Biology of Pentalonia nigronervosa and Its Efficiency as a Vector of Banana Bunchy Top Virus After Being Bred in Rat Taro (Typhonium flagelliforme)

by Dessy Andriani

Submission date: 27-Jan-2024 06:28PM (UTC+0700)
Submission ID: 2279605011
File name: Journal_of_Suboptimal_Lands_2023._12_2_1152-163l_Sinta_3_hl.pdf (518.33K)
Word count: 5937
Character count: 28364

Jurnal Lahan Suboptimal : Journal of Suboptimal Lands
ISSN: 2252-6188 (Print), ISSN: 2302-3015 (Online, www.jlsuboptimal.unsri.ac.id)
Vol. 12, No.2: 152-163 Oktober 2023
DOI: 10.36706/JLSO.12.2.2023.642

Biology of *Pentalonia nigronervosa* and Its Efficiency as a Vector of Banana Bunchy Top Virus After Being Bred in Rat Taro (*Typhonium flagelliforme*)

Biologi Pentalonia nigronervosa dan Efisiensinya Sebagai Vektor Banana Bunchy Top Virus Setelah di Biakkan pada Keladi Tikus (Typhonium flagelliforme)

Yunanda Audri Balqis[*)], Bambang Gunawan, Suparman SHK

Departement of Plant Protection, Faculty of Agriculture, Universitas Sriwijaya, Indralaya 30662, South Sumatra, Indonesia
[*)]Corresponding author: yunandaaudribalqis06@gmail.com

(Received: 27 February 2023, Accepted: 18 September 2023)

Citation: Balqis YA, Gunawan B, SHK Suparman. 2023. Biology of *Pentalonia nigronervosa* and its efficiency as a vector of banana bunchy top virus after being bred in rat taro (*Typhonium flagelliforme*). *Jurnal Lahan Suboptimal : Journal of Suboptimal Lands*. 12 (2): 152-163. DOI: 10.36706/JLSO.12.2.2023.642.

ABSTRAK

P. nigronervosa adalah serangga yang berperan sebagai vektor Banana Bunchy Top Virus, yang menyebabkan pisang yang terserang menjadi kerdil bahkan tidak berbuah. Tujuan dari penelitian adalah untuk mengetahui biologi dari *P. nigronervosa* pada keladi tikus, serta untuk mengetahui kemampuan atau efisiensinya dalam penularan penyakit BBTV pada pisang setelah diberi perlakuan. Penelitian ini bersifat experiment dengan mencoba mengetahui efisiensi transmisi BBTV oleh *P. nigronervosa* setelah ditularkan ke tanaman Keladi Tikus (*T. flagelliforme*) dengan peubah Pengamatan dan pengambilan data biologi *Pentalonia nigronervosa* pada tanaman Keladi Tikus, Pengamatan perkembangan penyakit BBTV pada tanaman pisang yang diinokulasi dari gejala pertama sampai gejela khasnya *bunchy top* terbentuk. Biologi *P. nigronervosa* pada keladi tikus. Setiap tahap dari keempat instar warna dan ukuran dari nimfa *P. nigronervosa* ini berubah. Saat memasuki instar peratama warna putih kecoklatan dengan panjang 0.61 sampai 0.69 mm, pada instar ke 2 berwarna coklat muda dengan panjang 0.71 sampai 0.83 mm, kemudian di instar ke 3 berwarna coklat kemerahan dengan rerata panjang 0.87 mm, dan pada instar ke4 berawarna coklat kehitaman dengan rerata panjang tubuh 1.31. Warna imago masih coklat kehitaman dan pada fase ini biasanya telah memiliki sayap namun pada perlakuan di tanaman keladi tikus imagonya tidak memiliki sayap dan rerata panjang tubuhnya 1.43 mm. Jadi pada uji lapangan, tanaman keladi tikus tidak dapat menghambat penyebaran dari penyakit BBTV namun dapat menjadi inang alternatif bagi kutu *P. nigronervosa*.

Kata kunci: *P. nigronervosa*, BBTV, pisang, keladi tikus

ABSTRACT

P. nigronervosa is an insect that acts as a vector of the Banana Bunchy Top Virus causing the affected banana to become stunted and even fruitless. This study aimed to find out the biology of *P. nigronervosa* in rat taro as well as its ability or efficiency in the transmission of BBTV disease in bananas after being treated. The study was experimenta,

