

Population of *Pentalonia nigronervosa* Coquerel (Hemiptera: Aphididae) in organs banana cultivars of the Genome AB

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ABSTRACT

This study aimed to determine the population and morphology of *Pentalonia nigronervosa* maintained on various AB-genome banana cultivars. The research used a Factorial Complete Randomised Design (CRD) with 4 banana cultivars and 3 replications. Indonesia was rich in horticultural crops, including bananas, which were widely cultivated in tropical regions for their high economic value. However, banana cultivation was often constrained by pest infestations, particularly aphids such as *P. nigronervosa* Coquerel, which can reduce plant productivity and act as vectors of important viral diseases. Therefore, studies on the population dynamics of *P. nigronervosa* across different organs of banana cultivars in the AB genome group were important for understanding pest distribution and for supporting effective pest management strategies. *P. nigronervosa* act as a pest and vector that can transmit diseases and result in a decrease in the productivity of banana plants. The population results of *P. nigronervosa* on plant part factors on days 5, 10, 15, and 20 on the leaf, stalk, and stems. The average population of *P. nigronervosa* was highest on day 15 at 45.67 in the stem section. The lowest average population on banana plant leaves on days 15 and 20 was 0.00. Population results of *P. nigronervosa* in the 5th, 10th, 15th, and 20th banana cultivars in the barangan, lilin, susu, and raja bulu cultivars. The average population of *P. nigronervosa* was highest on the 15th day of the banana susu plant cultivar 36.33. The average population was lowest on 20-day cultivars of bananas barangan and lilin 0.00.

Keywords: banana, genom, instar, population, *P. nigronervosa*

INTRODUCTION

Indonesia is a country rich in natural resources and rich in flora diversity (Setiawan, 2022; Isworo & Oetari, 2022). Indonesia has a high diversity of ecosystems; these ecosystems are inhabited by various species of flora and fauna. Each type of fauna and flora can be renewed and used sustainably (Siboro, 2019; Gunawan et al., 2016; Irawan & Chikmawati, 2021; Riwidiharso et al., 2020). Indonesia has many types of horticultural plants; one example is the banana plant. Bananas are horticultural crops that have high economic value and are widely cultivated in tropical countries (Nur'aini et al., 2025; Pasaru et

al., 2021; Riwidiharso et al., 2020; Sulistyaningsih, 2016; Vu et al., 2025). This happens because it is supported by soil conditions and the climate for fruit growth and development in banana plants (Wahidah et al., 2022). Bananas have the nickname of a thousand-benefit plant, because bananas can be used to treat various diseases (Afzal et al., 2022). Bananas can reduce symptoms of asthma and leukaemia, help strengthen bones and be used as a cosmetic beauty ingredient (Ekayanti et al., 2023).

Banana plants are genetically composed of genome A (*Musa acuminata*) and genome B (*Musa balbisiana*). There is a genome grouping;

banana cultivar populations are in the form of triploids AAA, AAB and ABB (Dash & Rai, 2016). The crossing between genome A and genome B results in various genetic variations that undergo several processes that play an important role in the evolution of banana plants (Ekasari et al., 2012). Bananas with AAA and ABB genomes are widely cultivated because these cultivars can be consumed fresh or processed. The AAB banana genome is a banana that must be processed first before it is consumed. Banana cultivars with AAB and ABB genomes have disease resistance and tolerance to low-productivity environmental conditions, or called marginal environmental conditions (Wahyuningtyas et al., 2009).

Banana plant cultivation can cause several problems that are often faced by farmers, namely, banana plants are susceptible to pest attacks and diseases, have a short shelf life, and exhibit low productivity and variable quality. Banana plants produce *perishable agricultural products* that are susceptible to damage. The damage that occurs is usually caused by various factors, namely, physiological factors, chemical factors, microbiological factors, and physical factors (Eibad et al., 2023). *Pentalonia nigronervosa* aphids act as pests and vectors that can transmit diseases and result in a decrease in banana plant productivity (Arsi et al., 2023; Foottit & Maw, 2019; Singh et al., 2022). Symptoms of attack on banana plants due to *P. nigronervosa* aphid attack are dark green lines or dots; the lines or dots are in the form of breaks on the leaf veins; the leaves will look narrower; and the banana leaves will be easily broken (Irwansyah et al., 2019; Guyot et al., 2023; Halbert & Baker, 2015; Mathers et al., 2020; Sutrawati & Ginting, 2020). Various diseases and pests that attack banana plants can reduce economic value and harm farmers. The *P. nigronervosa* aphid is a vector insect that can cause dwarf disease or *Banana Bunchy Top Virus* (BBTV) (Arubi et al., 2021; Drenth & Kema, 2021; Liu et al., 2024). The *Banana Bunchy Top Virus* was first found in Java and Bali. The aphid *P. nigronervosa*, which moves from banana plants infected with the banana dwarf virus, will maintain its infectivity for approximately 48 hours (Mokolind et al., 2021). In addition to the *Banana Bunchy Top*

