PREFERENCES OF *Pentalonia caladii* van der GOOT AND ITS POTENSIAL AS A VECTOR FOR BANANA BUNCHY TOP VIRUS

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Abstract. Bananas (*Musa* sp.) are vital horticultural crops in Indonesia, where the Banana bunchy top virus (BBTV) poses a major threat. Previous studies have identified *Pentalonia caladii* as a potential vector for BBTV. This research examined the preferences of *P. caladii* among four banana cultivars: Kepok, Cavendish, Raja, and Tanduk, and evaluated its transmission potential as a BBTV vector on Raja and Kepok cultivars. A Completely Randomized Block Design (CRBD) was used for the experiments, and the data were analyzed with ANOVA and LSD tests at a 5% significance level. The findings showed that *P. caladii* preferred the Tanduk cultivar most, followed by Raja, Kepok, and Cavendish. Additionally, *P. caladii* exhibited a mild capacity to transmit BBTV with an incubation period of about 19.6 days on cv. Raja and 29.6 days on cv. Kepok, with the average of disease incidence 33.3-40%. These findings suggest that *P. caladii* could reproduce well on banana and serve as a vector for BBTV.

Keywords: banana, BBTV, *Pentalonia caladii*

A. Introduction

Banana cultivation faces several challenges, particularly from pests and diseases that impact the quality and yield of bananas. A significant threat is the banana bunchy top disease (BBTD), caused by the banana bunchy top virus (BBTV). Infected bananas exhibit symptoms such as chlorotic, narrow leaves and dwarfism (1). BBTV can infect banana plants during both vegetative and generative phases. In the vegetative phase, it prevents fruit production, while in the generative phase, it renders the fruit unsuitable for harvest (2). Banana dwarf disease is particularly destructive, often leading to yield losses of up to 100% (3). The primary vector for BBTV is the banana aphid Pentalonia nigronervosa, which can also survive on alternate hosts like caladium, ginger, and curcuma (4).

P. caladii, known as the "taro aphid," shares similarities with *P. nigronervosa* but has different host plants, primarily within the Araceae family, such as Colocasia and Xanthosoma (5). Although *P. caladii* can transmit BBTV under certain conditions, it is less effective than *P. nigronervosa*. Its wide host range necessitates understanding its potential as a BBTV vector to inform control strategies for banana dwarf disease (6).

Pentalonia can harbour the virus for 15-20 days, during which it can infect healthy plants. While the virus does not replicate within the aphid and is not passed to offspring, both the virus and the aphid coexist on host plants, adversely affecting them and neighbouring plants (7–9).

Surveys in South Sumatra revealed banana dwarf disease across various banana varieties, with incidence rates varying by location (4). The spread of the disease indicates active or passive vector involvement. Instances of BBTV symptoms were noted on banana plants without

P. caladii, while *P. caladii* was found on symptomless plants. This suggests that *P. caladii* may have differing preferences for banana genotypes (10). Research indicates that mites favor plants with mixed A and B genomes over those with only A or B genomes, prompting the need for preference tests on various banana plants (11).

Given these insights, understanding *P. caladii's* preferences and its role as a BBTV vector is crucial for developing effective disease management strategies to mitigate the spread of BBTV and its associated economic losses.

B. Methods

There were two experiments in this research.

1. Preferences Test

Four banana cultivars i.e. Kepok, Cavendish, Raja, and Tanduk, were tested with *P. caladii* collected from taro plants and raised in a screen house until the population was adequate. The banana cultivars were arranged in a circular formation within a cage, with one healthy banana infested with 80 *P. caladii* placed in the center. The aphids were allowed to move to the other bananas, and observations on natality, mortality, and habitat were conducted every three days over 30 days.

2. BBTV Transmission Test

Two banana cultivars favored by the aphids were selected for the transmission test. *P. caladii* were allowed to feed on a BBTV-infected banana for 48 hours. After this, ten viruliferous aphids were transferred to a healthy banana for virus transmission. Following a 48-hour acquisition period, the aphids were treated with 0.4 mL/L lambda-cyhalothrin. Parameters observed included the incubation period for bunchy top disease and disease incidence (DI), which was calculated as per method (12).

$$DI = \frac{\text{number of plant with bunchy top symptoms}}{\text{total number of test plants}} \text{ x } 100\%$$

C. Results And Discussion

1. Preference Test

a. Natality

The preference of P. caladii for the banana cultivars tested can be seen from the natality or presence of aphids on each cultivar as listed in Table 1. The results of the statistical analysis in Table 1 show that all banana cultivars infested with P. caladii show significant differences. This can be seen that all P. caladii actively move to all banana cultivars. The largest number of P. caladii was found in treatment P4 (banana cultivar tanduk), then P3 (banana cultivar raja), P1 (banana cultivar kepok), and the least in treatment P2 (banana cultivar cavendish).

