Biology and Seasonal incidence of pseudostem weevil, *Odoiporus longicollis* Olivier (Coleoptera: Curculionidae) in banana

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ABSTRACT: In order to study the biology and seasonal incidence of banana pseudostem weevil, *Odoiporus longicollis* Olivier, laboratory as well as field experiments were conducted during 2012-13. The incubation period varied from 3 - 4 (mean 3.6 ± 0.54) days. The grub passed through five instars to complete the larval period. The total larval period varied from 30 to 35 (Mean 32.2 ± 1.92) days. The pre pupal period lasted for 3 to 5 (mean 4.1 ± 0.89) days. The pupal period lasted for 17 to 20 (mean 18.6 ± 1.34) days. The total life cycle of *O. longicollis* from egg to adult emergence varied from 53.0 to 65.0 (mean 58.4 ± 4.39) days. The adult individuals reared in the laboratory survived for 65 to 80 (mean 74.2 ± 6.87) days. The incidence of pseudostem weevil on banana commenced from February and continued its activity till the month of December 2012 and the maximum number of population (12.76 insects per plant) was recorded during second fortnight of August 2012. The number of holes was observed maximum (14.87 per plant) during second fortnight of August. All the weather parameters except relative humidity at 07 hrs and 14 hrs. had significant impact on weevil population and number of holes on pseudostem. All these weather parameters together produced 89.0 and 89.2 per cent impact on weevil population and number of holes produced, respectively.

Keywords: Banana, biology, pseudostem weevil, seasonal incidence

INTRODUCTION
Banana is the second most important fruit crop of Bihar grown in about 31.9 thousand hectares with an annual production of 1517.1 MT, and productivity of 47.6 MT/ hectare (NHB, 2010-2011). Like other fruit crops, banana too, is subjected to a wide variety of biotic and abiotic constraints. The incidence of insect pests is one of them. About 19 pests are found associated with banana in India from planting to harvesting (Padmanaban et al. 2002). Of these, the banana pseudostem weevil, *Odoiporus longicollis* Olivier (Coleoptera : Curculionidae) has been recognized as the major key pest of banana in Bihar. Banana pseudostem weevil is a monophagous pest of banana and plantains limiting the production and productivity, posing serious threat to banana production (Visalakshi et al. 1989, Valmayor et al. 1994). The severity of the loss is greater when infestation occurs at the early vegetative stage (5 months old). It is estimated that banana pseudostem weevil causes 10-90 per cent yield loss depending on the growth stage of the crop and management efficiency (Padmanaban and Sathiamoorthy, 2001). The density is high from late May to June and from late September to mid October that cause heavy damage (Luo et al. 1985). In Bihar, the pest activity is high from February-November (Prasad and Singh, 1988). In severely infested plantations, more than 20 per cent plants do not flower due to this reason.

MATERIALS AND METHODS

Biology
To study the biology and seasonal incidence of banana pseudostem weevil, laboratory as well as field experiments were conducted during 2012-13. The biology of *O. longicollis* was studied in the laboratory of Department of Entomology, whereas, a field experiment was laid out at the research farm of R.A.U., Pusa (Samastipur), Bihar to assess the seasonal incidence of *O. longicollis*. Meteorological observations with regard to ambient temperature (°C), relative humidity (%), rainfall (mm), prevailing at Research Farm, R.A.U., Pusa (Samastipur) were recorded daily during crop season from May 2012 to April 2013. The data so obtained were finally merged together to get average fortnightly temperature, relative humidity and rainfall, for the period under investigation.

Rearing of *O. longicollis* was done on pseudostem of banana (cv. Alpan) kept in rearing cages (24” × 12” × 12”). The pseudostem was cut into pieces of 10 cm length. Five small holes were made in the cut surface. Grubs of the weevil collected from the field were introduced at the rate of one per hole. The pieces of pseudostem were changed once in two days and the larvae were taken out and introduced into fresh ones. This was continued till pupation. After pupation, the
cocoons were collected and kept in glass troughs covered with wet muslin cloth for adult emergence.

Newly emerged adults were collected. Male and female adults were separated based on their rostral characters (Jayasree, 1992). Five pairs of weevils were isolated from the cage immediately after adult emergence from the cocoons. They were kept in pairs separately in small rearing cages. Pieces of healthy pseudostem of banana were provided in the cages for feeding. The eggs laid in the air chambers of the sheath were collected from the cages and the eggs deposited in the sheath were isolated with fine camel hair brush and counted separately. The pseudostem pieces were replaced with fresh ones every day. Eggs were examined every day for the emergence of grub. For the study of the incubation period, five freshly laid eggs were taken out from the pseudostem and were kept on filter paper in three covered petridishes with sufficient moisture. To maintain sufficient moisture inside, a few drops of water were given on the filter paper. At the time of hatching the hand lens was used to see the changes occurring on the eggs.