Virus (BBTV) disease, which commonly attacks banana plants. (Kusuma et al., 2020). The objective of this research was to determine the biology of aphids and the maintained population of *P. nigronervosa* in 4 banana cultivars with the AB genome.

MATERIALS AND METHODS

Place, Equipment and Materials

This research was carried out in the Plant Protection Study Program, Department of Plant Pests and Diseases, Entomology Laboratory, Faculty of Agriculture, Sriwijaya University, North Indralaya District, Ogan Ilir Regency, South Sumatra.

The tools used in the research were: Glue tool, Gembor, Mosquito net, Microscope, Macro lens, and Breeding rack. The materials used in the study were: Large glass cups, Small bowl cups, Gauze cloth, *Pentalonia nigronervosa* aphids, Glue guns, Toothpicks, Polybags, Cement, Caladium plants, Banana barangan, banana lilin, banana susu and banana raja bulu. The research was conducted using a Factorial Complete Random Design with 4 banana cultivars, each part replicated 3 times. The following was the use of the Factorial Complete Random Design (Figure 1).

BR D1	RB D3	RB B3
BR T2	LL B1	SS B1
LL D3	BR B2	SS T2
LL T2	BR T3	LL B3
SS D2	BR D2	LL T1
SS T3	LL D2	BR B3
SS B2	LL T3	BR T1
RB T3	SS D3	BR D3
RB B2	SS T1	SS D1
RB D1	RB B1	LL D1
LL B2	RB T2	RB D2
BR B1	SS B3	RB T1

Note: BR: Banana Barangan, LL: Banana Lilin, SS: Banana Susu, RB: Banana Raja Bulu, D: Leaf, T: Leaf Stalk, B: Stem

Figure 1. Experimental research design arrangement

Preparation of Banana Plants

Banana plant preparation begins with providing soil media and polybags. Polybags were filled with soil and placed 4 types of banana seeds. Banana plants from 4 different cultivars were cared for and arranged by genotype to make their development easy to observe. Caladium

plants used as a host medium for breeding aphids, *P. nigronervosa*, were planted in a pot. Banana plants and caladium plants were watered daily. The preparation of *P. nigronervosa* aphids begins by collecting aphids from diseased plants in the field, then transferring them to plants in the Araceae family as hosts. The breeding and maintenance of aphids was carried out in a laboratory room that is suitable for the conditions of the aphids to breed, and the caladium plants were watered daily.

Application Media

The application media in the study uses cement as a hardener, and the supports were skewers. The skewer was placed in the centre of the cement, leading to the top of the cover or to a vertical position. The cement medium was dissolved and moulded in a small bowl, plastic cup, or other container, then left to rest until it hardened. After the cement had hardened a little, the skewer was inserted into the middle of the cement, and the cement was left until it had hardened completely. The media cover tool was made of a large plastic cup. The bottom of the cup is rounded and hollowed out. After a hole was made in the bottom of the cup, it was closed with gauze, which was glued in place. The application of *P. nigronervosa* aphid on banana begins with 4 banana cultivars, namely leaf, stalk, and banana stem cut to 5 cm.

The banana leaf, stalk and stem that had been cut were inserted on a skewer that had been filled with water at the bottom of the cement surface of the application medium. Next, after being cut, place 1 *P. nigronervosa* aphid with 3 replicates. Aphids were observed for 21 days. Observations in the study were conducted on the population of *P. nigronervosa* aphids across the treatment factors of plant parts and 4 banana cultivars. The aphid population was counted for 21 days. Observations in the study were carried out by observing the morphology of the *P. nigronervosa* aphid, which consisted of the body color of the aphid and the size of the aphid's body from instar 1 to instar 4.