trying to find out the efficiency of BBTV transmission by *P. nigronervosa* after being transmitted to the plant of rat taro (*T. flagelliforme*) with the variables of observation and the taking of biological data of *Pentalonia nigronervosa* in the rat taro plant, Observation of the development of BBTV disease in banana plants inoculated from the first symptoms until the typical phenomenon of bunchy top was formed. Biology of *P. nigronervosa* in rat taro. Each stage of the four color instars and The size of the nymph of *P. nigronervosa* changed. When entering the first brownish-white instar with a length of 0.61 to 0.69 mm, in the 2nd instar it was light brown with a length of 0.71 to 0.83 mm, then in the 3rd instar it was reddish brown with an average length of 0.87 mm, and in the 4th instar it was blackish brown with an average body length of 1.31 mm. The imago color was still blackish brown, and in this phase it usually had wings, but in the treatment of the imago rat taro plant, it had no wings, and the average body length was 1.43 mm. In the field tests, the rat taro plants could not inhibit the spread of BBTV disease but could be an alternative host for *P. nigronervosa* ticks.

Keywords: *P. nigronervosa*, BBTV, banana, rat taro

INTRODUCTION

The spread of stunting disease in bananas caused by banana aphids, namely *P. nigronervosa as a* vector of the BBTV virus. This disease is one of the most important diseases in bananas because it can cause losses reaching 100% because the bananas exposed to the diseases caused by this virus will experience extreme crop failure (Qazi, 2016). *P. nigronervosa* ticks have (four) nymphal instars. The newborn instar has an oval shape that turns slightly elongated. It is reddish brown with four antennae segments (Basak et al., 2015). The second instar nymph resembles a Nymph The first instar was about 0.8 mm long. The third age Fairy was brown about 0.9 mm long (Efendi et al., 2022). At this age, the eyes began to be clearly visible, and it had 5 antennae internodes (Bagariang et al., 2019).

Four already had 6 antenna internodes, Light brown, 1.2 mm long. The percentage of attacks ranged from 21.52% to 55.23%, attacking banana plantations in Indonesia, such as in Java, Bali, Kalimantan, Jayapura, Lampung and South Sumatra (Poorani et al., 2022). The banana production in 2020 amounted to 8,182,756.00 tons (Latifah et al., 2021). In the past five years, banana production has increased. Nevertheless, the banana planting will not encounter the obstacles of technical limitations and planting bans. These cultivation restrictions include pests and diseases (Leunufna et al., 2019). Several diseases have been proven to reduce the quality and quantity of banana plants, namely the diseases caused by Banana Bunchy Top Virus (BBTV) spread by the banana aphid (Tricahyati et al., 2022a).

To prevent this disease from attacking bananas, there are several things that can be done such as cleaning infested plants (eradication) regularly (Halbert et al., 2015). The symptoms in plants infected with the BBTV virus are leaf bones arising, wrinkled, narrowed, and easily broken (Chabi et al., 2022) *P. nigronervosa* can cause a 100% loss within 21.6 days (Jebakumar et al., 2018) (Jekayinoluwa et al., 2020). The plants infected with BBTV do not bear fruit when they are young, and infected plants continue to produce when they mature, but the fruits are abnormal and inedible (Rahayuniati et al., 2021a). BBTV was spread by *P. nigronervosa*. *P. nigronervosa* is circulating and spreading the virus continuously (Mathers et al., 2020). In addition to banana plants, *P. nigronervosa* is also found to be related to several types of plants, such as ginger, galangal, taro and cardamom (Watanabe et al., 2013a).

The spread of *Banana Bunchy Top Virus* is caused by the virus that causes banana stunting disease strongly influenced by, which is temperature because the living environment of *P. nigronervosa* ticks will

greatly affect its population and the spread of the disease (Chakraborty et al., 2021).

P. nigronervosa spreads the stunting virus on bananas. The virus circulates within the body of the tick but does not replicate within its vector body nor is there any transovarial transmission (Watanabe & Bressan 2013b). To be an infective viral vector, *P. nigronervosa* must obtain hosts or plants affected by banana stunting virus for at least 4 hours, but most of these leaf ticks must skip the feeding period of up to 18 hours (Damasco et al., 2020). Once the tick has become infective, this vector can maintain its infectiveness for a period of time from 15 - 20 days, it can even be up to its entire life (Rahayuniati et al., 2021a). In this study, *Typhonium flagelliforme* may be an alternative host or even a plant that can minimize the spread of BBTV disease (Erawan et al., 2019). The study aimed to find out the biology of *P. nigronervosa* in rat taros, and its ability or efficiency in the transmission of BBTV disease in bananas after being treated.

MATERIALS AND METHODS

Time and Place

The study was carried out in the Insectarium Room and the back land of the Department of Plant Disease Pests of Faculty of Agriculture, Universitas Sriwijaya, Indralaya. The study was conducted from July to December2021. There were two parts to this investigation. The biology of *P. nigronervosa* in the Rat Taro plant was observed in the first stage, and the second step involved infecting *P. nigronervosa* from an infected or sick banana to a planter and then to a healthy banana.