The results of the study are in accordance with research from (10), which states that, in general, aphids prefer plants with triploid and tetraploid genotypes that combine the A and B genomes (AAB, AAAB) compared to genotypes that only combine the A genome (AA or AAA) or only B (BB and BBB). The banana cultivars used in this study were the kepok cultivar (ABB), the banana cultivar raja (AAB), tanduk (AAB), and cavendish (AAA). This causes the cavendish banana cultivar to be the cultivar least preferred by P. caladii.

Table 1. Natality of P. caladii on banana plants

Treatment	Natality (individual)		
	Day 3	Day 15	Day 30
P1	1.33 c	8 b	17 b
P2	0.33 c	3.7 c	3.5 c
P3	3.7 a	12.5 a	26 a
P4	2.5 b	13.33 a	26.83 a

Notes: P1 = Kepok, P2 = Cavendish, P3 = Raja, P4 = Tanduk.

Numbers followed by different letters in the same column indicate a significant difference in LSD at the 5% level.

The movement of *P. caladii* indicates that aphids actively relocate from less preferred plants to more suitable hosts. Adult P. caladii utilize their wings to move between plants and can also be assisted by ant colonies (13).

b. Mortality

P. caladii mortality was assessed by counting the deceased individuals. According to the study results in Table 2, there was no significant difference observed, as *P. caladii* can rapidly live and reproduce on banana plants. The longevity of *P. caladii* highlights the aphids' ability to thrive on various plants.

Table 2. Mortality

Perlakuan	Mortality (individual)		
	Day 3	Day 15	Day 30
P1	0 a	1.17 a	3.3 a
P2	0.17 a	0.83 a	3,3 a
P3	0 a	0.7 a	3.17 a
P4	0 a	0.5 a	3.5 a

Notes: P1 = Kepok, P2 = Cavendish, P3 = Raja, P4 = Tanduk.

Numbers not followed by different letters in the same column indicate a not significant difference in LSD at the 5% level.

Research indicates that mortality rates of *P. caladii* on banana plants are very low, allowing for continued population growth across all banana cultivars. This low mortality enables *P. caladii* to survive on these plants for up to 30 days, demonstrating its compatibility with all cultivars, where natality exceeds mortality (11).

The low mortality rates may result from banana plants infested with *P. caladii* being housed in cages covered with organza cloth in a screen house, protecting them from rain and fungal infections that could increase mortality. The high humidity contributes to elevated mortality due to the growth of the entomopathogenic fungus *Verticillium intertextum*. Additionally, in the absence of biotic factors like predators, mortality in *P. caladii* is primarily influenced by abiotic factors such as rainfall (14,15).

c. Habitat

The study on the habitat of *P. caladii* across various banana cultivars revealed notable differences (Figure 1). *P. caladii* primarily inhabited the stem and leaf sheath. Specifically, in Kepok, Cavendish, and Raja cultivars, *P. caladii* was predominantly found on the leaf sheath, while in the Tanduk cultivar, it was mainly located on the stem (Fig. 1).

This preference for the leaf sheath aligns with (11) findings, which indicate that *P. caladii* favors sheltered areas behind banana leaf sheaths and at the lower sections of host plants. The soft texture of the leaf stalk allows *P. caladii* to easily insert its stylet to extract phloem fluid. Furthermore, the tendency to seek concealed locations helps *P. caladii* evade natural predators.

(1) noted that aphids typically thrive and reproduce in enclosed spaces, such as leaf stalks of older plants or underground parts.

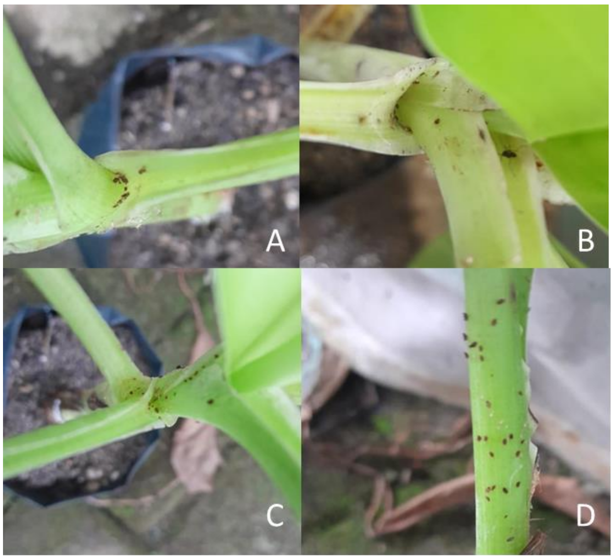

Figure 1. Habitat of *P. caladii* on banana cultivars:
A. Kepok, B. Cavendish, C. Raja, D. Tanduk