Data Analysis

Data analysis of the results of this research was carried out using *Analysis of Variance*

(ANOVA) to determine the morphological and population results of *P. nigronervosa* against the treatment of 4 cultivars of banana plant parts.

RESULTS

Population of *Pentalonia nigronervosa* in Plant Component Factors

Based on the results of observations made, the population results of *Pentalonia nigronervosa* on the plant part factor on days 5, 10, 15, 20 on the leaves, stalks, and stems. The average population of *P. nigronervosa* was highest on day 15 at 45.67 in the stem. The lowest average population in the leaves of banana plants on the 15th and 20th days was 0.00 (Tabel 1). On day 5, *P. nigronervosa* populations in the leaf, stalk, and stem were not significantly different for each treatment. On day 10 in leaf, stalk, and stem were significantly different for each treatment. On day 15 in leaf, stalk, and stem were significantly different for each treatment. On day 20 in leaf and stalk were not significantly different, while in stem it was significantly different from leaf and stalk.

Population of *Pentalonia nigronervosa* on Banana Cultivar Factors

Based on the results of the observations made, the population results of *Pentalonia nigronervosa* on the 5th, 10th, 15th, and 20th banana cultivars in the Barangan, Lilin, Susu, and Raja Bulu cultivars. The average population of *P. nigronervosa* was highest on day 15 of the Susu banana plant cultivar, at 36.33. The average population was lowest on day 20 in the banana barangan and lilin cultivars (Table 2). On day 5, the population of *P. nigronervosa* on the banana cultivar factor for the Barangan, Lilin, Susu, and Raja Bulu cultivars did not differ significantly across treatments. On the 10th day, the Barangan, Lilin, Susu, and Raja Bulu cultivars did not differ significantly across treatments. On the 15th day, the barangan, lilin, susu, and raja bulu cultivars differed significantly across treatments. On the 20th day, the barangan and lilin cultivars were not significantly different, whereas the susu cultivar was significantly different from the barangan, lilin and raja bulu. In the Raja Buru

cultivar, it differs significantly from barangan, lilin, and susu (Figures 2, 3, 4, & 5).

In Figure 6 above was the development of instar 1 to instar 4 aphids in the cultivars of barangan banana plants. Instar 1 was 0.3 mm, instar 2 was 0.8 mm, instar 3 was 1 mm, and instar 4 was 1.3 mm. Figure 7 above showed the development from instar 1 to instar 4 in aphids on lilin banana plants. Instar 1 was 0.3 mm, instar 2 was 0.7 mm, instar 3 was 1 mm, and instar 4 was 1.4 mm.

In Figure 8 above is the development of instar 1 to instar 4 aphids in the cultivars of susu

banana plants. Instar 1 was 0.4 mm, instar 2 was 0.8 mm, instar 3 is 1.1 mm and instar 4 is 1.3 mm. In Figure 9 above was the development of instar 1 to instar 4 aphids in the cultivars of raja bulu banana plant. Instar 1 was 0.4 mm, instar 2 was 0.8 mm, instar 3 was 1 mm and instar 4 was 1.3 mm. In Figure 10 above, there was a comparison of antennae in the aphid *P. nigronervosa*. Instar 1 have 4 antenna segments, instars 2 and 3 have 5 antenna segments, and instar 4 has 6 antenna segments.

Table 1. Population of *Pentalonia nigronervosa* on plant parts

Organs Crop	Population of <i>Pentalonia nigronervosa</i> day -			
	5	10	15	20
Leaf	42.67±1.55	14.67±1.20a	0.00±0.00a	0.00±0a
Leaf stalk	43.33±0.67	29.00±2.06b	0.33±0.07b	0.00±0a
Stem	33.00±0.63	32.67±2.66c	45.67±7.44c	27.00±4.59b
F. Calculation	2.23 ^{tn}	3.43*	35.29*	15.42*
F. Table	3.40	3.40	3.40	3.40
BNJ 5%	-	0.18	0.12	0.12

Note: Numbers followed by the same letter were different not real *) significant. ^{tn}) No. significant