Maintenance and Propagation of *Pentalonia nigronervosa*

Bananas with the diseased *P. nigronervosa* aphid were used to propagate healthy bananas and taro. Indoors, daily watering was done during the propagation process. To maintain the population of *P. nigronervosa* ticks, the plant needed to be replanted or supplemented as soon as it died.

Land Preparation

The field was cleared of weeds by chopping or cutting weeds with a lawn mower, after which it was allowed to dry and the grass that grew again was sprayed with herbicides. The land cleared of weeds was then leveled in order for the existing bunds to be flat and the land was ready to be used for laying the polybags.

Banana Seedling Transfer

Banana seedlings of about 1-2 months old were taken from the field using tools After which the bananas were planted in lace of The prepared seedlings. The seedling place was mixed with manure and sawdust. If the roots of banana plant had already spread and could adjust to the environment and the leaves were refreshed, then they were transferred to the polybags.

P. nigronervosa infestation

The P. nigronervosa tick that attacked the healthy bananas had already reached instar 3, was brownish, had already developed black limbs, and had five internodes on each of its antennae. For three days, the aphids were moved to the taro plant on the rats.

Infestation of Infective *P. nigronervosa* to Healthy Bananas

The sick banana's *P. nigronervosa* offspring was introduced to the plant 72 or 3 days in advance. It was then given to or injected into the healthy bananas. Up to five heads of P. *nigronervosa* were found on each healthy plant of a banana.

Infestation of Infective *P. nigronervosa* from the Rat Taro to the Healthy Bananas

The infectious *P. nigronervosa* was immediately transferred to the healthy bananas, where it was continuously

monitored until the banana started to exhibit BBTV disease symptoms.

The Observed Variables

a. The Biology of *P. nigronervosa*

The biology of *P. nigronervosa* throughout its first life cycle was the first variable to be observed. This involved transferring the organism to plants in instar 1, watching the transition from instar 1 to instar 2, and so forth. The ticks' reproductive cycles were counted during the biological experiment, and it was also noted when they gave birth.

b. Incubation Period

The incubation period was determined by tracking the onset of symptoms in five banana plants that had P. nigronervosa infestations. The observations began the day following the tick infestation and continued daily until the symptoms were brought on by the healthy plants.

c. Disease Incidence

The observation of disease incidence was carried out to see and also observe the symptoms caused by the BBTV vector that attacked banana plants, namely *P. nigronervosa* which was observed per group of plants.

d. Attack Rate Calculation

The calculation of the level of attack by aphids was determined by a score of 0 to a score of 3. The severity of the attack was according (Table 1). The data obtained was then processed to calculate the intensity of the disease according:

$$\textbf{Disease Intensity} = \frac{\sum(ni \times v) \times 100\%}{Z \times N}$$

Information:
ni = Number of units of observation with equivalent values
v = Observation score
Z = Total highest score
N = Number of observation units

e. Population Calculations of *Pentalonia nigronervosa*

The calculation of the population of *P. nigronervosa* was carried out by manually counting the number of aphid colonies on plants and documenting them with a cellphone camera. The ticks were counted on all existing plants.

Table 1. Table of aphids infestation rate calculations

Score	Information
0	If the plant was healthy and there were no visible signs of stunting
1	If the infection was a little stunted disease: the edges of the leaves turn slightly yellow and the leaves narrow and there were one to two diseased banana stems in the clump
2	If moderate stunting disease infection: moderate yellowing of the leaf edges, leaves narrow, shortened and stunted, and three to four infected banana stems found in the clump
3	If the stunt disease infection was severe: yellowing of the edges of the leaves was quite severe, the leaves were narrowed, twisted, causing distortion, stunted and necrotic, and more than four infected banana stems were found in the clump

RESULTS

P. nigronervosa in rat taro plants: biological data

The banana aphid of *P. nigronervosa* could grow and multiply in rat taros. The *P. nigronervosa* ticks transferred to the rat taros had four nymphal instars. The reproduction of *P. nigronervosa* was completely without mating or parthenogenesis. The observation of biological tests showed that *P. nigronervosa* had different characteristics of each instar, ranging from color, body length, body width, and instar lifespan. The observational data of the biological test of Pentalonia nigronervosa in rat taro were as followed:

First Instar

The first instar of *P. nigronervosa* on rat taro was transparent brown (Figure 1).

P. nigronervosa's first instar had a body length that varied from 0.61 to 0.69 mm and a breadth that varied from 0.28 to 0.37 mm (Table 2). The tick was measured one day after it was born. With an average birth time of 6.1 days and a range of 4 to 7 days, the size of the tick in this first instar may rise (Table 2).

