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Some Studies on Biology of *Pentalonia nigronervosa* Conquarrel- The Vector of Banana Bunchy Top Virus

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Abstract

liology of viviparous black banana aphid, *Pontalonia nigronervosa* Coq., vector of Banana Bunchy Top Virus (BBTV) was studied on banana under growth chamber at a photoperiod of 16:8 hours (light:dark), 55±5 percent humidity and at 20±8°C. From the time of its birth as a nymph, *P. nigronervosa* took a period of 10 to 14 days with an average of 10.6 days to develop to the final nymphal moult. Fecundity was 1-4 nymphs per day. Over 10 days it ranged from 9 to 26 nymphs/aphid, the average being 13.2. The average body length, width and length of hind tibia of adult aphid were 0.507 mm, 0.282 mm and 358.18 µm, respectively. Life span of *P. nigronervosa* ranged from 19 to 26 days with an average of 20.3 days.

Introduction

Banana (*Musaceae* spp.) is an important fruit crop of Pakistan occupying an area of 23,500 ha with a yearly production of 209,820 tones (Anonymous, 1997a, b). About 87 percent of the total area in Pakistan is planted in Sindh province with a production of 89 percent of the total banana production (Khalid and Soomro, 1993). The widely cultivated variety is Dwarf Cavendish, however, Willium Hybrid is also grown in some areas. The major banana growing districts of Sindh are Thatta, Badin, Hyderabad, Mirpurkhas, Sanghar, Nawabshah, Naushero-Feroze and Khairpur.

In 1989, a disease known as Banana Bunchy Top Disease (BBTD) was observed in some areas of Sindh and later the cause of the disease was identified to be the Banana Bunchy Top Virus (BBTV) in 1991 by Khalid *et al*. (1993). BBTD is one of the most destructive viral diseases threatening banana industry worldwide. In young infected plants, leaves show marginal chlorosis and dark green streaks develop on leaf veins, midrib and pseudostem. Numerous small suckers with progressively stunted growth emerge from infected plants. As disease develops, leaves become upright and bunched at the apex of the plant ultimately resulting to bunchy appearance (Fig. 1). Since 1889, the disease has spread to many parts of the world including Australia, Asia, Africa and South Pacific but has not been detected from America (Hu *et al*., 1996).

BBTV has a multi-component genome having nine single-stranded, circular DNA components (cssDNA), each about 1 Kb with isometric particles about 18-20 nm in, diameter, a single coat protein about Mr 20500 (Thomas and Dietzgen, 1991; Burns *et al*., 1995). BBTV has been classified as a member of a recently recognized virus group "nanoviruses" (Dale *et al*., 1998). It is transmitted in a persistent manner black banana aphid (*Pentalonia nigronervosa* Coq.) which is the only known vector of BBTV (Thomas *et al*., 1994). Although the disease was identified in 1991 but the presence of its vector in Pakistan was established later (Soomro and Khalid, 1994). *P. nigronervosa* is an exotic pest in the country and occurs on banana plants unusually in small to very large colonies and is distributed throughout the banana belt of Sindh irrespective of BBTV presence. However, the role of aphid in disease spread has not been understood. Due to the lack of systematic disease study, basic data vital for working out any meaningful management strategy, on BBTV is not available. Recently work has been initiated on characterization of BBTV and its vector-*P. nigronervosa* for the development of a sound management strategy.

Materials and Methods

Plant material: Apparently healthy banana suckers of Dwarf cavendish were planted in pots containing clay, sand and peat in equal ratios. These plants were maintained in a growth room at a photoperiod of 16:8 hours (light:dark) at 25-30°C. The light was provided by high intensity mercury lamps. Full strength Hoagland nutrient solution 100 ml/plant was added to each plant at two weeks interval. Twenty potted plants of approximately three months age at 3-4 leaf stage were arranged in rows randomly. The plants were regularly re-randomized to reduce variability in the experiment. The experiment was conducted with 20 replicates using completely randomized design.

Collection and maintenance of *P. nigronervosa*: *P. nigronervosa* were collected from banana plantation near Nawabshah, Sindh. Aphids were kept in transparent prepex cages (36.25 x 36.25 x 56.25 cm) on healthy banana plants under growth room conditions at 15-25°C with 80 percent humidity maintained by putting warm water containers in cages. To check over-crowdedness, aphids were frequently shifted to new plants.

