temperature, morning relative humidity (RH₁), evening relative humidity (RH₂) and rainfall (RF) were recorded from the portal Crop Weather Outlook, All India Coordinated Research Project on Agrometeorology (AICRPAM). The data recorded on incidence of insect pests of banana at fortnight interval in fixed plot survey and weather parameters were then computed for statistical analysis. Simple Pearson correlation was done using statistical software SPSS version 26 while the multiple regression was carried out in Microsoft Excel.

To study the incidence of new and emerging pests in banana, fixed plot surveys were done during 2018–2023. The observations were taken from the field at fortnight interval with a view to record the incidence of new pests of the crop.

RESULTS AND DISCUSSION

8 insect species namely *Basilepta subcostata* (Jacoby); *Odoiporus longicollis* (Olivier); *Spodoptera litura* (Fabricius); *Kophene cuprea* (Moore); *Olene mendosa* (Hubner); *Pentalonia nigronervosa* (Coquerel); *Aleurodicus rugioperculatus* (Martin); and *Stephanitis typica* (Distant) belonging to three order, viz. Coleoptera, Lepidoptera and Hemiptera were recorded during the roving survey of banana. A spider mite species *Oligonychus sapienticolus* (Gupta) was also observed as damaging pest of banana in West Bengal. Among them, the leaf and fruit scarring beetle *B. subcostata* (Jacoby) caused considerable damage to new tender leaves and fruits. This present finding is in confirmation with the findings of Mahalanobish *et al.* (2020) who has mentioned tremendous influence of the insect on both quantity and quality of banana. Iesa (2021) also reported the pest incidence on leaves and fruits and

qualitative damage caused by the insect which degrades the cosmetic value of the fruits. The author also reported existence of this pest in many Indian states like Assam, Bihar, Chhattisgarh and in the north-eastern Hill regions. Bhagabati and Deka (2013) and Mishra *et al.* in (2015) also reported the spread of this pest in these states. Probably hot and humid climate of these states favour the multiplication of this pest. Pseudostem weevil, *O. longicollis* Oliver incidence was noticed throughout the year in all varieties commercially grown in the region especially in ratoon crops. This present finding is in confirmation with the report of Biswas *et al.* (2015) who have reported the pest in all the varieties of banana cultivated in West Bengal like Martaman, Champa, Kanchkala, Kabuli etc. However, newly planted and well maintained fields were found almost free from infestation of this insect. The other insects observed were bag worm, *K. cuprea* (Moore); leaf caterpillar, *S. litura* (Fabricius); brown tussock hairy caterpillar, *O. mendosa* (Hubner); rugose spiralling whitefly, *A. rugioperculatus* (Martin); aphid, *P. nigronervosa* (Coquerel) and lace wing bug, *S. typica* (Distant). The bag worm, *K. cuprea* was described from Kolkata, West Bengal in 1879 and later on Padmanaban (2018) and Poorani *et al.* (2021) reported the existence of bag worm species on banana and they also reported the species as emerging pest of banana. These reports are in validation with the present findings where the larvae were found to attack on leaves and make irregular circular hole. Banana lacewing bug *S. typica* was also found in all the surveyed location during 2022–2023. This insect (nymphs and adults) was observed to feed on ventral surface of the leaves and caused characteristic stippling on infested leaves. This insect was found active throughout the year but caused severe infestation from May–September. This insect was originally recorded from banana (Distant 1903), but found to feed on turmeric, ginger and cardamom as well (Poorani *et al.* 2019). Mathen *et al.* (1983) recorded the insect as a major pest of coconut in South India and in the present study, this pest was recorded as emerging problem of banana foliage in West Bengal. *Olene mendosa* or brown tussock moth (Lepidoptera: Erebidae) incidence was also noticed for the first time during roving surveys as well as in the fixed plot surveys of banana in West Bengal. Apart from different insects, red spider mite, *O. sapienticolus* Gupta was also observed in all surveyed locations which is in confirmation with the study done by Dey and Karmakar (2020).

