Host preference of *Pentalonia nigronervosa* Coquerel and *P. caladii* van der Goot (Hemiptera: Aphididae) on various host plants

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**Abstract.** *Pentalonia nigronervosa* and *P. caladii* are insect vectors of *Banana bunchy top virus* (BBTV) that cause banana bunchy top disease. The disease is considered an economically essential problem because it may cause significant yield loss. This study aimed to provide information on the host preferences of *Pentalonia* on various host plants. The research was conducted from September 2019 to January 2020 at the Insect Biosystematics Laboratory and Cikabayan Greenhouse, Department of Plant Protection, Faculty of Agriculture, IPB University. The host preference test was carried out in a 200 cm x 200 cm x 150 cm wire screen cage. *Dieffenbachia* sp. was placed in the center of the cage, and the other plants were placed around it with a distance between plants of 50 cm. As many as sixty adults of *Pentalonia* were infested on *Dieffenbachia* sp. They were given time to move freely to the other host plants. The test was carried out for one month with observation intervals of three days. The t-test shows that *Pentalonia* is not significantly different on either *Costus* sp. and *Dieffenbachia* sp. with the value of P>0.164 and P>0.321, respectively. The preferred host by *P. nigronervosa* based on the highest population is the family Musaceae, whereas *P. caladii* highly preferred the family Araceae (Taro).

1. **Introduction**

The genus *Pentalonia* Coquerel is classified into Order Hemiptera, Suborder Stenorrhyncha, Family Aphididae, and Subfamily Aphidinae [1]. *Pentalonia* Coquerel has been reported to be vectors that can spread and persistently transmit *Banana bunchy top virus* (BBTV) [2][3]. The impact of BBTV infection in the Southern region of Cameroon, Africa, has decreased the production of banana cv. Cavendish Williams and Plantain hybrid variety PITA 23 to 100 and 96%, respectively [4].

The first survey of banana bunchy top disease was carried out in May 2019 in several regions of West Sumatera. Based on the survey, it was found that the plants were infected with banana bunchy top disease symptoms, although no *Pentalonia* was found in those plants. In contrast, *Pentalonia* was found in bananas without BBTV symptoms. According to [5], this phenomenon indicates the suitability of the host to the banana genotype. Thus, it has become the basis for conducting host preference tests of *Pentalonia* on various host plants. Information about host preference of *Pentalonia* is necessary as basic information on the potential host plant that acts as a source of BBTV inoculum. Hence, this study was
conducted to provide information on the host preference of *P. nigronervosa* and *P. caladii* on various host plants.

2. Materials and methods
This research was conducted from September 2019 to January 2020. Slide preparation and morphometric identification were carried out at the Insect Biosystematics Laboratory, Department of Plant Protection, Faculty of Agriculture, Bogor Agricultural University. The experiment and care of aphids were carried out in the Cikabayan Greenhouse.

2.1. Host plant preparation
Plant species used in the test consisted of four banana cultivars, i.e., cv. Cavendish / *Musa acuminata* (AAA); cv. Raja / *M. textile* (AAB), cv. Mas / *Musa acuminata* ladyfinger (AA), and cv. Kepok/ *M. balbisiana* (ABB); Bentul taro (*Colocasia esculenta*), Red ginger (*Zingiber* sp.), Pacing flower (*Costus* sp.), Heliconia (*Heliconia* sp.), Galangal (*Alpinia galanga*), and *Dieffenbachia* sp. The banana seedlings were acclimatized for a month and proceeded planted in a polybag of 30 cm x 30 cm. The planting media was composed of soil, roasted rice husk, and manure with a ratio of 1:1:1. The seedlings were put into a gauze cage to avoid infestation of aphids and then situated in a location with sufficient sun exposure. They were watered every three days. The plants used as hosts were two months old plant.

2.2. Aphid preparation
Aphid was found on banana and taro plantations in Cikabayan, Bogor. Identification of the morphometric characters of the aphid was carried out using a Leica M 205C microscope and Leica version 4.4.0 application software. The banana and taro plants were kept in the screen house until the amount was sufficient for the test requirement.

2.3. Host preference test (free-choice test)
The test was carried out following a completely randomized design with ten host plants as treatments and three replications. The host preference experiment was carried out in a 200 cm x 200 cm x 150 cm wire-screen cage. *Dieffenbachia* sp. was placed in the center of the cage, and the other plants were around it with a distance between plants of 50 cm. Plywood (190 cm x 190 cm) with holes for the plants was placed on top of the host plant’s polybag. As many as sixty adults of *Pentalonia* were infested on *Dieffenbachia* sp. *Pentalonia* was allowed to spread actively to each host plant. The test was carried out for one month with observation intervals of three days. The variables observed were the number of aphid population, both of wingless (aptera) and winged (alate) adults.

2.4. Data analysis
Data of *Pentalonia* host preference on ten different host plants was analyzed statistically using ANOVA (Analysis of Variance) and followed by Tukey’s test at a 95% level using Minitab 17 software.

