Studies on population dynamics and damage potential of banana leaf and fruit scarring beetle, *Basilepta subcostatum* jacoby on local and wild banana genotypes of Tripura

Pinku Paul, Sukhen Chandra Das, Saurav Saha and S Uma

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**Abstract**

The present experiments was conducted to study the population dynamics and damage potential of banana leaf and fruit scarring beetle, *Basilepta subcostatum* Jacoby on eight local and wild banana genotypes like Shabri (AAB), Mizo-Cavendish (AAA), Katch Kela (ABB), Champa (AAB), Gopi (ABB), Attia Kela (BB), Kanai Basi (AA) and *Musa flaviflora* at banana orchard, College of Agriculture, Tripura during 2018-19. The highest mean number of beetle population per plant and scars on 10 sq.cm leaf were recorded on Mizo-Cavendish (16.84/ plant and 21.26/ 10 cm²) followed by Shabri banana (13.36/ plant and 16.20/ 10 cm²) and katch Kela (9.62/ plant and 12.63/ 10 cm²). Whereas, the lowest population and scars were recorded on *Musa flaviflora* (0.24/plant and 0.37/ 10 cm²), Kanai-Basi (0.35/ plant and 0.69/10 cm²) and Attia Kela (0.67/ plant and 1.51 /10 cm²). The highest beetle population and peak infestation (scars) noticed during 27rd standard week (July 3rd week) to 39th standard week (Sept. 4th week). The incidence of beetle population and scars produced by the beetle was positively and significantly correlated with rainfall, maximum an d minimum temperature except relative humidity. Significantly highest fruit damage per bunch was recorded in Shabri cultivar (87.53 %) followed by Mizo-Cavendish (78.13 %) and Champa (65.86 %). Also the least infested bunches were Kanai Bas., *Musa flaviflora* and Attia Kela which ranged from 2 to 5 per cent.

**Keywords:** banana leaf and fruit scarring beetle, *Basilepta subcostatum*, local and wild genotypes, scars, correlation

**Introduction**

Banana and plantain (*Musa* sp.) are one of the most old known fruit crops and widely grown in India. It is the second most important fruit crop next to mango. It evolved in the humid tropical regions of S.E. Asia with India as one of its centres of origin. The major banana growing states in India are Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Kerala, Bihar, Orissa and West Bengal [5]. The North eastern states of India namely Tripura, Assam, Arunachal Pradesh, Meghalaya, Mizoram and Manipur have been the richest source of natural banana diversity. It is the most important fruit crop of Tripura next to jackfruit and pineapple with rich source of vitamins and minerals. It provides nutritional, health security and also livelihood opportunities to the rural and urban people of Tripura. Area under banana cultivation in Tripura is 13,274 ha with an annual production is 130085.20 mt with a productivity of 9.8 t/ ha. However, maximum (70%) area of banana cultivation is under Shabri banana compared to the other varieties. Shabri banana and Mizo-Cavendish are very popular and excellent (in respect of flavour, texture, aroma and TSS) cultivars of Tripura for fresh consumption with medium plant stature. Now the production and productivity of banana is being affected by several pests and diseases. About 19 insect pests have been found associated with banana from planting to harvesting in India [12]. Banana leaf and fruit scarring beetle *Basilepta subcostatum* (Jacoby) (Coleoptera: Chrysomelidae) is considered as one of the most economically important pests in Eastern India which is reported to occur in West Bengal and some other parts of India also [6]. The peak incidence was in April and continued till end of the rainy season [13] and the extent of damage inflicted upon banana crop by this pest has been reported to be around 80 per cent and in case of severe infestation, the percentage of infested orchards, and intensity of the pest have
been recorded up to 100 per cent [13]. As the beetle population causes serious damage (by scars) on leaves and banana peel, has tremendously influenced on both quantity and quality of banana which reduces the market acceptability. It is a serious pest of north-east India which causes 19.3 per cent damage of fruit yield [1]. Scanning of literature pertaining to this aspect revealed that, studies related to population dynamics and damage potential of banana leaf and fruit scarring beetle, Basilepta subcostatum Jacoby on local and wild banana genotypes of Tripura are lacking. In this background, the present investigations are planned.