Second Instar

The *P. nigronervosa* tick's color changed to light brown in the second instar, but its size and shape remained largely the same as in the first instar (Figure 2).

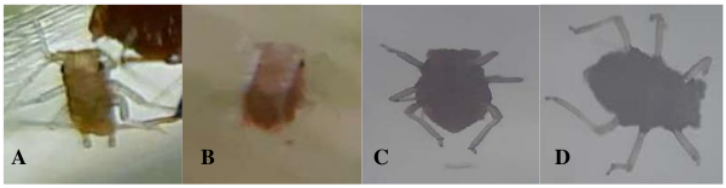

Figure 1. *Pentalonia nigronervosa* (A) The first instar, (B) aphids after 1 day of hatching, (C) The first instar abdomen, (D) The first instar dorsal

Figure 2. *Pentalonia nigronervosa* (A) the second instar abdomen, (B) the second instar dorsal., (C) the second instar showing color

Table 2. Characteristic data of P. nigronervosa the first instar on rat taro

Plants	Characteristics of the the first instar aphid *Pentalonia nigronervosa*			
	Color	Length(mm)	Width(mm)	Instar age (days)
1	Brownish white	0.61	0.33	7
2	Brownish white	0.61	0.29	6
3	Brownish white	0.51	0.28	4
4	Brownish white	0.63	0.34	7
5	Brownish white	0.69	0.37	4
6	Brownish white	0.66	0.33	3
7	Brownish white	0.63	0.32	4
8	Brownish white	0.76	0.33	4
9	Brownish white	0.67	0.29	3
10	Transparent	0.67	0.32	3
Amount		6.44	3.2	6.1
Average		0.644	0.32	0.61
Standard deviation		0.02	0.01	0.50

The second instar of *P. nigronervosa* had a body length that varied from 0.71 to 0.83 mm and a breadth that varied from 0.36 to 58 mm (Table 3). This measurement was made one day after the tick began molting. As could be seen in table (3), the tick's size might rise as the molting process continued, lasting an average of 2.5 days and up to 3 days (3).

Third Instar

The *P. nigronervosa* third instar in rat taro was reddish brown, already greater in size, and considerably different in morphology from the first instar; the limbs started to turn reddish brown before the body took on an oval shape (Figure 3).

P. nigronervosa's third instar had a body length that varied from 0.83 to 0.97 mm and a breadth that varied from 0.41 to 6 mm (Table 4). The tick was measured one day after it molted to enter the following instar. According to (Table 4), the tick's size in this third instar may rise as the molting period lengthens from 1 to 3 days, with an average of 2.2 days (Table 4).

Table 3 Characteristic data of *P. nigronervosa* the second instar on rat taro

Plants	Characteristics of the second instar aphid *Pentalonia nigronervosa*			
	Color	Length(mm)	Width(m)	Instar age (days)
1	Light brown	0.71	0.36	3
2	Light brown	0.83	0.55	3
3	Light brown	0.72	0.45	3
4	Light brown	0.79	0.48	1
5	Light brown	0.79	0.47	3
6	Light brown	0.78	0.47	2
7	Light brown	0.74	0.51	1
8	Light brown	0.83	0.53	2
9	Light brown	0.73	0.58	2
10	Light brown	0.72	0.44	3
Amount		7.64	4.84	25
Average		0.764	0.48	2.50
Standard deviation		0.01	0.02	0.26

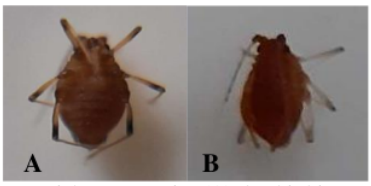

Figure 3. *Pentalonia nigronervosa* tick on taro mice (A) the third instar abdomen, (B) the third dorsal

Table 4 Characteristic data of P. nigronervosa the third instar on rat taro

Plants	Characteristics of the third instar aphid *Pentalonia nigronervosa*			
	Color	Length(mm)	Width(m)	Instar age (days)
1	Reddish brown	0.87	0.41	3
2	Reddish brown	0.97	0.56	3
3	Reddish brown	0.85	0.5	1
4	Reddish brown	0.88	0.51	2
5	Reddish brown	0.87	0.52	1
6	Reddish brown	0.87	0.47	3
7	Reddish brown	0.83	0.55	2
8	Reddish brown	0.92	0.56	3
9	Reddish brown	0.86	0.6	2
10	Reddish brown	0.83	0.5	2
Amount		8.75	4.64	22
Average		0.875	0.46	2.20
Standard deviation		0.01	0.02	0.25

Fourth Instar

The fourth instar of *P. nigronervosa* in rat taro was blackish brown, has grown larger, and has a body form that was quite different from the instars before it (Figure 4). The legs were also beginning to turn blackish brown (Figure 4.) *P. nigronervosa* of the fourth instar had a body length of 1.21–1.37 mm and a breadth of 0.53–7.7 mm (Table 4.4). The tick was measured one day after it molted to enter the imago phase. The size of the tick in this fourth instar could vary depending on the tick's age. the molting process took between one and two days on average, as illustrated in (Table 5).

