

# Biology, of the Bunchy Top Aphid *Pentalonia nigronervosa* Coq. (Aphididae, Hemiptera)

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## Introduction

*Pentalonia nigronervosa* Coq. commonly known as the Banana aphid is the vector of the 'Bunchy Top\* disease of plantain, (2), (6) and (4). Cultivation of plantain had been a thriving industry in Kerala till 1942. In 1943 the Bunchy Top disease made its appearance near Kottayam in Central Kerala and spread to the other parts. A Survey made in 1950 at the instance of the I. C. A. R. showed that the disease had extended over an area of about 3000 sq. miles bringing about an annual loss of about four crores of rupees. At present the disease has spread to a much larger area.

The Bunchy Top disease is caused by a virus transmitted by the Banana aphid *Pentalonia nigronervosa* Coq. In view of the importance of the aphid as the vector of this dreaded disease, studies were taken up on its biology, seasonal fluctuations, etc. The present paper embodies results of studies made on the life-history of the insect under field conditions. Works of Froggatt (2), Magee (6), Zeck and Eastwood (11), Smith (10) and Kolkaita and Soliman (5) provide some information on the biology of the insect in

countries other than India. No information is available on the biology of the aphid under conditions existing in India; and since climatic and biotic factors of the environment play a great role in the life-history and abundance of the vector, it was considered important to study its biology under the environmental conditions existing in Kerala.

## Materials and methods

For rearing the aphid, it was found necessary to provide fresh plant tissues and leave the insects undisturbed. The following method was adopted to provide these conditions :- Small healthy banana suckers about 2 feet high were planted in flower pots and kept in shade. A hurricane lantern chimney was pushed over the plant and made to rest on a shelf of cloth tied round the pseudostem a few inches above the soil level, as shown in Fig. t. The top opening of the chimney was then closed with cotton wool or cloth. The chimney was gently lifted up from the bottom cloth-rest and the aphids were then gently placed on the stem. The chimney was again pressed down on to the cloth rest and the upper portion closed. For close examination of the aphids also, the

chimney was moved up in the same way. Examination was usually carried out with the help of a hand lens.

To study the duration of the different instars, one healthy female aphid was placed on the plant and as soon as it brought forth a young one, the parent was removed leaving the nymph on the plant. This nymph was then watched closely till it attained maturity, for observing the different instars it passed through and their durations.

#### **Location of the aphid on the host plant**

*P. nigronervosa* occurs on the banana plants usually in small to very large colonies. Both winged and wingless viviparous females and nymphs are present in these colonies, the wingless forms being more abundant than the winged forms.

On the plants, the aphids occur mainly in sheltered situations; only very rarely the pests are found exposed. The three important regions on the plant where the colonies concentrate are: (a) the base of the pseudo-stem, (b) the top region of the pseudo-stem and (c) the leafaxils. Most of the aphids are confined around the base of the pseudo-stem near the soil level and at times several inches below the ground level. Here the colonies are sheltered by the old dried up leaf sheaths or by soil. On the top of the pseudo-stem aphid colonies remain sheltered by the dried up outer leaf sheaths. Colonies are often found in the leafaxils also. But during the monsoon the leafaxils get filled up with rain water, as also during the months of December and January when the axils are full with dew. During such times aphids seldom thrive in the leaf axils.

During seasons when aphids are abundant, they are seen on parts of plants other than

those mentioned above. Some of these situations are even exposed. For example the aphids are found in colonies on an exposed surface of tender leaves, mostly on the under side, on the sides of the mid rib or at the tip and within unopened leaves.

On a rough estimate it has been seen that 45% of the total number of aphids present on a plant are confined to the base of the pseudo-stem, 35% to the top of the pseudo-stem and the remaining 20% to the leaf axils and other regions.