3. Results and discussion

3.1. Morphological identification of *Pentalonia*
*Pentalonia* has many similarities. Both have a reddish-brown body color, the antenna is longer than the body, and the third segment antenna has secondary rhinaria. Antenal tubercle on the head’s surface is parallel or divergent, and the base of the femur is brown, with pale brown or black tubular siphunculi. Although many features are similar, this particular species is different, as proven by the length of the ultimate rostrum segment (URS). The length of URS on *P. nigronervosa* is 0.14 ± 0.001 mm, significantly different from *P. caladii*, which is 0.11 ± 0.00 mm (Figure 1). As reported by [6], the length of the ultimate rostrum segment of *Pentalonia* was different.
3.2. Host preference of Pentalonia

The host preference of *P. nigronervosa* involved cv. Kepok, cv. Raja, cv. Mas, *Costus* sp., *C. esculenta*, cv. Cavendish, *Zingiber* sp. On the other hand, the host preference of *P. caladii* involved *C. esculenta*, cv. Cavendish, cv. Raja, cv. Kepok, cv. Mas, *Heliconia* sp, *Costus* sp. The total population of *P. nigronervosa* was 50 individuals, while the population of *P. caladii* was 23.2 from 60 individuals previously infested with *Pentalonia* adults. It indicated that the host plant has greatly affected the population of both species [7] and also showed that they are a polyphagous insect. Several studies by [8], [9], [10], [11], [12], [13] have also stated that *Pentalonia* is a polyphagous insect. However, no aptera and alate populations of *Pentalonia* were found on *A. galangal* and *Dieffenbachia* sp. *P. nigronervosa* was also absent in *Heliconia* sp., meanwhile, *P. caladii* was also absent in *Zingiber* sp. These results were following [14] that *P. nigronervosa* is hardly found on *Heliconia* sp.

According to the results of the analysis of variance (Table 1), the highest Aptera population of *P. nigronervosa* is found on cv. Kepok (63.1 ± 19.5 individuals) and is significantly different based on the t-test (P-value = 0.004 < 0.05), meanwhile *P. caladii* is the highest on *C. esculenta* (22.83 ± 6.32 individuals) and is significantly different based on the t-test (P-value 0.03 < 0.05). However, the aptera and alate populations of *Pentalonia* are not significantly diverse on *Costus* sp. (P-value 0.164 > 0.05) and *Dieffenbachia* sp. (P-value 0.321 > 0.05). The population of *P. nigronervosa* (4.03 ± 2.25 individuals) is higher than that of *P. caladii* (0.75 ± 0.37 individuals) on *Costus* sp. (Table 1), although *P. caladii* was not found on *Dieffenbachia* sp. This was following the results of research [15], that *P. nigronervosa* is the highest on banana, and *P. caladii* is the highest in cardamom and taro. Furthermore, [16] also reported that *P. nigronervosa* has a high preference for the cv. Kepok. Based on the results, cv. Kepok was susceptible to *P. nigronervosa*, but based on the incidence of banana bunchy top disease (presence of BBTV virus, incubation period, and intensity of damage), cv. Kepok was a tolerant plant [17]. Based on the result above, it is thought that although the population of *P. nigronervosa* and *P. caladii* were high, the spread and transmission of *Banana bunchy top virus* were lower.
### Table 1. Host preference of *P. nigronervosa* and *P. caladii* on ten various host plants

| Family       | Host Plants | Species       | Apter {\textit{a}} (Individuals) (mean ± SE) | Alate (%) | t-test | P-value | Part of Plant               |
|--------------|-------------|---------------|---------------------------------------------|-----------|--------|---------|-----------------------------|
|              |             | *P. n*        | 0.39 ± 0.28 b                              | 0         | 4.19*  | 0.000*  | The base pseudostem         |
|              |             | *P. c*        | 10.58 ± 2.08 b                             | 0         |        |         |                             |
|              |              | **Cv. Cavendish** |                                |           |        |         |                             |
|              |             | *P. n*        | 63.14 ± 19.5 a                             | 0.22      | 2.97*  | 0.004*  |                             |
|              |             | *P. c*        | 2.91 ± 0.63 bc                             | 0         |        |         |                             |
|              | Musaceae    | *Cv. Kepok*   | *P. n* 63.14 ± 19.5 a                      | 0.22      | 2.97*  | 0.004*  | The youngest leaves         |
|              |              |              | *P. c* 2.91 ± 0.63 bc                      | 0         |        |         | and base pseudostem        |
|              |              | **Cv. Mas**   | *P. n* 6.56 ± 1.17 b                       | 0.07      | 2.23*  | 0.023*  |                             |
|              |              |              | *P. c* 2.91 ± 0.74 bc                      | 0         |        |         |                             |
|              |              | **Cv. Raja**  | *P. n* 22.87 ± 5.53 b                      | 0.13      | 3.01*  | 0.004*  | The youngest leaves and base |
|              |              |              | *P. c* 4.39 ± 0.71 bc                      | 1.67      |        |         | pseudostem                  |
|              | Heliconiaceae| *Heliconia sp.* | *P. n* 0.00 ± 0.00 b                       | 0         | 2.73*  | 0.008*  | The youngest leaves and base |
|              |              |              | *P. c* 1.86 ± 0.64 bc                      | 0         |        |         | pseudostem                  |
|              |              | **Zingiber sp.** | *P. n* 0.25 ± 0.11 b                       | 0         | 2.24*  | 0.028*  | The youngest leaves         |
|              |              |              | *P. c* 0.00 ± 0.00 c                        | 0         |        |         |                             |
|              |              | *A. galanga*  | *P. n* 0.00 ± 0.00 b                       | 0         | 0      | 0       | -                           |
|              |              |              | *P. c* 0.00 ± 0.00 c                        | 0         |        |         |                             |
|              |              | **Costus sp.** | *P. n* 4.03 ± 2.25 b                       | 0         | 1.41 NS| 0.164 NS| The base pseudostem         |
|              |              |              | *P. c* 0.75 ± 0.37 c                        | 0         |        |         |                             |
|              | Zingiberaceae|              | *P. n* 0.03 ± 0.03 b                       | 0         | 1.00 NS| 0.321 NS| The youngest leaves and base |
|              |              |              | *P. c* 0.00 ± 0.00 c                        | 0         |        |         | pseudostem                  |
|              |              | **Dieffenbachia sp.** | *P. n* 2.91 ± 0.63 bc                       | 0         | 3.09*  | 0.003*  | The youngest leaves and base |
|              |              |              | *P. c* 22.83 ± 6.32 a                       | 1.67      |        |         | pseudostem                  |