To assess the larval behaviour and the duration of different larval instars of banana pseudostem weevil, the newly hatched larvae were collected and transferred carefully using a wet camel hair brush into fresh pseudostem pieces of 10 cm in length into the test tube. The pseudostem pieces were changed once in two days till pupation of the grubs. While transferring into fresh pseudostem pieces, the larvae were examined for signs of moulting. The interval between two molts was taken as length of the each instar. Constant humidity of 100 percent R.H. level was maintained by utilizing water soaked cotton balls. The rearing provided an opportunity to observe the behaviour and development of the larvae and to assess the number of grub instars. The fifth instar larvae enters a non-feeding pre-pupal stage and constructs a cocoon by winding short pieces of fibrous materials of the sheath around its body (Padmanaban and Sathiamoorthy, 2001). The date and time of cocoon formations were recorded as soon as they were formed. After pupation, the cocoons were collected along with pieces of pseudostem and kept in petri dishes for adult emergence and the pupal period was recorded. As soon as the adult weevils emerged from the cocoons, they were separated in pairs and reared in rearing cages on pieces of banana leaf sheath. The longevity of both male and female weevils along with prevailing temperatures was noted.

**Seasonal incidence**

With a view to determine fluctuations in the seasonal incidence of pseudostem weevil in North Bihar condition, a fixed plot survey was conducted at Research Farm, R.A.U., Pusa, (Sarnastipur), Bihar during 2012-13. For this purpose forty banana plants (cv. Alpan), about five months old crop, were tagged. The inter and intra row spacing of banana crop was kept at 2×2 sq. meter, respectively. The crop was grown by adopting all the recommended agronomic practices uniformly, keeping them completely free from insecticidal contamination.

The observation on pest activity was initiated to monitor the pest population at fortnightly intervals throughout the year from May 2012 to April 2013. The data so obtained were merged together to calculate mean fortnight population. The number was recorded by counting them on forty tagged plants including those hidden inside the pseudostem during morning hours before 9 AM. The data, so obtained, were finally used to work out the mean number of insects per plant.

Similarly, total number of holes made by insects was also counted on the pseudostem. Data on mean number of insects and holes were correlated with meteorological parameters recorded simultaneously.

**RESULTS AND DISCUSSION**

**Biology of O. longicollis**

Under laboratory conditions a cluster of 4-5 eggs was laid at the cut end of the pseudostem within the air chamber by the adult female weevil. Freshly laid eggs were translucent, yellowish in colour and more or less cylindrical in shape with rounded ends, with somewhat prominent area of air space at the anterior end. The incubation period was studied by taking these eggs from the pseudostem and was kept on filter paper in 5 covered petridishes with sufficient moisture. The incubation period varied from 3 - 4 (mean 3.6 ± 0.54) days.

This finding is in partial agreement with the result of Thippaiah et al. (2012) who reported that the mean incubation period varied between 3-5 days during June to August and between 5-8 days during December to February. The present finding is also in conformity with the results of Padmanaban and Sathimoorthy (2001).

**Larval period:** The number of larval instars was found to be five (Table 1). Freshly emerged larva was yellowish white, apodus, soft, wrinkled, bulged in the
middle and pointed towards both ends. The first instar lasted for 3 to 4 (Mean 3.3 ± 0.44) days. Head was yellowish brown with anterior margin of cranium reddish brown. The body appeared whitish in colour. The second instar occupied 3 to 5 (Mean 4.2 ± 0.83) days. The third instar grub lasted for 5 to 6 (Mean 5.6 ± 0.5) days. The fourth instar grub increased in size, and occupied 6 to 7 (Mean 6.9 ± 0.45) days. The third, fourth and fifth instars are voracious feeders and riddle the pseudostem by cutting sometimes holes on the outer surface for better aeration of the tunnels, thereby cause heavy damage to the plantations (Azam, et al. 2010). Fifth instar was yellowish white, stout, fleshly and head free, reddish brown in colour and rounded abdominal tip. Mandibles stout, more or less triangular with bluntly pointed three apical denticles. This instar occupied 12 to 13 (Mean 12.4 ± 0.54) days. The total larval period varied from 30 to 35 (Mean 32.2 ± 1.92) days (Table 1).