Basilepta subcostata was observed in the field almost year round except 23rd, 24th and 1st fortnight and its peak infestation was observed from 13th–17th fortnight (12.28–16.58 numbers of adults/20 cm²) (Fig. 1). The maximum and minimum temperature ($r = 0.696^{**}$ and 0.900^{**}), morning and evening relative humidity ($r = 0.450^*$ and 0.798^{**}), rainfall ($r = 0.868^{**}$) showed significant positive correlation with the pest population while sunshine hours ($r = -0.487^*$) showed negative correlation with the same (Table 1). Sah *et al.* (2022) reported positive correlation of the same insect with weather parameters like maximum and minimum temperature, rainfall and negative correlation

Table 1 Correlation between incidence of banana insect pests and weather factors

Insect	Maximum temperature	Minimum temperature	Morning relative humidity	Evening relative humidity	Rainfall	Sunshine
Scarring beetle	0.696**	0.900**	0.450*	0.798**	0.868**	-0.487*
Pseudostem weevil	0.299	0.640**	0.817**	0.862**	0.754**	-0.662**
Rugose spiraling whitefly	0.880**	0.912**	0.088	0.544**	0.656**	-0.188
Spider mite	-0.525**	-0.728**	-0.387	-0.746**	-0.847**	0.521**

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed).

with relative humidity in Bihar which partially supports the present outcome where relative humidity showed positive correlation. The all-weather parameters studied collectively influenced 90% variation in scarring beetle incidence (Table 2). Mishra *et al.* (2015) also reported 89% variation of the pest due to combined effect of weather parameter in Assam which is in accordance to the present findings. There was no incidence of pseudostem weevil during 23rd to 10th fortnight i.e. November to May but peak incidence observed from 12th–18th fortnight i.e. June to September (Fig. 1) in ratoon crop. The minimum temperature ($r = 0.640^{**}$), morning and evening relative humidity ($r = 0.817^{**}$ and 0.862^{**}), rainfall ($r = 0.754^{**}$) showed significant positive correlation with the pest population while sun shine hours showed significant negative correlation ($r = -0.662^{**}$) (Table 1). Biswas *et al.* (2015) also reported similar kind of results on the incidence pattern of this insect in West Bengal and stated that the insect remains active throughout the year and gradually increased its population during the first and second ratoon crop which supports the present finding. The result of multiple regression analysis showed R^2 value of 0.869 that indicates all the weather factors were collectively responsible for 87% variation in the incidence of banana pseudostem weevil (Table 2). Rugose spiralling whitefly incidence was observed in the field throughout the year except severe winter months. Higher pest population was recorded from 8th–18th fortnight i.e. from April–October (7.12–8.24 numbers of whitefly adult/spiral) and 5–8 spirals per leaf and thereafter, the pest population decreased. Peak pest population was observed during 12th and 13th fortnight (12.18 adults/spiral) (Fig. 1). The correlation analysis of weather parameters showed significant

positive relationship of maximum and minimum temperature ($r = 0.880^{**}$ and 0.912^{**}), evening relative humidity ($r = 0.544^{**}$) and rainfall ($r = 0.656^{**}$) with incidence of rugose spiralling whitefly. However, the morning relative humidity ($r = 0.088$) showed positive relationship with pest incidence and sunshine hours ($r = -0.188$) showed negative relationship (Table 1). This present outcome of the study is in confirmation of the study done by Devi *et al.* (2023) who have reported significant positive relationship of relative humidity with the incidence of this pest attacking guava in Andhra Pradesh. The result of multiple regression revealed that all the weather parameters were collectively responsible for 87% variation in pest incidence (Table 2). The spider mite, *O. sapienticolus* population was observed throughout the year. The pest population was found higher during dry months and peak infestation was observed during 6th fortnight (4.44 mites/3 cm²) (Fig. 1). The pest showed significant negative correlation with maximum and minimum temperature ($r = -0.525^{**}$ and -0.728^{**}), evening relative humidity ($r = -0.746^{**}$) and rainfall ($r = -0.847^{**}$) while it