Table 2. Population of *Pentalonia nigronervosa* on plant part factors

Banana Cultivation Factors	Population of <i>Pentalonia nigronervosa</i> day -			
	5	10	15	20
Barangan	27.00±1.39	18.67±3.08	0.33±0.09b	0.00±0a
Lilin	23.67±4.94	12.67±3.60	0.00±0.09a	0.00±0a
Susu	36.00±5.86	22.67±4.33	36.33±0.09d	22.33±0c
Raja Bulu	32.33±0.59	22.33±2.04	9.33±2.54c	4.67±1.27b
F. Calculation	2.37 ^{tn}	0.52 ^{tn}	16.24*	7.70*
F. Table	3.01	3.01	3.01	3.01
BNJ 5%	-	-	0.24	0.26

Note: Numbers followed by the same letter were different not real *) *) significant. ^{tn}) No. significant

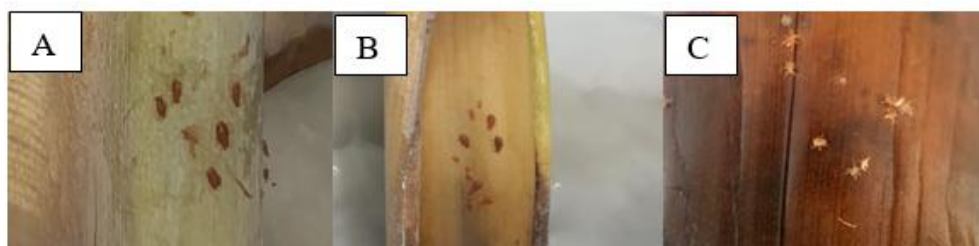


Figure 2. Population of *Pentalonia nigronervosa* in the part of the Barangan banana plant; Leaf (A); Stalk (B); Stem (C)

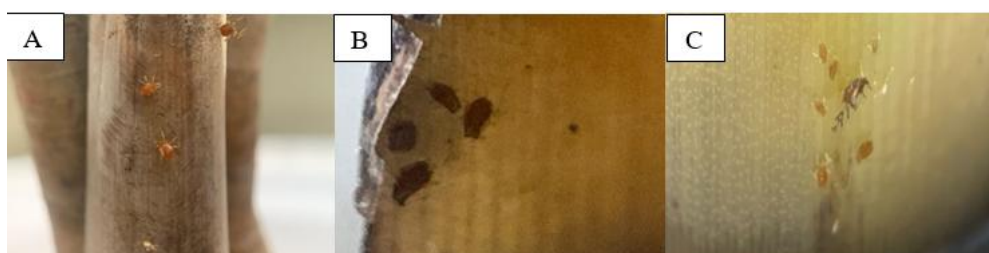


Figure 3. Population of *Pentalonia nigronervosa* in the part of the lilin banana plant; Leaf (A); Stalk (B); Stem (C)



Figure 4. Population of *Pentalonia nigronervosa* in the part of the susu banana plant; Leaf (A); Stalk (B); Stem (C)

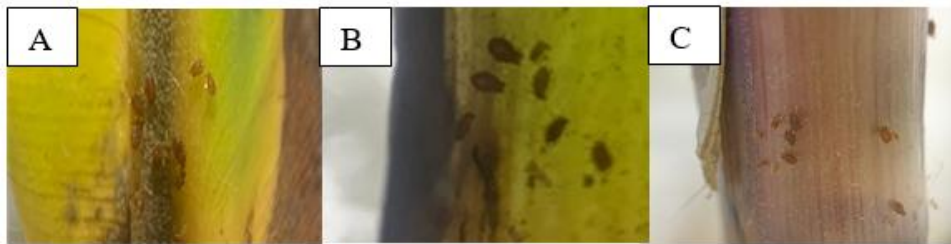


Figure 5. Population of *Pentalonia nigronervosa* in the part of the raja bulu banana plant; Leaf (A); Stalk (B); Stem (C)

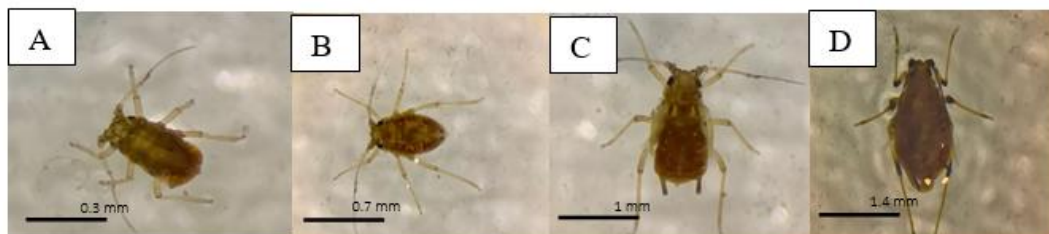


Figure 6. Instar 1 (A); Instar 2 (B); Instar 3 (C); Instar 4 (D); *Pentalonia nigronervosa* in the host plant of the Barangan banana