Ocfemia et al (8) found the aphids colonising on the roots and corms of Manila hemp in Philippines during the dry seasons. Ogilvie (9) located aphid colonies on the flowers and tips of fruits of banana in Egypt. Magee (6) however could not find aphids on the roots of banana. In the present survey also it was not possible to detect the presence of the aphids on roots underneath the soil; neither could they be detected on flowers and fruits though they were occasionally noticed on the exposed roots of plants.

Presence of aphid colonies may not be uniform on all the plants in a particular locality. Often one could observe comparatively aphid-free plants in close proximity to plants harbouring large colonies of it.

#### **Dissemination of the Aphid.**

Magee (6) and Goddard (3), based on careful observations made in the field, stated that the dispersion of *P. nigronervosa* is accomplished mainly by flight. Contrary to this observation, Ocfemia (7) found that the aphid is not capable of prolonged flight and that it is spread from plant to plant chiefly by ants.

In the present investigations, besides regular field observations on the dissemination

of the aphid, a few trials were conducted in the laboratory to study the modes of locomotion adopted by disturbed insects. Following are the observations of such studies :-

1. In the field the aphids are usually not seen flying about. 2. The winged adults are sluggish in their movements as their wingless counterparts. When the winged aphids are disturbed by poking them with a fine brush or with the point of a needle, they immediately walk away without making any effort to fly. 3. When winged aphids are dropped down from heights of 2-3-feet, they fall vertically down to the ground with out-stretched wings. On reaching the ground the stretched out wings are folded back. Even in such circumstances no effort is made by the aphids to fly.

From the above observations it is probable that dispersion of aphids takes place more by direct contact transfer from plant to plant than through any other external agency. Wind probably plays a vital role in disseminating the aphids, especially the winged forms. As is indicated in the trials conducted above, wings in this aphid do not appear to function for active flight. However, when stretched out, the wings may function to sustain the aphids in air, when they can be carried away by the wind. In Kerala, bunchy top disease of plantain spread to the different parts of the state through the haphazard movements of infected suckers and parts of plants within the state. The aphids also appear to get disseminated through the same agency.

#### Life History

Males of *P. nigronevosa* have not been observed so far. The female breeds parthenogenitically. Egg stage also is not known.

The females give birth to young ones. These viviparous females may be winged or wingless.

#### Birth of nymphs.

The female aphid commences bringing forth young ones one day after its emergence as an adult. The process of giving birth to young ones is very slow. The mother aphid remains stationary during the event. The head of the young nymph first becomes visible at the anal tip of the mother. Gradually the whole nymph is pushed out taking about five minutes for the whole process. If during the act of giving birth, the mother aphid is disturbed, it moves about with the partly emerged nymph. The nymph is completely liberated only after regaining the static posture.

Birth of young nymphs generally takes place during day time. The young ones are never brought forth in quick succession one after another. Only one nymph is born at a time. After the birth of one nymph a minimum period of three to four hours elapses before the next nymph is born.

After its birth the young nymph remains stationary for a while during which period the full expansion of the body and the hardening of the cuticle are accomplished.

#### Reproductive potential of the pest

To study the reproductive capacity of *P. nigronevosa* individual adult aphids were placed on plantain stem within glass chimneys as described already. The number of young nymphs brought forth daily was observed and recorded. These observations were continued throughout the imaginal existence of each aphid. Reproductive capacity of five aphids were studied and their results are given in table I.

It will be seen that one aphid produces 32 to 50 young ones during its life time, the

average being 40.5. One to three nymphs are brought forth per day by a single aphid. Commencing on the second day of the emergence of adult the viviparous activity proceeds uninterrupted till finally it is stopped

once for all. The aphid is actively viviparous for half to three quarters of its life span. The adult continues to live for sometime after the cessation of bringing forth the young ones.