.Imago *P. nigronervosa*

Imago in rat taro was blackish brown which has increased in size and body shape was different from the previous instar, all parts of the body were clearly visible, such as the limbs, antennae and eyes (Figure 5). In this phase, *P. nigronervosa* ticks generally have wings if they were in their natural habitat or host. However, when treating passing plants, such as rat taro, no winged imagos were found, contrary to what was expected given that the population was still small and there was no need to move because the feed source remained adequate or perhaps due to the influence of the local climate (temperature and humidity). During this stage, the imago's length varies from 1.4 to 1.7 mm and its width from 0.93 to 0.99 mm. The mean tillers ranged from 18.3 to 12.5 in age, with a reproductive period of 8.2 (Table 6).

Environmental Data of *Pentalonia nigronervosa* Biological Test on Rat Taro

Biological tests of *P. nigronervosa* taro mice were carried out in the insectarium room where the temperature could be adjusted to be suitable for the development of *P. nigronervosa*. Environmental data on *P. nigronervosa* biological tests on rat taro could be seen in (Table 6).

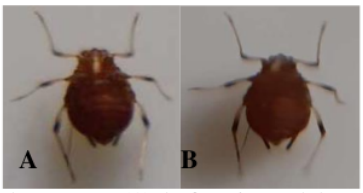

Figure 4. *P. nigronervosa* tick on rat taro (A) the fourt instar abdomen, (B) the fourt instar dorsal

Table 5. Characteristic data of *P. nigronervosa* the fourth instar in rat taro

Plants	Characteristics of the fourth instar aphid *Pentalonia nigronervosa*			
	lor	Length(mm)	Width(m)	Instar age (days)
1	Dark brown	1.3	0.53	2
2	Dark brown	1.21	0.64	1
3	Dark brown	1.33	0.69	2
4	Dark brown	1.31	0.67	1
5	Dark brown	1.35	0.73	2
6	Dark brown	1.37	0.77	1
7	Dark brown	1.31	0.65	2
8	Dark brown	1.22	0.6	2
9	Dark brown	1.34	0.7	2
10	Dark brown	1.4	0.75	1
Amount		13.14	6.73	16
Average		1.314	0.67	1.6
Standard deviation		0.02	0.02	0.16

Incubation Period of BBTV Disease

The symptoms arising due to the attack of Banana bunchy top virus disease occurred no later than 14 days after the inoculation of *P. nigronervosa* ticks onto bananas where the symptoms on the leaves appeared wrinkled, yellowish in color and the leaf bones arose (Figure 6). The data of the observations were presented in the appendix then the average of BBTV disease attacks on banana plants using the 4 treatments with the Anova test and the 5% BNJ test was shown in the Table 7.

BBTV Disease Attack

This BBTV disease attack started with the appearance of wrinkled marks on the leaves, and then the leaf color changed to yellowish and the leaf bones began to appear (Figure 7). The mean of BBTV disease attacks in the four treatments could be seen in (Table 8) where the F count was 0.54 and the F table was 3.49, means the results were not significantly different (tn) this could be influenced by several environmental factors, namely temperature, humidity, weather and the presence of natural enemies.

Figure 5. P. nigronervosa ticks on taro mice (A) imago abdomen, (B) imago dorsal

Table 6. Characteristic data of *P. nigronervosa* imago phase on rat taro

Plants	Characteristics of the aphid *Pentalonia nigronervosa* imago							
	Colors	P (mm)	L (mm)	U-I (day)	J-A (tail)	M-R	% B	Adult age (days)
1	Dark brown	1.42	0.97	13	15	6	0	13
2	Dark brown	1.4	0.94	10	13	6	0	10
3	Dark brown	1.44	0.97	15	17	10	0	15
4	Dark brown	1.41	0.95	13	25	10	0	13
5	Dark brown	1,42	0.99	16	15	12	0	16
6	Dark brown	1,45	0.99	10	19	7	0	10
7	Dark brown	1.42	0.93	11	17	7	0	11
8	Dark brown	1.44	0.94	13	22	8	0	13
9	Dark brown	1.47	0.99	9	19	6	0	9
10	Dark brown	1.46	0.97	15	21	10	0	15
Amount		11.46	8.67	125	183	82	0	125
Average		1.4325	0.96	12.5	18.3	8.2	0	12.5
Standard deviation		0.01	0.01	0.76	1.16	0.68	0	0.76