### Materials and methods

The experiment to assess the population dynamics and the damage potential of banana leaf and fruit scarring beetle, Basilepta subcostatum Jacoby on different local and wild banana genotypes of Tripura was laid out in RBD with 8 treatments (5 local and 3 wild cultivars), 3 replication (each replication has 18 plants) and spacing 2x2 m² at Banana orchard of College of Agriculture, Tripura (23°54"49’ N-Latitude, 91°19"09’ E-Longitude Altitude 12.80 m above mean sea level).

#### Table 1: Details of Banana genotype for assessment of population dynamics and the damage potential by Basilepta subcostatum Jacoby.

| Treatment | Banana Cultivar | Genotype | Cultivar |
|-----------|-----------------|----------|----------|
| 1         | Shabri          | AAB      | Local    |
| 2         | Champa          | AAB      | Local    |
| 3         | Gopi            | AAB      | Local    |
| 4         | Katch Kela      | ABR      | Local    |
| 5         | Mizo-Cavendish  | AAA      | Local    |
| 6         | Attia Kela      | BB       | Wild     |
| 7         | Kanai Basi      | AA       | Wild     |
| 8         | Musa flaviflora | --       | Wild     |

The natural population and scars of B. subcostatum on eight banana cultivars were recorded at fortnightly intervals during February, 2018 to January, 2019. Beetle population was observed from four youngest leaves of randomly selected 7 plants in each replication. The beetle populations were recorded by counting the beetles on leaves and also inside whorl of crown leaves during morning hours and the average number of beetle/plant was worked out. Total number of scars made by the beetles was also counted from 10 cm² leaf surface area of top, middle and lower portion of three youngest leaves of the 7 randomly selected plants (each replication) and the mean scars per 10 cm² leaf area was worked out.

### Correlation studies with weather parameter

The data on the mean no. of beetle population per plant and mean no. of scars per 10 cm² leaf area were subjected to correlation studies to know the relationship between pest incidence and weather parameters prevailed in Tripura by using SPSS (Statistical Package for Social Sciences) software.

#### Percent (%) fruit damage per bunch (or Percent bunch damage)

Fruit damage (%) per bunch was calculated at harvesting stage from randomly selected 7 plants in each replication and the mean percentage of damage was calculated. The data was subjected to DMRT (Dunken Multiple Range Test) statistical analysis by using SPSS software.

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\text{Percent (\%)} \text{ fruit damage per bunch} = \frac{\text{No. of Infested finger / Bunch} \times \text{Total no. of finger in a bunch}}{\text{Percent bunch damage}} 
\]

### Results and Discussion

Incidence of scarring beetle observed in banana orchard of College of Agriculture, Tripura once in a fortnight from February, 2018 to January, 2019 and results are presented in Table 2 to 7. The sign of the presence of this pest was irregular patches on unfurled and furled leaf. The beetle lived within the roll of the central leaf, flower bracts and fed the epidermis of leaves and causing scars on them.
Incidence of *B. subcostatum* on local banana cultivars

**Shabri banana:** The incidence of *B. subcostatum* on Shabri was noticed throughout the year i.e. from 5th standard (std.) week, 2018 and to 3rd std. week 2019 (Table 2). The beetle population was ranged from 7.12 to 22.25 per plant with average of 13.66. Whereas, the maximum beetle population (22.25/plant) was observed on 33rd SMW (Standard Meteorological Week) i.e. Aug. 3rd week. The mean number of scars per 10 cm² leaf ranges from 8.36 to 27.50 with mean no. of 16.20. The maximum leaf damage was also observed on 33rd SMW.

**Mizo-cavendish banana**

From Table 2 it is clear that, during 39th std. week the maximum number of mean beetle population were recorded 24.81/plant. The mean population was ranged from 9.7 to 24.81 per plant. The average leaf damage from Feb. 2018 to January 2019 was 21.26 scars per 10 cm² leaf. While during 39th std week, the maximum damage was 35.00 scars per 10 cm² leaf.