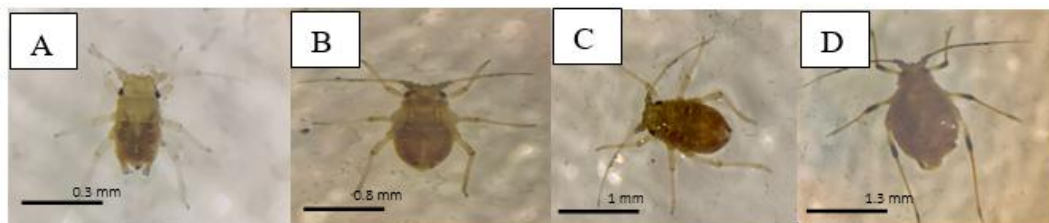


Figure 7. Instar 1 (A); Instar 2 (B); Instar 3 (C); Instar 4 (D); *Pentalonia nigronervosa* in the host plant of the lilin banana

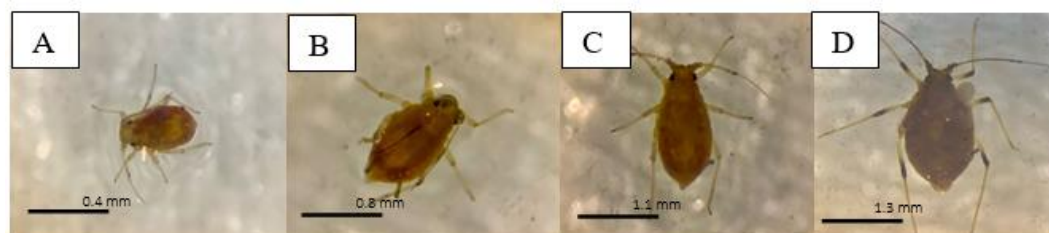


Figure 8. Instar 1 (A); Instar 2 (B); Instar 3 (C); Instar 4 (D); *Pentalonia nigronervosa* in the host plant, susu banana



Figure 9. Instar 1 (A); Instar 2 (B); Instar 3 (C); Instar 4 (D); *Pentalonia nigronervosa* on the host plant raja bulu banana

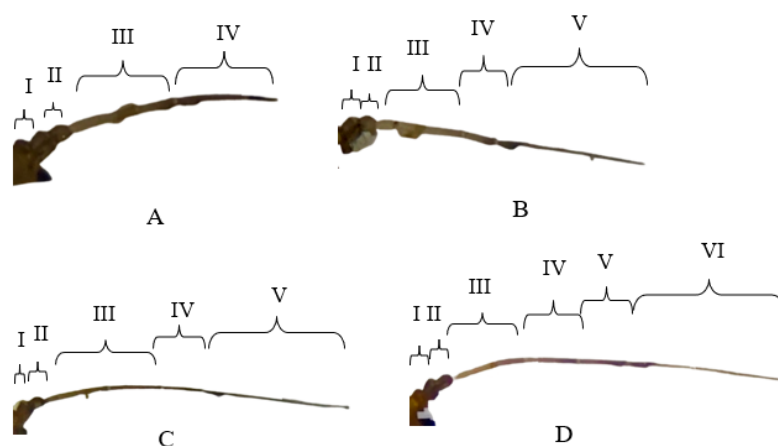


Figure 10. Antenna *P. nigronervosa*. Instar 1 (A), Instar 2 (B), Instar 3 (C), Instar 4 (D)

DISCUSSION

Pentalonia nigronervosa aphid is an insect that acts as a pest that can cause losses to banana plants. *Pentalonia nigronervosa* aphid is an insect belonging to the Order Hemiptera and the Aphididae Family. *P. nigronervosa* aphids are known as important pests on banana plants because *P. nigronervosa* aphids transmit Banana Bunchy Top Virus (BBTV) disease by puncturing their stylet in phloem vessels, and then the aphids will suck the liquid from inside the phloem vessels (Suparman et al., 2023). Banana Bunchy Top Virus (BBTV) disease is caused by aphids, *P. nigronervosa*, which make healthy plants sick, causing banana plants to become dwarfed, develop necrosis, and become brittle and easily broken. *P. nigronervosa* reproduces by parthenogenesis, where female aphid individuals can produce offspring without mating with male aphids (Robson et al., 2007).