Figure 6. Pictures of banana leaves before and after being attacked by BBTV (A) leaves that were still healthy, (B), Symptoms of disease caused by BBTV

Table 7. BBTV disease attack table

Treatment	Mean Incubation Period of Pentakit BBTV Group (Days)
P1	3.24 ± 0.62
P2	3.13 ± 0.49
P3	3.24 ± 0.38
P4	3.47 ± 0.48
F count	0.55
F table	3.49
BNJ 5%	tn

Figure 7. Pictures of banana plants affected by stunt disease (BBTV)

Table 8. Table of BBTV disease attack averages in banana plants

Treatment	Average BBTV Disease Attack on Plants
P1	66 ± 10.54
P2	59 ± 6.66
P3	59 ± 6.66
P4	59 ± 6.66
F count	0.54
F table	3.49
BNJ 5%	tn

DISCUSSION

The tick of *P. nigronervosa* in instar four was transferred to the rat taro plant. The *P. nigronervosa* ticks multiplied or reproduced in less than 24 hours, which adapted well to the rat taro. It was supported an the adequate temperature and environment. All of the tests performed on each instar showed that at each stage of the four instars the color and size of these banana aphid nymphs changed. When entering the first instar, it was brownish-white color with a length of 0.61 to 0.69 mm, in the 2nd instar it, was light brown with a length of 0.71 to 0.83 mm, then in the 3rd instar the banana aphid was reddish brown with an average length of 0.87 mm, and in the last instar the banana aphid was blackish brown with an average body length of 1.31 mm in accordance with the results of the study. In the imago stadia the color of this banana aphid was still blackish brown and in this phase usually the tick had wings but in the treatment in the rat taro the imago had no wings and the average body length was 1.43 mm. This *P. nigronervosa* tick could multiply very well in the Araceae family, one of which is the rat taro. In his research this *P. nigronervosa* tick can reproduce in just 12 hours after being infested.

The banana aphid *P. nigronervosa*, like the majority of other aphid species, lacks an egg-laying stage. Alternatively, you could say that the aphids *P. nigronervosa* are totally parthenogenetic, or without mating, in which case all the chicks produced are female. In contrast to banana and other araceae plants, however, rat taro received less seedlings from *P. nigronervosa* (Pinili et al., 2013). It is possible that the morphology of the different plants can affect the population of the banana aphid, such as taro mice. Because rat taro is a

small plant and this can cause sinensis to occur faster so that the aphids will quickly lose their source of water and nutrients. *P. nigronervosa* usually resides in the sheaths of plants such as bananas and rat taro (Rahmah et al., 2021). Banana aphid populations can also be influenced by two factors, namely abiotic and biotic. What is meant by abiotic factors are temperature and humidity. The optimum temperature for the development and propagation of *P. nigronervosa* ranges from 15 to 25 degrees Celsius with 80% humidity. At the time of the study, the temperature and humidity in the insectarium ranged from 23 to 20°C with an RH of 50 to 88%. Meanwhile, biotic factors consist of food nutrition sources and natural enemies (Tricahyati et al., 2022b). Unsuitable for the banana aphid as a source of food or nourishment In contrast to the rat taro, which has adequate surface water content in the plants, *P. nigronervosa* has low or no water content in the plants, a too-hard surface, and an unappealing material shape. This banana aphids really like the material even though it is hard.

Inoculation on banana plants was carried out in the afternoon so that the surrounding temperature was not too hot, when inoculation of the *P. nigronervosa* bug was carried out on healthy bananas, it was found that the fastest time for symptoms to appear was 15 days after inoculation where P1 showed the most symptoms. Symptoms appear starting with the presence of wrinkles on the leaves which are then conical upwards and break easily after that followed by the color of the leaves turning yellow according to the results of the study. When the attack symptoms are severe, the banana plants will become stunted. Most of the bananas attacked by BBTV are difficult to bear fruit on and some don't even bear fruit. In the 4 treatments, there were 23 bananas with no symptoms and 37 bananas with symptoms. Of the 23 bananas that were asymptomatic, 5 bananas were from P1, 6 bananas were from P2, 6 bananas were from P3 and 6 bananas were from P4. And the results in this study were not significantly different (tn) where rat taro used as a passing plant could not inhibit the spread of the BBTV virus. This can be caused by environmental factors such as weather, temperature and humidity, the presence of natural enemies and others. However, this plant can be an alternative host for the disease vector, namely *P. nigronervosa*. However, it is suggested that rat taro should not be around bananas to minimize the spread and population of *P. nigronervosa* and BBTV disease.