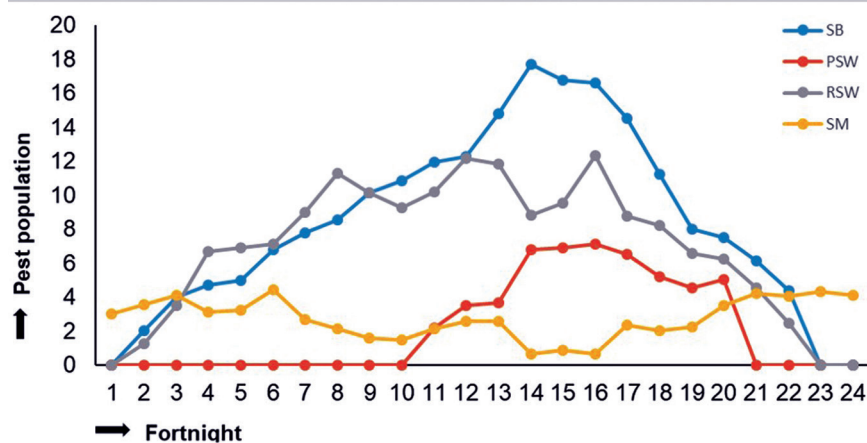


Fig. 1 Population dynamics of major pests of banana in West Bengal.

SB, Scarring beetle; PSW, Pseudostem weevil; RSW, Rugose spiraling whitefly; SM, Spider mite.

Table 2 Multiple regression with incidence of banana insect pests vs. weather factors

Name of the insect	Regression question	R^2 value
Scarring beetle	$19.605 - 1.123X1 + 1.519X2 + 0.081X3 - 0.261X4 + 0.673X5 - 0.402X6$	0.896
Pseudostem weevil	$-76.922 - 1.154X1 + 0.394X2 + 0.850X3 - 0.007X4 - 0.179X5 - 0.191X6$	0.869
Rugose spiraling whitefly	$-2.412 + 1.088X1 - 0.195X2 - 0.276X3 + 0.138X4 - 0.042X5 - 0.607X6$	0.873
Spider mite	$-0.641 - 0.308X1 + 0.238X2 + 0.146X3 - 0.078X4 - 0.216X5 + 0.045X6$	0.767