**Katch kela**

The maximum beetle population on Katch Kela (14.82/plant) was recorded during 37th std. week with average population of 9.62 per plant (Table 2). The maximum scares of 19.08 per 10 cm² leaf was also recorded at 37th std week which coincided with a mean leaf scars of 12.63/10 cm².

**Champa**

The population density of *B. subcostatum* on Champa ranged from 2.52 to 13.50 per plant with mean no. of 7.92/plant (Table 2). The maximum appearance and the highest infestation of the beetle were noticed during 39th standard week. The maximum no. of scares per 10 cm² leaf was recorded on 17.80 at with mean scares of 10.51.

**Gopi**

The average beetle population on Gopi ranged from 4.00 to 12.20 per plant with average of 8.42 beetles per plant (Table 2). The incidence of beetle population observed throughout the year. The highest incidence of beetle was noticed at 37th std. week and the maximum leaf scars was also recorded at the same week i.e. 14.74 no. of scars/10 cm² of leaf with average scars of 10.31.

Incidence of *B. subcostatum* on wild banana cultivars

**Attia kela**

The first appearance of banana leaf and fruit scarring beetle was started during 13th std. week and persisted on Attia Kela upto 47th standard week (Table 3). The mean number of beetle population per plant varied from 0.00 to 2.10 per plant with the mean population 0.67.

### Table 3: Incidence of *B. subcostatum* on different wild banana cultivars of Tripura during 2018-19.

| Observation | Attia Kela (BB) | Kanai Basi (AA) | Musa flaviflora |
|-------------|----------------|----------------|-----------------|
| SMW         | Mean no. of Beetle/ plant | Mean no. of scars/ 10 cm² of leaf | Mean no. of Beetle/ plant | Mean no. of scars/ 10 cm² of leaf | Mean no. of Beetle/ plant | Mean no. of scars/ 10 cm² of leaf |
| 5           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11          | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 13          | 0.20 | 0.46 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15          | 0.50 | 1.14 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17          | 0.60 | 1.32 | 0.30 | 0.45 | 0.00 | 0.00 |
| 19          | 0.70 | 1.54 | 0.20 | 0.32 | 0.20 | 0.38 |
| 21          | 0.60 | 1.32 | 0.30 | 0.57 | 0.40 | 0.64 |
| 23          | 0.80 | 1.77 | 0.60 | 1.13 | 0.60 | 0.94 |
| 25          | 1.40 | 3.08 | 1.20 | 2.27 | 1.00 | 1.30 |
| 27          | 1.60 | 3.52 | 2.00 | 3.78 | 1.20 | 1.45 |
| 29          | 1.00 | 2.20 | 1.10 | 2.08 | 1.40 | 1.50 |
| 31          | 1.50 | 3.35 | 0.00 | 0.64 | 0.40 | 0.73 |
| 33          | 1.30 | 2.98 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35          | 1.00 | 2.23 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37          | 2.00 | 4.46 | 1.60 | 3.02 | 0.00 | 0.00 |
| 39          | 2.10 | 4.67 | 0.80 | 1.50 | 0.20 | 0.38 |
Maximum leaf damage (scars/10 cm²) of was recorded 4.67 nos. at 39th std. week. The mean nos. of scars per 10 cm² leaf caused by the beetle was 1.51.

**Kanai Basi**

The population density of *B. subcostatum* on Kanai Basi ranged from 0.00 to 2.00/plant with mean of 0.35/ plant. The first appearance of snails was noticed during 17th std. week and persisted in nursery up to 43rd std. Week (Table 3). The maximum no. of scars per 10 cm² of leaf (3.78%) was recorded at 27th std. week with seasonal mean of 0.69 nos. scars per 10 sq. cm of leaf.