*P.n= P. nigronervosa; P.c= P. caladii.*

Mean values followed by different letters are significantly different from each other at Tukey's test, α =0.05. NS = no significant (P>0.05), * = significant p<0.05 (t-test).

The result indicates that *Pentalonia* was active on the preferred plant surface. The alate of *P. nigronervosa* presents on cv. Kepok (0.22%), cv. Raja (0.13%), and cv. Mas (0.07%), meanwhile, the alate of *P. caladii* is only found on *C. esculenta* and cv. Raja with 1.67% population in each. The presence of the alate population has resulted from the increase of colony density and the decline of plant nutrition [18]. According to research [2], [3], the winged aphids (alate) show the ability to transmit and spread BBTV. Besides alate, the aptera of *Pentalonia* can also spread to host plants with the help of transfer media (plywood) and wind. *P. nigronervosa* and *P. caladii* are known as insect vectors of *Banana bunchy top virus* that cause bunchy top disease. If the alate and aptera of *Pentalonia* present in high density, the chance for bunchy top disease to spread becomes high as well [19]. An insect’s fitness can be influenced by their host plants as they choose numerous plants to complete their growth and development [20], [21], [22], [23].

Based on the observation, *Pentalonia* was mostly found at the base of the pseudostem and youngest leaves to take nutrients from each host plant. They particularly choose these parts of a plant because it is softer [24]; hence the stylet can easily pierce and suck the nutrients needed by the *Pentalonia*. On the other hand, *Pentalonia* was also found in the secluded part of a plant, which kept their natural enemies away from *Pentalonia* [25]. The presence of aphids in large colonies are always followed by the attendance of ants [26]. The ants are attracted to and feed on honeydew produced by an aphid [24]. They
can carry around an aphid from plant to plant and use it as their food resources [27] [28]. On the other hand, the ants protect the aphid colonies from predators and parasitoids [25]. The preference category was determined based on the percentage of *Pentalonia* population, high >20%, moderate 5-20%, and low less than 5% [16]. According to Figure 2, the highest preferred host plant by *P. nigronerova* was cv. Kepok; moderately preferred were cv. Mas, cv. Raja, *Costus* sp., *C. esculenta*, *Zingiber* sp., *Dieffenbachia* sp. *Heliconia* sp.; and the least preferred host plant by *P. nigronerova* was *A. galanga*. The highest preferred host plants by *P. caladii* were *C. esculenta* and cv. Cavendish; moderately preferred were cv. Mas, cv. Raja, cv. Kepok, *Heliconia* sp., and *Costus* sp. The least preferred host plants by *P. caladii* were *A. galanga*, *Dieffenbachia* sp., and *Zingiber* sp.

![Figure 2. Host preference of *P. nigronerova* and *P. caladii* on host plants](image)

Thus, it can be seen that the moderate and low preferred host plants by *P. nigronerova* and *P. caladii* can be used as alternative hosts. Different types of plants also differ in the quality and quantity of nutrients available. A plant’s nutritional quality is one of the essential factors affecting the fecundity of herbivorous insects [29], [30], [31]. A suitable host plant causes the insects to remain permanently on the host, whereas an unsuitable host plant causes the insects to stay temporarily.

4. Conclusion and recommendations
The preferred host by *P. nigronerova* based on the highest population was the family Musaceae, cv. Kepok, cv. Raja, cv. Mas, and cv. Cavendish. The highest population of *P. caladii* was found in the family Araceae (*C. esculenta*) and Musaceae (cv. Cavendish and cv. Raja). Further research is needed to determine the development of banana cultivars resistant to *P. nigronerova* and *P. caladii*.

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