At the time of application to healthy banana plants it has entered the rainy season so the bananas are covered with clear plastic to protect the fleas that have been inoculated from rainwater in the afternoon if there is no rain the plastic will be opened, after 5 to 6 days the plastic is released. P1 symptoms appear the fastest on day 15 and the longest on day 17 while P2 on days 14 to 18, in P3 the symptoms appear the fastest on day 14 to 19 and in P4 symptoms appear the fastest on days 14 to 21. Judging from these results, P1 issued the fastest symptoms, in which P1 aphids from diseased bananas were immediately transferred to healthy bananas, while P2 (24 hours), P3 (48 hours) and P4 (72 hours) were passed first to the passing plant, namely rat taro.

CONCLUSION

In conclusion, *P. nigronervosa* can thrive and proliferate in rat taro plants, however it does so less successfully than when banana plants serve as its primary host. The imago of the *P. nigronervosa* tick did not have wings, according to the results of the biology test. In other words, *P. nigronervosa* did not reach a dense population in rat taro plants due to a lack of nutrients. Field experiments' findings indicated that while the rat taro plants couldn't stop the development of the BBTV disease, they might serve as a different host for *P. nigronervosa* ticks. Therefore, it is advised not to plant or place this rat taro

plant near the banana plant; this is done to lower the population.

REFERENCES

Bagariang W, Hidayat P, Hidayat SH. 2019. Morphometric analysis and host range of the genus pentalonia coquerel (*Hemiptera: Aphididae*) Infesting Banana in Java. *Jurnal Perlindungan Tanaman Indonesia*. 23 (2): 171-178. DOI: 10.22146/jpti.38220.

Basak G, Banerjee A, Bandyopadhyay B. 2015. Studies on Some Bio-Ecological Aspects and Varietal Preference of Banana Aphid, Pentalonia Nigronervosa Coquerel (*Hemiptera: Aphididae*). *Journal Crop and Weed*. 11 (2): 181–186.

CHABI, Modeste, Anicet GD, Hubert AS, Bonaventure OAO. 2022. Variation in symptom development and infectivity of the banana bunchy top disease on four varieties of *Musa* Sp. 1–23.

Chakraborty S, Mritunjoy B, Snigdha S, Moupiya R, Jayanta T. 2021. Effect of Banana Bunchy Top Virus on the Heat Shock Protein Genes of Pentalonia Nigronervosa during Temperature Susceptibility and Its Effect on Virus Transmission. *Agronomy*. 11 (9): 1-14. DOI: 10.3390/agronomy11091866.

Damasco, Olivia P, Fe M Del Cueva, Jonathan CD, Ryan RPT. 2020. Gamma Radiation and In Vitro Induced Banana Bunchy Top Virus (BBTV) Resistant Mutant Lines of Banana Cv 'Lakatan' (*Musa* Sp., AA). *Philippine Journal of Science*. 149 (Special Issue 1):159–173. DOI: 10.56899/149.s1.19.

Efendi RA, Suparman SHK, Hamidson H. 2022. Biology of Pentalonia Nigronervosa Coquerel on Various Zingiberaceous Crops. *BIOVALENTIA: Biological Research Journal*. 8 (2): 118–129. DOI: 10.24233/biov.8.2.2022.308.

Erawan, Suharmana T, Hidayat RA, Iskandar J. 2019. Etnobotanical Study on Banana in Karangwangi Village, Cianjur District, West Java. *Jurnal Biodjati*. 4 (1): 112–25. DOI: 10.15575/biodjati.v4i1.2954.

Halbert, Susan E, Carlye AB. 2015. Banana Bunchy Top Virus and Its Vector Pentalonia Nigronervosa (*Hemiptera : Aphididae*) 1. *Pathology Circular*. 417 (417).

Poorani J, Mohanasundaram A, Thanigairaj R. 2022. Natural Enemies of Pentalonia Nigronervosa Coquerel, a Vector of Bunchy Top of Banana and Biology of Its Most Effective Predator Scymnus Nubilus Mulsant. *Indian Journal of Entomology*. 1–4. DOI: 10.55446/ije.2021.377.

Jebakumar, Manohar R, Balasubramanian V, Selvarajan V. 2018. Virus Titre Determines the Efficiency of Pentalonia Nigronervosa (*Aphididae: Hemiptera*) to Transmit Banana Bunchy Top Virus. *VirusDisease*. 29 (4): 499–505. DOI: 10.13057/biodiv/d220321.

Jekayinoluwa, Temitope, Tripathi L, Tripathi JN, Ntui VO, Obiero G, Muge E, Dale J. 2020. RNAi Technology for Management of Banana Bunchy Top Disease. *Food and Energy Security*. 9 (4): 1–15. DOI: 10.1002/fes3.247.