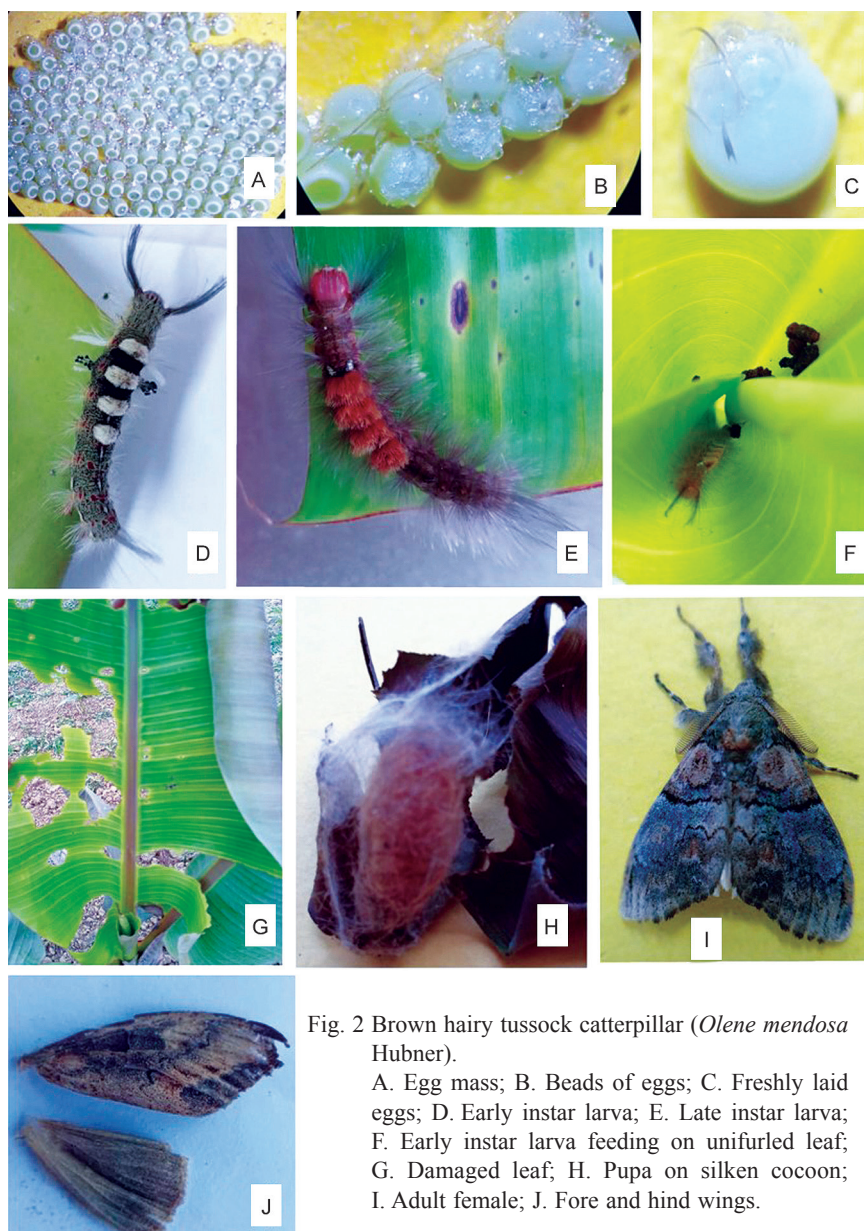


Fig. 2 Brown hairy tussock caterpillar (*Olene mendosa* Hubner).

A. Egg mass; B. Beads of eggs; C. Freshly laid eggs; D. Early instar larva; E. Late instar larva; F. Early instar larva feeding on unfurled leaf; G. Damaged leaf; H. Pupa on silken cocoon; I. Adult female; J. Fore and hind wings.

showed significant positive correlation with the sunshine hours ($r = 0.521^{**}$). The morning relative humidity showed non-significantly negative correlation ($r = -0.387$) with the same pest (Table 1). 77% variation of spider mite incidence ($R^2 = 0.767$) was observed with weather parameters, when taken together (Table 2). Dey and Karmakar (2019) also reported highest rate of fecundity during March–April which supports the present findings.

Occurrence of new and emerging insect species damaging Banana in West Bengal: During the roving surveys as well as in fixed plot surveys conducted during 2021–22, brown tussock hairy caterpillar, *O. mendosa* was observed in banana fields from Nadia district of West Bengal during 3rd–4th fortnight. The pest was recorded in early stages of crop growth only. The female laid 400–450 cream coloured eggs in cluster. The top portion of the egg was bowl-shaped or dunked with whitish ring (Fig. 2 A, B, C). The larva

was typically hairy with four tufts of hair or tussock on the back. In early instar larvae, the tussock was found whitish in colour (Fig. 2 D) while in the late instars, these tussocks turn into brown colour (Fig. 2 E). The head of early instar larvae was brown in colour which in later stages turned into red (Fig. 2 F, G). The insect was found pupated by making silken cocoon under damaged leaves (Fig. 2 H). The adult moth possesses distinct bipectinate antennae, forewing smooth, brown coloured with dark specks at the outer margin while the hind wings are greyish in colour (Fig. 2 I, J).

Damage symptoms: The larval stage of the insect was observed feeding mainly on the unfurled leaf. The insect hides inside the leaf petiole and start feeding over it (Fig. 7 and 8). Due to its continuous feeding, the central leaf gets damaged that leads to death of the seedling suckers. However, the insect was not observed feeding on older plants; the younger plants of banana were found more preferred by this insect. Dhilepan (1992) and Saravanan *et al.* (2018) reported the infestation of tussock caterpillar, *Dasychira mendosa* (Hubner) on nursery seedlings of oil palm in Kerala and Andhra Pradesh, respectively.

The present experiment could be concluded with findings that the banana leaf and fruit scarring beetle, pseudostem weevil, rugose spiralling whitefly and spider mite emerged out as the major insect pests causing

considerable damage to banana almost throughout the year in gangetic basin of West Bengal. Among them, the banana leaf and fruit scarring beetle recorded as the most dominant species causing considerable qualitative loss of banana fruit. This information will certainly be helpful to the researchers for planning suitable management strategies. Some insects of minor importance like lace wing bug is becoming the emerging problem of banana in West Bengal as this insect deteriorate the market quality of banana leaves. Besides these, the occurrence of brown tussock hairy caterpillar has been reported for the first time from banana in West Bengal. As this pest is polyphagous in nature, the present information will also be helpful for future behavioural and management studies. Hence, it would be important to follow up these studies to clearly understand how these insects and mite species could cause economic damage and need sustainable management strategies. The present study also indicate the

need of systematic monitoring of new and emerging pest incidence and crop losses by the plant protection scientists and extension workers.

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