**Musa flaviflora**

The incidence of banana leaf and fruit scarring beetle on *Musa flaviflora* revealed that the first appearance of beetle was noticed during 19th standard week (0.02/plant) and persisted up to 45th std. weeks (Table 3). The population density was ranged from 0.00 to 1.40 per plant with a mean population of 0.24. Whereas, the maximum beetle damage (1.50 per 10 sq. cm of leaf) was at 29th standard week. The mean no. scars per 10 sq. cm of leaf by *B. subcostatum* on *Musa flaviflora* was 0.37. After 49th std. week onwards there was no beetle population.

Correlation of incidence of beetle population and damage (scars /10cm² of leaf) with weather parameters

The incidence of beetle population on different banana cultivars are correlated with meteorological parameters and their correlation coefficients are given in Table 4. It indicates significant positive relationship with all the meteorological parameters except relative humidity. The correlation studies revealed that population had positive and significant correlation with maximum temperature (r = 0.637 for Shabri, 0.583 (Mizo-Cavendish), 0.719 (Champa), 0.674 (katch Kela), 0.718 (Gopi), 0.566 (Attia Kela), 0.352 (Kanai Basi) and 0.393 (*Musa flaviflora*) and minimum temperatures (r = 0.841 for Shabri; Mizo-Cavendish- 0.796; Champa- 0.867; Katch Kela- 0.849; Gopi- 0.864; Attia Kela- 0.781; Kanai Basi- 0.528 and *Musa flaviflora*- 0.507). Also the correlation coefficient of rainfall shows significant and positive (r = 0.508 for Shabri; 0.417 (Mizo-Cavendish), 0.428 (Champa), 0.447 (Katch Kela), 0.465 (Gopi), 0.390 (Attia Kela), 0.552 (Kanai Basi) and 0.572 (*Musa flaviflora*)) with the incidence of *B. subcostatum* population. While the relative humidity exhibited non-significant negative correlation for all the varieties (r = -0.338 for Shabri, -0.182 (Mizo-Cavendish), -0.305 (Champa), -0.297 (Katch Kela), -0.336 (Gopi), -0.196 (Attia Kela), -0.144 (Kanai Basi) and -0.147 (*Musa flaviflora*).

**Table 4:** Correlation coefficient between *B. subcostata* incidence and weather parameters on different banana cultivars (2018-19).

| Parameters     | Shabri | Mizo-Cavendish | Champa | Katch Kela | Gopi | Attia Kela | Kanai Basi | *Musa flaviflora* |
|----------------|--------|----------------|--------|------------|------|------------|------------|-------------------|
| Max. Temp.     | 0.637**| 0.583**        | 0.719**| 0.674**    | 0.718**| 0.566**    | 0.352*     | 0.393*            |
| Min. Temp.     | 0.841**| 0.796**        | 0.867**| 0.849**    | 0.864**| 0.781**    | 0.528*     | 0.507**           |
| RH             | -0.338 | -0.182         | -0.305 | -0.297     | -0.336 | -0.196     | -0.144     | -0.147            |
| Total Rainfall | 0.508**| 0.417*         | 0.428* | 0.447*     | 0.465* | 0.390*     | 0.552**    | 0.572**           |

**Table 5:** Correlation coefficient between leaf damage (scars) by *B. subcostata* and weather parameters on different banana cultivars (2018-19).

| Parameters     | Shabri | Mizo-Cavendish | Champa | Katch Kela | Gopi | Attia Kela | Kanai Basi | *Musa flaviflora* |
|----------------|--------|----------------|--------|------------|------|------------|------------|-------------------|
| Max. Temp.     | 0.638**| 0.509**        | 0.664**| 0.671**    | 0.707**| 0.564**    | 0.356*     | 0.486*            |
| Min. Temp.     | 0.810**| 0.696**        | 0.807**| 0.843**    | 0.872**| 0.776**    | 0.550*     | 0.588**           |
| RH             | -0.224 | -0.107         | -0.257 | -0.302     | -0.330 | -0.196     | -0.920     | -0.151            |
| Total Rainfall | 0.441* | 0.214          | 0.250 | 0.432*     | 0.455* | 0.390*     | 0.551*     | 0.623**           |

With rainfall. Whereas, correlation of the dependent variables with relative humidity was non-significant and negative irrespective of all varieties.