Latifah, Hidayat SH, Mutaqin KH, Widodo, Sutanto A. 2021. Survey of Banana Bunchy Top Virus on Non-Cultivated Bananas in West Java. *IOP Conference Series: Earth and Environmental Science*. 694 (1).

Leunufna, Semuel, Woltering E, Hogeveen-vEE, Van dWJ. 2019. Inventory on Banana (*Musa* Spp.) as Trading Commodities in Maluku Islands, Indonesia. *African Journal of Agricultural Research*. 14 (33): 1693–1712. DOI: 10.5897/ajar2018.13541.

Mathers, Thomas C, Mugford ST, Hogenhout SA, Tripathi L. 2020. Genome Sequence of the Banana Aphid, Pentalonia Nigronervosa Coquerel (*Hemiptera: Aphididae*) and Its Symbionts. *G3: Genes, Genomes, Genetics*. 10 (12): 4315–4321. DOI: 10.1534/g3.120.401358.

Pinili, Marita SP, Agashima IN, Izon TOD, Atsuaki KTN. 2013. Cross-transmission and new alternate hosts of banana bunchy top virus. *Tropical Agriculture and Development*. 57 (1): 1–7. DOI: 10.1002/fes3.247.

Qazi J. 2016. Banana Bunchy Top Virus and the Bunchy Top Disease. *Journal of General Plant Pathology*. 82 (1): 2–11. DOI: 10.1007/s10327-015-0642-7.

Rahayuniati, Feti R, Hartono S, Somowiyarjo S, Subandiyah S, Thomas JE. 2021a. Characterization of banana bunchy top virus on Sumatra (Indonesia) Wild Banana. *Biodiversitas*. 22 (3): 1243–1249. DOI: 10.13057/biodiv/d220321.

Rahayuniati, Feti R, Subandiyah S, Hartono S, Somowiyarjo S, Kurniawan REK, Prakoso AB, Crew K, Vance ME, Ray JD, Thomas JE. 2021b. Recent distribution and diversity analysis on banana bunchy top virus of banana and alternative host in Indonesia. *Tropical Plant Pathology*. 46 (5): 506–517. DOI: 10.1007/s40858-021-00443-3.

Rahmah S, Maryana N, Hidayat P. 2021. Host preference of pentalonia nigronervosa coquerel and P. Caladii van Der Goot (*Hemiptera: Aphididae*) on Various Host Plants. *IOP Conference Series: Earth and Environmental Science*. 694 (1). DOI: 10.1088/1755-1315/694/1/012050.

Tricahyati T, Suparman S, Irsan C. 2022a. Natural enemies of pentalonia nigronervosa, vector of banana bunchy top virus. *Biodiversitas*. 23 (7): 3675–3684. DOI: 10.13057/biodiv/d230745.

Tricahyati T, Suparman S, Irsan C. 2022b. Effect of mortality of banana bunchy top virus inoculum sources on its transmission efficiency. *Sainmatika: Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam*. 19 (1): 55. DOI: 10.31851/sainmatika.v19i1.7977.

Watanabe S, Bressan A. 2013b. Tropism, compartmentalization and retention of banana bunchy top virus (*Nanoviridae*) in the Aphid Vector Pentalonia Nigronervosa. *Journal of General Virology*. 94 (PART11): 209–219. DOI: 10.1099/vir.0.047308-0.

Watanabe, Shizu, Greenwell AM, Bressan A. 2013a. Localization, concentration, and transmission efficiency of banana bunchy top virus in four asexual lineages of pentalonia aphids. *Viruses*. 5 (2): 758–776. DOI: 10.3390/v5020758.

Biology of Pentalonia nigronervosa and Its Efficiency as a Vector of Banana Bunchy Top Virus After Being Bred in Rat Taro (Typhonium flagelliforme)

ORIGINALITY REPORT

3%	%	3%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Muhammad Riyan Hidayah, Susilawati Susilawati, Suwandi Suwandi, Benyamin Lakitan. "EFFECT OF POPULATION DENSITY AND WATER SUBSTRATE INTERFACE OF GROWTH AND YIELD RED LETTUCE", BIOVALENTIA: Biological Research Journal, 2023 Publication	1%
2	Rizki Anwar Efendi, Suparman SHK, Harman Hamidson. "BIOLOGY OF Pentalonia nigronervosa COQUEREL ON VARIOUS ZINGIBERACEOUS CROPS", BIOVALENTIA: Biological Research Journal, 2022 Publication	1%
3	Christopher Alphonce Mduda, Juma Mahmud Hussein, Masoud Hadi Muruke. "Discrimination of Tanzanian stingless bee species (Hymenoptera, Apidae, Meliponini) based on nest characteristics", Biologia, 2023 Publication	1%

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		