In the study, observations of the aphid *P. nigronervosa* show a life cycle from instar 1 to instar 4. In the first instar, *P. nigronervosa*, the body of the aphid is oval, then turns elongated, brownish-red, with a body size of the first-instar aphid of 0.3–0.4 mm, and the antennae consist of four segments. The second instar, *P. nigronervosa*, has the same body shape and color as the first instar, with a body size of 0.7–0.8 mm and an antenna consisting of five segments. The third instar of *P. nigronervosa*'s body is brown with a body size of 1–1.1 mm, and the antenna consists of five segments. The fourth instar of *P. nigronervosa*'s body is light brown

with a body size of 1.3–1.4 mm, and the antenna of *P. nigronervosa* consists of six segments. The life cycle of *P. nigronervosa* begins in the nymph phase and lasts 9 to 16 days until the imago (adult) emerges. In the nymph phase, *P. nigronervosa* takes 10 to 14 days to develop and undergo the final moult. *P. nigronervosa* survives for 19 to 26 days, with an average of about 20 days. With this duration, aphids can produce 30 generations in a year. Female aphids give birth to the same offspring, namely females as well, with a fecundity level of 1 to 4 nymphs per day and no female aphids were found that gave birth to male genital aphids (Suparman et al., 2015).

Based on the results of observation of aphid populations in the banana plant parts. The highest aphid population is 59 in the stem of the banana plant. This is suspected because the stem of the banana plant usually has better nutrient availability than the leaves and stalks. Aphids tend to choose places with high concentrations of nutrients to support growth and reproduction. The leaf and stem parts of the plant wither quickly, so the nutrients in the aphid food are reduced, while the stem of the banana plant can store water, so it does not wither quickly. The increase and decrease in the aphid population is due to population density and the availability of food sources for aphids, and there are factors that affect the growth of aphids, which are biotic factors and abiotic factors. Examples of biotic factors include food incompatibility, such as low water content in plant parts, perennial surfaces, and nutrient content in plants needed by aphids (Suparman et al., 2023). Examples of abiotic

factors are temperature and humidity. At the time of observation, the room temperature was 24–29°C, and the room humidity was 69–9%. The optimum temperature for the breeding of aphids *P. nigronervosa* is 20–25°C (Robson et al., 2007) and the humidity for *P. nigronervosa* aphid breeding is 80% (Yasmin et al., 2001). Based on the results of observations of aphid populations on banana plant cultivation factors. The highest aphid population was in the banana susu cultivar. It is thought that the banana susu cultivar provides the necessary nutrients for the growth and reproduction of *P. nigronervosa*. Banana susu cultivars provide favourable conditions for aphids to breed, such as sufficient water and nutrients. Food availability affects the population density of *P. nigronervosa*; sufficient food availability allows the population of *P. nigronervosa* aphids to develop. If food availability is insufficient, it will cause the population of *P. nigronervosa* aphids to decrease. Sufficient, high-quality food sources will increase the aphid population. Because aphids need the right nutrients to carry out growth, reproduction, and environmental adaptation activities. With an optimal food source, aphids can move normally and productively, so that the aphid population will increase significantly. In addition, the availability of sufficient nutrients also increases the fecundity of female aphids, so aphids can produce a large number of nymphs, which in turn will increase the overall population. Therefore, it is important to ensure that the environment where aphids live has sufficient food sources to support their population's development.

CONCLUSION

The conclusions of this research are the population of *Pentalonia nigronervosa* in relation to the factors of banana plants. The highest aphid population is in the stem of the banana plant. The *P. nigronervosa* population develops most in the susu banana plant cultivar. Aphids go through a life cycle consisting of instars 1 to 4, measuring 0.3–1.4 mm. The highest population of *Pentalonia nigronervosa* on banana stems. Lack of nutrients in the host plant can affect the

development of the *P. nigronervosa* aphid population.

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