2. BBTV Transmission test

a. Incubation period

The analysis of variance indicates a significant difference in the effect of treatment on the incubation period (Table 3). This period is measured from BBTV virus infection via the P. caladii vector until the first symptoms appear, such as yellowing, pale leaves, and vein lines (12,16).

Table 3. Incubation period and symptoms of bunchy top disease

Combination of treatments	Incubation (days)	Symptoms
Control	-	Asymptomatic
Infected Raja	19.6	Yellow leaf margin, chlorotic, thick leaf bones, J-hook near mid- rib, vein clearing, reduction of lamina width
Infected Kepok	29.6	Dark green streak on lamina, limited vein clearing, no significant reduction of lamina width.

Numbers followed by different letters in the same column indicate a significant difference in LSD at the 5% level.

Table 3 demonstrated that *P. caladii* can transmit BBTV to banana cultivars, with a faster incubation period observed in Raja compared to Kepok. Variations in incubation periods were influenced by host resistance, pathogen virulence, and environmental factors, especially temperature and humidity (17).

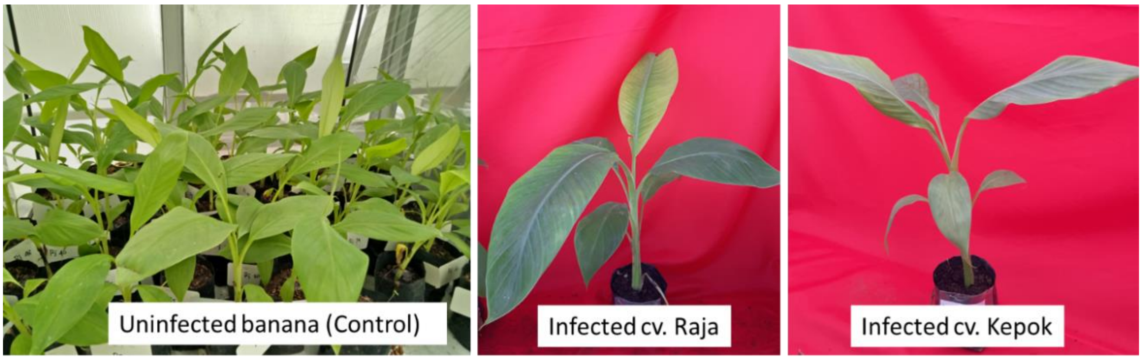

Figure 2. Differences of bunchy top disease symptoms on cv Raja and cv Kepok compared to control

b. Disease Incidence

Disease symptom incidence can be affected by various factors, including the experimental location, banana cultivar, and planting medium. (17). (12) stated that BBTV infection is influenced by the host plant's genetics, physiological changes, and environmental conditions. Furthermore, (18) said that banana cultivars with the AA/AAA genome are more susceptible to BBTV than those with the AAB/ABB genome.

Table 4. Disease incidence

Treatments	Day 15	Day 20	Day 25	Day 30
Control	0	0	0	0
Raja	0	23.33	36.67	40
Kepok	0	0	0	33.30

Symptoms of BBTV that appear due to viruses can affect the plant growth process or growth hormones, namely phytohormones. Phytohormones are directly related, so they have an impact on plant growth. Phytohormones have an important role in the growth, development, and defense against plant virus infections (Fig. 2). If phytohormones are affected by a virus infection, it will harm plant growth (19). (18,20) also said that the symptoms of dwarf disease in banana plants are caused because plants infected with viruses will experience disorders in the plant's metabolic and physiological systems. In general, plants infected by viruses will experience decreased production of growth regulators (hormones), and levels of growth-inhibitory compounds will increase. Dwarf symptoms in plants are influenced by decreased production of growth hormones produced by plants and decreased chlorophyll levels.

D. Conclusion

P. caladii prefers the horn banana cultivar most, followed by raja, kepok, and least of all, Cavendish. It can transmit the BBTV virus to the raja and kepok cultivars, albeit mildly, causing infected leaves to narrow, yellow, and show abnormal growth.

E. Acknowledgement

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