Padmanaban et al. (2001) documented that the total larval period varied from 30.5 to 35 (Mean 33.1 ± 1.85) days during June-August and, between 51 to 62 (Mean 58.7 ± 3.71) days during December-February. Thippaiah et al. (2012) observed there were five larval instars having

<table>
<thead>
<tr>
<th>Instar</th>
<th>Range</th>
<th>Larval period (days)</th>
<th>Mean ± S.D</th>
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<tbody>
<tr>
<td>I</td>
<td>3-4</td>
<td>3.3 ± 0.44</td>
<td></td>
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<tr>
<td>II</td>
<td>3-5</td>
<td>4.2 ± 0.83</td>
<td></td>
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<tr>
<td>III</td>
<td>5-6</td>
<td>5.6 ± 0.5</td>
<td></td>
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<tr>
<td>IV</td>
<td>6-7</td>
<td>6.9 ± 0.45</td>
<td></td>
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<tr>
<td>V</td>
<td>12-13</td>
<td>12.4 ± 0.54</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Life stages</th>
<th>Range</th>
<th>Mean ± S.D</th>
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</thead>
<tbody>
<tr>
<td>Incubation period (days)</td>
<td>3-4</td>
<td>3.6 ± 0.54</td>
</tr>
<tr>
<td>Larval period (days)</td>
<td>30-35</td>
<td>32.2 ± 1.92</td>
</tr>
<tr>
<td>Pre- pupal period (days)</td>
<td>3-5</td>
<td>4.1 ± 0.89</td>
</tr>
<tr>
<td>Pupal period (days)</td>
<td>17-20</td>
<td>18.6 ± 1.34</td>
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<tr>
<td>Total developmental period (days)</td>
<td>53-65</td>
<td>58.4 ± 4.39</td>
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<tr>
<td>Adult longevity (days)</td>
<td>65-80</td>
<td>74.2 ± 6.87</td>
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Table 2. Correlation coefficient and regression equation between weather parameters (X) and number of insects per plant (Y)

<table>
<thead>
<tr>
<th>Weather parameters</th>
<th>Correlation coefficient (r)</th>
<th>Regression coefficient (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum temperature (°C) (X)</td>
<td>0.549*</td>
<td>0.280</td>
</tr>
<tr>
<td>Minimum temperature (°C)(X₂)</td>
<td>0.882**</td>
<td>0.387</td>
</tr>
<tr>
<td>R.H 7 hrs (%) (X₃)</td>
<td>-0.017 NS</td>
<td>0.082</td>
</tr>
<tr>
<td>R.H 14 hrs (%) (X₄)</td>
<td>0.324 NS</td>
<td>0.154</td>
</tr>
<tr>
<td>Rainfall (mm)(X₅)</td>
<td>0.475*</td>
<td>-0.002</td>
</tr>
</tbody>
</table>

**Significant at 1%  
*Significant at 5%  
NS =Non-significant

Multiple regression equation:

\[ Y = -27.409 + 0.280 (X₁) + 0.387 (X₂) + 0.082 (X₃) + 0.154 (X₄) - 0.002 (X₅) \]

Coefficient of determination (R²) = 0.89
Fig. 1: Seasonal incidence of pseudostem weevil, *O. longicollis* on banana cv. Alpan in relation to weather parameters during 2012-13.

Mean 2.80, 4.10, 5.40, 6.90 and 13.10 days for I, II, III, IV and V instars, respectively which is more or less similar to the present findings. Similar observations have been reported by various other workers (Anon., 2006; Ocampo and Medina, 2006; Bhagawati et al. 2009).

**Pre - Pupal and Pupal period:** The fifth instar larvae before entering into prepupal stage makes the cocoon by winding short pieces of fibrous materials of the leaf sheath around its body. The cocoon was dark brown in colour, elongate and cylindrical in shape. The pre - pupal period lasted for 3 to 5 (mean 4.1 ± 0.89) days. The pupa was exarate type, yellowish in colour with setae on the head and base of the rostrum and a tuft of hairs on the anal region. The pupal period lasted for 17 to 20 (mean 18.6 ± 1.34) days. Similar type of work has been documented by several workers (Ocampo and Medina, 2006; Myat, 2010; Azam et al. 2010 and Thippaiah et al. 2012).

**Total life cycle:** The total life cycle of *O. longicollis* from egg to adult emergence varied from 53.0 to 65.0 (Mean 58.4 ± 4.39) days (Table 2). The present result is in close conformity with the report of Thippaiah *et al.* (2012) who documented that the total life cycle of *O. longicollis* from egg to adult emergence varied from 53.0 to 66.0 (mean 59.90 ± 5.20) days during June-August and 80 -100 days with an average of (mean 90.9 ± 6.72) days during December-February.