**Table 6:** Meteorological data recorded for the year 2018-19 at ICAR, Tripura (February, 2018 to January, 2019)

| Months         | Weeks | Standard Meteorological (SMW) | Max Temp.(°C) | Min Temp. (°C) | Relative Humidity (%) | Total Rainfall (mm) |
|----------------|-------|------------------------------|--------------|--------------|----------------------|---------------------|
| Feb 1st week   | 5     | 22.1                         | 9.9          | 100          | 0                    | 0                   |
| Feb 3rd week   | 7     | 25.7                         | 10.4         | 98           | 0                    | 0                   |
| March 1st week | 9     | 30.5                         | 18.2         | 93           | 0.6                  | 0                   |
| March 3rd week | 11    | 32.7                         | 20.9         | 93           | 0                    | 0                   |
| March 5th week | 13    | 32.6                         | 20.3         | 91           | 51.8                 | 0                   |
The data on damage infestation (scars/10cm² of leaf) by B. subcostatum in West Tripura District was correlated with the prevailing weather parameters and result presented in Table 5. Data revealed that maximum and minimum temperature exerted positive and significant relationship with the leaf damage (scars). Rainfall shows significant positive correlation in case of Shabri, Katch Kela, Gopi, Attia Kela, Kani Basi, Musa flaviflora, while it shows only positive correlation with leaf damage in Mizo-Cavendish (r = 0.214) and Champa (r = 0.250) cultivars and leaf damage on rest of the cultivars shows significant and positive correlation.

Percent (%) fruit damage per bunch (or Per cent bunch damage)
Beetle feeds on the skin of newly emerged young and tender fruits, upper and lower surface of the flower bracts causing innumerable scars on them. Scars on the fruits grew bigger as the fruit matured and fruits become disfigured. Infested fruits got spotted and severe scarring of fruit skin led to underdeveloped fruit. The damage potential of B. subcostatum on different local and wild banana bunch (Table 7) ranged from 2.20 per cent to 87.53 per cent.

Table 7: Percent (%) fruit damage per bunch (or percent bunch damage) by B. subcostatum on local and wild banana cultivars of Tripura during 2018-2019.

| Sl. No | Genotypes / Cultivars | Percent (%) fruit damage per bunch (or percent bunch damage) |
|--------|------------------------|----------------------------------------------------------|
| 1      | Shabri                 | 87.53 * (69.32) a                                        |
| 2      | Champa                 | 65.86 (54.24) c                                          |
| 3      | Gopi                   | 52.60 (46.63) d                                          |
| 4      | Katch Kela             | 58.30 (49.89) cd                                         |
| 5      | Mizo-Cavendish         | 78.13 (62.11) b                                          |
| 6      | Attia Kela             | 5.53 (13.60) e                                          |
| 7      | Kanai Basi             | 3.47 (10.73) ef                                         |
| 8      | Musa flaviflora        | 2.20 (8.52) f                                          |

S.Emt: 1.96, C.D. @ 5% 5.93, C.V. (%) 7.66

Figures in the parenthesis are arc sin** transformed values, Values in the column followed by common letters are non significant at p = 0.05 as per DMRT.

Among the different cultivars the Shabri bunch was recorded significantly highest damage of 87.53 per cent. The second highest bunch damage was recorded on Mizo-Cavendish, 78.13 per cent. The damage on Champa, katch Kela and Gopi bunches were 65.86, 58.50, 52.60 per cent; respectively were another three next preferred hosts. Whereas, least bunch damage noticed on the rest of the banana genotypes viz., Musa flaviflora, Kanai Basi and Attia Kela which recorded 2.20, 3.47, 5.53 per cent, respectively. The per cent bunch damage is significantly differed with Attia Kela and Musa flaviflora. But there is no significant difference of bunch damage between Kanai Basi and Attia Kela or Musa flaviflora.