Development time: Development time is defined as the time from birth of the aphid nymph until the start of its reproduction. Single adult aphids were caged individually on

Fig. 1: Chlorosis, dark green streaks on banana leaf veins, midrib and pseudostem

Fig. 2: Caged aphid on banana leaf

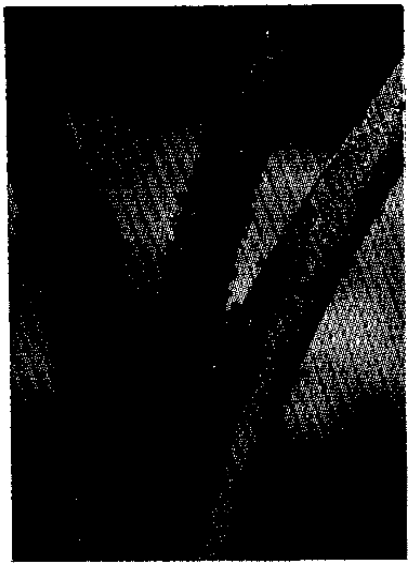

Fig. 3: Aphid colony on banana

a leaf of each banana plant. The cage was designed as of Markula (1963). Each cage consists of two prepex rings. The rings are covered on the outer side with a nylon mesh, and the rim of the open end is linked with foam to prevent leaf injury. The cage is held together with a hair clip (Fig. 2). After 24 hours only one newly born nymph was retained. Aphid nymphs were observed daily until they were grown up to adult and begin to reproduce.

Fecundity: Adult aphids were clip caged and were observed for number of nymphs produced daily and over 10 days. The cages were daily inspected when reproduction started. The newly born nymphs were counted daily and removed from clip cages leaving the gravid female in the cage.

Life span: The life span of this viviparous aphid was determined by observing time from the birth of newly born nymph developing to an adult till its mortality.

Table 1: Some biological parameters of *P. nigronervosa* reared on banana plants (Dwarf Cavendish) under semi-natural conditions

Parameters	Observations		Standard Deviation
Development time (days)	Mean	11.6	
	Range	10-14 days	1.12
Fecundity (over 10 days)	Mean	13.2	
	Range	9-26 nymphs/aphid	0.91
Body length (mm)	Mean	0.507	
n = 30	Range	0.40-0.57	0.75
Body width (mm)	Mean	0.282	
n = 30	Range	0.19-0.37	0.70
Hind Tibia Length (pm)	Mean	358.18	
	Average	280-380	0.40
Life span (days)	Mean	20.3	
	Range	19-26 days	0.90

*Mean of 20 replicates except for body length and width where n = 30

Aphid size: After the fecundity has been assessed for 10 lays, adult aphids were collected and preserved in 70 percent ethanol. The body size (length and width) of 30 aphids mounted on microscopic slides in glycerin) and one hind ibia length on each preserved aphid was measured using a nicroscope eyepiece graticule (Hohmann *et al*., 1988).

Results and Discussion

The colonies of *P. nigronervosa* were successfully established on banana (Fig. 3). However, population of aphids fluctuated throughout the year but their availability was helped study their biology.

The average development time of *P. nigronervosa* was found as 11.6 days (range 10-14). Daily fecundity was 1 to 4 nymphs/aphid while 9 to 23 nymphs/aphid were produced by adult aphids over a period of 10 days. The adult body length and width of aphid was 0.507 mm and 0.282 mm, respectively. The mean length of hind tibia was 358.18 µm. Life span of aphid ranged from 19 to 26 days with an average of 20.3 days (Table 1).

The present results are consistent with previous findings of Vishwanathan *et al*. (1992) who found that nymphal development of *P. nigronervosa f. typica* took 9-13 days, fecundity 3 to 20/female and adult longevity varied from 9.9 to 12.5 days. Similarly Lomerio and Calilung (1993) reported that development period of *P. nigronervosa* ranged from 6 to 21 days and generation time ranged from 20-28 days on five food plants in green house conditions. Identical were the findings of Sharma (1988).

In the present study biology of *P. nigronervosa* was conducted under growth room conditions but the results can not be generalized as aphid population increase is so much involved with ecological and physiological factors. However, further study on the influences of important ecological and physiological factors that effect the reproductive increase for the development of a broad base spectrum for aphid monitoring is needed in this regard.

P. nigronervosa is mainly associated with banana worldwide and so far not adaptable to other hosts (Thomas *et al*.,1994). In Pakistan, we have also found that *P. nigronervosa* is a specific pest ofbanana. However, it is not known whether aphid can maintain itself by alternation between a number of hosts. The study showed that *P. nigronervosa* can successfully be grown under controlled conditions. Its availability will pave the way to initiate other virus-vector related studies.

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