**Adult stage:** Adults were robust, reddish brown and black in colour. Some adults mostly remained inside the pseudostem and fed on the dead plant tissue. The reddish brown and bigger weevils were females, whereas the black and smaller weevils were males. The colour difference is due to sexual dimorphism. The adult individuals reared in the laboratory survived for 65 to 80 (Mean 74.2 ± 6.87) days (Table 1). Thippaiah *et al.* (2012) reported that the adult individuals reared in the laboratory survived for 52 to 60 days with an average of (Mean 56.2 ± 3.0) days during June - August and 75 to 90 (Mean 81 ± 5.42) days during December-February. These present results are more or less in agreement with the findings of Shukla and Kumar (1969); Dutt and Maiti (1972a); Visalakshi *et al.* (1989); Lalitha *et al.* (2000); Padmanaban *et al.* (2001); Ocampo and Medina (2006); Justin *et al.* (2008) and Azam *et al.* (2010).
Seasonal incidence of pseudostem weevil at Pusa

The incidence of pseudostem weevil on banana commenced from February and continued its activity till the month of December 2012. The data pertaining to mean number of insect per plant has been illustrated in Fig. 1. The maximum number of population (12.76 insects per plant) during second fortnight of August 2012 was recorded with corresponding weather parameters i.e., maximum, minimum temperature (°C), relative humidity (%) at 07 and 14 hrs and rainfall (mm) were 33.4, 26.0, 91, 77 and 24.6, respectively. These weather parameters were found to be congenial for the population buildup of pseudostem weevil. The weevil population started declining gradually from October to December and became untraceable in the month of January 2013.

The number of holes was observed maximum (14.87/plant) during second fortnight of August 2012 with corresponding weather parameters. The data pertaining to the mean number of holes on the pseudostem followed the same trend as mean number of insect per plant as illustrated in Fig. 1. All the weather parameters, except relative humidity at 07 hrs and 14 hrs., had significant impact on weevil population and number of holes on pseudostem. All these weather parameters combinedly produced 89.0 and 89.2 percent impact on weevil population and number of holes produced, respectively.

Correlation coefficient: The correlation analysis between weather parameters and the mean number of insects have been summarised in Table 3. The data revealed that all the weather parameters, under study, except the relative humidity at 07 hrs and 14 hrs highly influenced the pest population. The correlation coefficient (r) was computed as 0.549, 0.882 and 0.475 for maximum, minimum temperatures, and rainfall, respectively. The relative humidity recorded (r = -0.017) at 07 hrs and (r = 0.324) at 14 hrs showed non significant effect on weevil population. The weather parameters were found to contribute around 89.0 per cent impact on weevil population of *O. longicollis* when acted together (R² = 0.89).

The correlation between weather parameters and number of holes caused by *O. longicollis* on banana pseudostem has been presented in Table 3. The data revealed that maximum, minimum temperature and rainfall maintained highly positive correlation with number of holes; the correlation coefficient (r) was 0.593, 0.897 and 0.469, respectively. The relative humidity recorded at 07 hrs and 14 hrs again did not show any significant influence on number of holes made by *O. longicollis* (r = 0.091 at 07 hrs and r = 0.385 at 14 hrs). However, all the weather parameters together governed 89.2% towards number of holes made by the pseudostem weevil (R² = 0.892). The population density of *O. longicollis* at any location is the result of complex interaction of many physical and biological factors. The interaction between weevil population and prevailing weather condition as obtained in present investigation provided a good support to the earlier findings of Luo et al. (1985), Zhou and Wu, (1986), and Azam et al. (2010). The study of the impact of various meteorological parameters is important as the abiotic factors regulate the biotic factors of environment which in turn influence insect population in any agro-ecosystem. The result of study will be helpful in the formation of a forecasting model for *O. longicollis* in banana.

REFERENCES


Table 3: Correlation coefficient and regression equation between weather parameters (X) and number of holes per plant (Y)

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<tr>
<td>Maximum temperature (°C)</td>
<td>0.593*</td>
<td>0.399</td>
</tr>
<tr>
<td>Minimum temperature (°C)</td>
<td>0.897**</td>
<td>0.351</td>
</tr>
<tr>
<td>R.H 7 hrs (%)</td>
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<td>0.017</td>
</tr>
<tr>
<td>R.H 14 hrs (%)</td>
<td>0.385 NS</td>
<td>0.199</td>
</tr>
<tr>
<td>Rainfall (mm)</td>
<td>0.469*</td>
<td>-0.001</td>
</tr>
</tbody>
</table>

Coefficient of determination (R²) = 0.892

Multiple regression equation:

\[ Y = -26.267 + 0.399 (X_1) + 0.351 (X_2) + 0.017 (X_3) + 0.199 (X_4) - 0.001 (X_5) \]

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