TABLE I  
Reproductive capacity of *P. Digranervosa*

Sl. No	Winged or wingless.	Date of emergence of adult.	Date of commencement of laying young ones.	Date of death of aphid	Longevity of adult in days.	Total number of young ones laid.
1.	Wingless	8- 9-'56	9- 9-'56	5-10-'56	27	36
2.	Wingless	30- 9-'56	1-10-'56	6-11-'56	37	49
3.	Wingless	12-10-'56	13-10-'56	14-11-'56	33	50
4.	Wingless	14-11-'56	15-11-'56	9-12-'56	25	34
5.	Wingless	8- 2-'57	9- 2-'57	4- 3-'57	24	32

#### Nymphs and nymphal durations.

The nymphs and nymphal durations of the wingless form alone have been fully studied. The winged adults also produce nymphs which are destined to develop into wingless forms.

#### First instar nymph (Fig. 4)

The newly born nymph is light brown in colour turning deep brown subsequently. After the birth it remains stationary when the full expansion of the body and limbs and hardening of the cuticle take place. It then moves about till it finds a suitable place on the plantain to itself by its mouth parts for feeding.

The newly emerged nymph measures 0.78 mm in length and 0.35 mm broad. The rostrum long, white or light yellow, considerably longer than half the length of the body and 0.49 mm in length. Antenna (Fig. 10) light yellow with, a black patch in

the centre, arises from protuberant antecorae which are situated at the antero-lateral corners of the head. Antenna 0.73 mm with four segments; first segment 0.053 mm, broader than long; second segment 0.045 mm, narrower than first segment; third segment slender, 0.17 mm, and carries a sensorium distally; fourth segment 0.42 mm, with 0.053 mm of base and 0.37 mm of spur and with a cluster of sensoria at base of spur. Legs long and pale yellow coloured. Cornicles cylindrical, short and stumpy; light yellow in colour with tips black, each 0.075 mm long and 0.054 mm broad with a slight constriction in the middle.

Duration of the first instar nymph is 2 days at the end of which it moults (vide table II.)

#### The Second instar nymph (Fig. 5.)

The newly moulted second instar nymph is light brown in colour turning deep brown