The perusal of literature revealed that the reviews pertaining to the incidence of B. subcostatum on different local (Shabri, Champa, Katch Kela, Gopi) and wild (Musa flaviflora, Kanai Basi and Attia Kela) banana genotypes are not available. Hence, the present study under Tripura climatic condition to be first of its kind. The investigation on the occurrence of the beetle population on different local and wild cultivars in Tripura revealed that the peak infestation (scars/10 cm² leaf) and maximum number of beetle population were found during 27th SMW (July 3rd week) to 39th SMW (Sept 5th week). The mean beetle population and mean scars/10 cm² of leaf were maximum in Mizo-Cavendish (16.84 beetle/plant and 21.26 scars/10 cm²) followed by Shabri cultivar (13.66 beetle/plant and 16.20 scars/10 cm²) (Fig. A). While the minimum beetle population and scars/10 cm² of leaf was noticed on Musa flaviflora (0.24 beetle/plant and 0.37 scars/10 cm²), Kanai
Basi (0.35 beetle/ plant and 0.69 scars/ 10 cm²) and Attia Kela (0.67 beetle/ plant and 1.51 scars/ 10 cm²). Due to low and scattered rainfall in February, 2018 and January, 2019 the incidence of beetle population was very less. Further, higher number of beetle, *B. subcostatum* recorded from July, 2018 to Sept. 2018 due to higher amount of total rainfall received during that period. Gradually the population and scares decreased from the first fortnight of October, 2018 in case of the five most infested varieties viz. Shabri, Mizo-Cavendish, Champa, Katch- Kela and Gopi. The present finding is in line with the results of the earlier workers who also found August- September months to be the peak period for scarring beetle incidence in Bihar (Mukherjee) [9] and West Bengal (Konar *et al.* [8]). The present finding is also conformity with Bhagabati and Deka [4] who reported the beetle population reach its minimum during January and February due to less rainfall during those months. Also the finding is in partial agreement with the result of Mishra *et al.* [11] who reported the highest population (32.2 beetles/plant) and scars (28.4 scars/5cm²) on Dwarf-Cavendish in Assam during second fortnight of August, 2011. Likewise Singh *et al.* [16] reported the extensive damage by the scarring beetle to leave as well as fruits during kharif season. Correlation study reveals that maximum temp., minimum temp, and rainfall exerted positive and significant effect but the relative humidity exerted negative impact both on beetle population and their damage (scars). It is an indication that weather condition plays a crucial rule in increasing the severity and incidence of pest. This finding corroborates with Das and Baruah [7] who endorsed the maximum and minimum temperature and rainfall were significant and positive and relative humidity was non-significant and negative with respect to beetle population as well as number of scars on leaf. The study conducted by Ahmad *et al.* [1] worked out the correlation coefficient for beetle population and weather parameters and pointed out that the crucial role of climatic factor with the pest population development. Mishra *et al.* [11] reported positive and significant correlation with various meteorological parameters except morning relative humidity. The highest bunch damage (Fig. B) was recorded on Shabri followed by Mizo- Cavendish and Champa. However, the lowest damage (Fig. C & D) was recorded on the wild types banana viz. *Musa flaviflora*, Kanai Basi and Attia Kela. Literature regarding the extend of bunch damage is also not available. Hence, it going to be the first study carried out on the estimation of *B. subcostatum* on local and wild banana genotypes of Tripura. However Such findings are somewhat related to the findings of Ahmad *et al.* [2] and Mukherjee [10] who revealed that the extent of damage by banana scarring beetle, *Nodostoma (Basilepta) subcostatum* has been approximately 30 per cent of the banana bunches during rainy season in Bihar and Sen and Prasad [14] who reported that *N. viridipennis* (another species of scarring beetle) was found to be the most destructive pest on different varieties of banana, Shabri, Champa, Amritasagar etc grown in Bangladesh.

**Conclusion**

Experimental results indicated that out of eight varieties evaluated, the least infested genotypes were *Musa flaviflora* followed by Kanai Basi and Attia Kela. It indicates these three genotypes can be used as resistance source for future crop improvement programme. This study will also helpful to predict the incidence of *B. subcostatum* on different local and wild banana genotypes of Tripura and to create proper integrated pest management programme (IPM) for its seasonal control.

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