**BUNCHY TOP APHID** (*Pentalonia nigronervosa* Coq.)

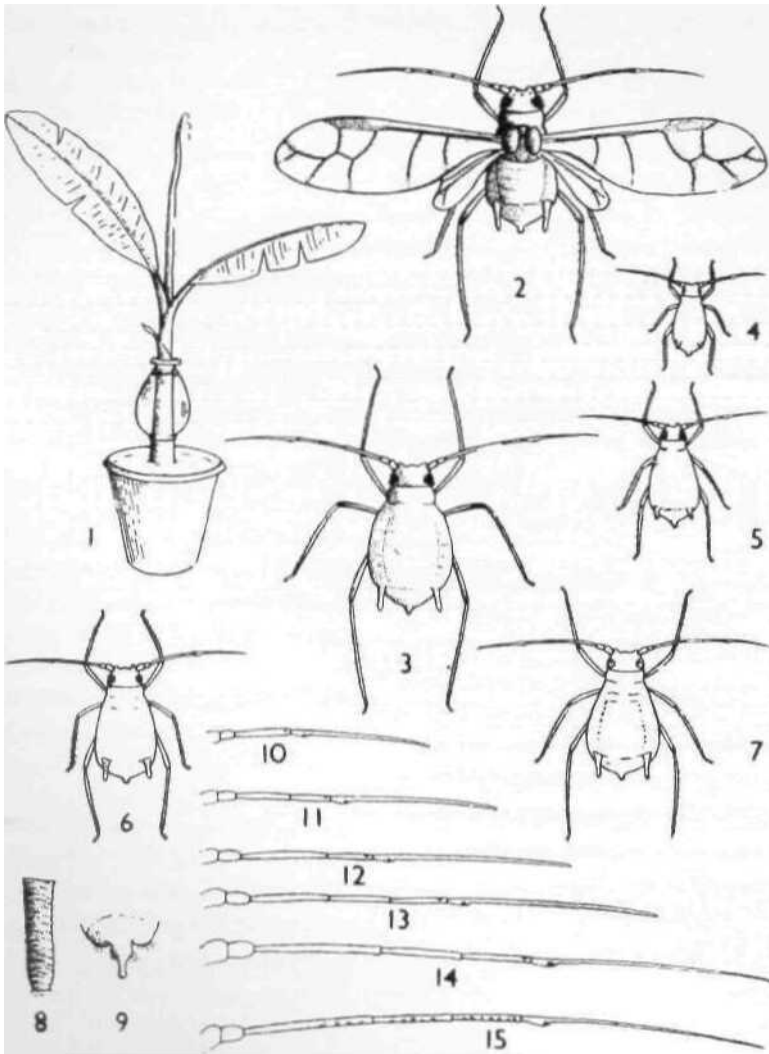


Fig 1. Rearing cage.

- |   |     |   |                    |
|---|-----|---|--------------------|
| , | 2.  | <i>Pentalonia nigronervosa</i> Coq.                     | Alate form         |
| , | 3.  | "   | Apterous form      |
| , | 4.  | "   | First instar nymph |
| , |     |   | Second "           |
| , | 6.  | "   | Third " "          |
| , | 7.  | "   | Final " "          |
| , | 8.  | Cornicle of <i>P. nigronervosa</i>                      | (Apterous adult)   |
| , | 9.  | Cauda of "  | "                  |
| , | 10. | Antenna of first instar nymph of <i>P. nigronervosa</i> | (Apterous adult)   |
| , | 11. | " Second " "  | " "                |
| , | 12. | " Third " "   | " "                |
| , | 13. | " Final " "   | " "                |
| , | 14. | " adult (Apterous adult).                               |                    |
| , | 15. | " alate adult   |                    |

later on. It is 1.05 mm long and 0.52 mm broad. Rostrum lona. 0.64 mm. Antenna (Fig. 11.) light yellow with a few minute black patches at middle, 0.91 mm with 5 segments. Segments starting from the base are 0.06 mm, 0.06 mm, 0.16mm 0.12 mm and 0.51 mm, respectively. Base of terminal segment 0.068 mm & spur 0.442 mm. Shape of segments as those of the segments of the first instar nymph. The fourth segment carries a sensorium distally, A cluster of sensoria present at the base of spur on fifth segment. Cornicle 0.15 mm long and 0.06 mm broad with the basal half light brown and the distal half deep brown to black and is cylindrical with a slight constriction in the middle. Legs with coxa brown, tips of femur and tibia black and rest light yellow or light brown. Duration of the second nymphal instar is 2-3 days (table 2)

#### **The Third instar nymph (Fig 6)**

Newly moulted third instar nymph is 1.2 mm long and 0.60 mm broad. Rostrum 0.71 mm. Antenna (Fig. 12) 1.14 mm with distal half black and basal half light brown and with live segments. The antennal segments from the scape are 0.068 mm, 0.068mm, 0.26 mm, 0.14 mm and 0.60 mm respectively The terminal segment with a base of 0.07 mm and a spur of 0.53 mm. Disposition of sensoria on the antenna as in the previous instar. Cornicle 0.2 mm long and 0.062 mm broad and is cylindrical with a slight constriction in the middle. Colouration of different parts of the body as in the previous instar nymph. Duration of the third instar nymph is two days (vide table 2).

#### **The Fourth instar nymph (Fig. 7)**

The newly moulted fourth instar nymph is 1.35 mm x 0.75 mm. Rostrum 0.76 mm, Antenna (Fig. 13) 1.40 mm with six segments, the segments from the base measure 0.09 mm,

0.075 mm, 0.24 mm, 0.18 mm, 0.17 mm and 0.64 mm respectively. The 6th segment with a base of 0.075 mm and a spur of 0.565 mm. The fifth segment carries a sensorium distally and the spur a cluster of sensoria at its base. Cornicle 0.29 mm x 0.068 mm, elongated and constricted slightly in the middle. Colouration of the aphid is as in the previous instar. Duration of the fourth instar nymph is 2-3-days (vide table 2) after which it undergoes the final moult giving rise to the adult wingless form.

#### **Fourth instar nymph (winged)**

The fourth instar winged nymph is 1.34 mm x 0.75 mm. Rostrum 0.78 mm. Antenna 1.55 mm with six segments. The segments 1-6 measure 0.08 mm, 0.07 mm, 0.28 mm, 0.20 mm, 0.19 mm, and 0.71 mm respectively. The base of terminal segment 0.08 mm and spur 0.63 mm. The fifth segment bears a sensorium at its apex and the spur a cluster of minute sensoria at the base. Cornicle 0.28 mm x 0.066 mm with a slight constriction in the middle. Two pairs of wing buds are present on the meso and meta thoracic segments. As different from the fourth instar apterous nymph, the three thoracic segments are distinct. The colouration of the fourth instar winged nymph is the same as that of the same stage wingless nymph.

#### **Duration of the complete life-cycle**

From the time of its birth as a nymph to the final nymphal moult the insect takes a period of 8-9 days, (vide table 2)

#### **The adult**

As has been mentioned earlier, the adult of *P. nigronervosa* exists in two morphologically different forms. These are the apterous viviparous female (Fig. 3) and the winged viviparous female (Fig. 2).

Descriptions of these two forms are already available (Coquerel (I), Zeck and Eastwood (II)). It will be seen that the two forms differ considerably in their morphological characters. Thus the winged form is characterised by the possession of two pairs of black-veined wings, distinct head, thorax and abdomen and the third, fourth, fifth and sixth antennal segments carrying sensoria. The apterous form has no wings; the separation between thorax and abdomen is not marked and the fifth and 6th antennal seg-

ments alone carry sensoria. It is interesting to note that while the distribution of sensoria on the antenna (Fig. 15) of the winged fourth instar nymph is similar to that of the fourth instar wingless nymph, that of the alate adult is entirely different from that of the apterous adult. The antenna, cornicle and cauda of apterous adult are shown in fig. 14, 8 and 9 respectively.

The longevity of the adult aphid varies from 23 to 37 days (vide table I)

TABLE II  
Duration of the immature stage of *P. nigronervosa*

Sl. No.	Date of birth of nymph	Date of first moult.	Date of second moult.	Date of third moult	Date of fourth moult	Total nymphal duration in days.
1.	20-7-'56	22-7-'56	24-7-'56	26-7-'56	28-7-'56	8
2.	20-7-'56	22-7-'56	24-7-'56	26-7-'56	29-7-'56	9
3.	21-7-'56	23-7-'56	26-7-'56	28-7-'56	30-7-'56	9
4.	19-8-'56	21-8-'56	23-8-'56	25-8-'56	28-8-'56	9
5.	19-8-'56	21-8-'56	22-8-'56	24-8-'56	27-8-'56	8
6.	19-8-'56	21-8-'56	23-8-'56	25-8-'56	27-8-'56	8
7.	20-8-'56	22-8-'56	24-8-'56	26-8-'56	28-8-'56	8
8.	20-8-'56	22-8-'56	24-8-'56	26-8-'56	29-8-'56	9

Temperature varied from 72.8 to 85.1° F.

Relative humidity from 85 to 88 %

### Summary

Studies have been made on the life-history, habits, reproductive capacity and longevity of *P. nigronervosa*, the banana aphid.

The aphid undergoes 4 moults passing through 4 nymphal instars. Nymphal period is 8-9 days. The longevity of an adult aphid is 23-37 days during which time it brings forth on an average of 40.5 nymphs.

The various nymphal instars of *P. nigronervosa* have been described in detail.

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