

Effect of Fermentation Extracts against *Bemisia tabaci* on Chilli Pepper (*Capsicum annuum*)

Pengaruh Pemberian Ekstrak Fermentasi terhadap Bemisia Tabaci pada Tanaman Cabai (Capsicum annuum)

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh dari pemberian ekstrak fermentasi terhadap perkembangan penyakit virus keriting kuning dan kutukebul pada tanaman cabai. Penelitian ini menggunakan rancangan acak kelompok. Setiap percobaan terdiri dari 4 perlakuan ekstrak fermentasi yaitu Air (kontrol), TSNGlu, BP4 dan BP4Glu. Hasil penularan menggunakan kutukebul pada penelitian ini menghasilkan gejala yang berupa keriting pada daun muda, warna daun relatif hijau. Gejala kuning yang umumnya ditemukan pada saat parah tidak dijumpai pada penelitian ini. gejala penyakit yang parah ditandai dengan warna kuning pada bagian atas daun dan tetap hijau pada bagian bawahnya. Cahaya yang kurang terang dilaboratorium hanya 350 lux, yang membuat gejala yang ditimbulkan ringan. Kurangnya intensitas cahaya membuat tanaman menjadi etiolasi dan tidak dapat melakukan proses fotosintesis dengan baik. Secara keseluruhan semua perlakuan tidak fermentasi dan juga LKPP penyakit tidak berpengaruh nyata terhadap perlakuan ekstrak fermentasi baik insidensi dan keparahan penyakit virus keriting kuning yang rendah. Perlakuan dengan cara penyemprotan secara tidak nyata mempengaruhi populasi kutu kebul, kecuali pada 7 hari setelah infestasi, berbanding terbalik dengan penyemprotan perlakuan dengan cara pengucuran berpengaruh secara nyata dari 14 hari setelah infestasi. Pada pertambahan tinggi tanaman perlakuan penyemprotan tidak berpengaruh nyata dan untuk perlakuan penyemprotan dengan pengucuran ekstrak fermentasi tidak berpengaruh nyata untuk luas kanopi tajuk tanaman.

Kata kunci: cabai, kutu kebul bemisia tabaci, penyemprotan dan pengucuran, virus keriting kuning

ABSTRACT

This experiment was aimed to determine the effects of application of fermentation extracts on the development of pepper yellow leaf curl and whitefly on chilli. Experiment

arranged in a completely randomized block design with four treatments (water as control, fermentations extracts named TSNGlu, BP4, and BP4Glu). The results showed symptoms in the form of curling of young leaves. The color of the leaves was relatively green. Yellow symptoms commonly found when severe were not found in the experiment. The symptoms of severe disease are marked in yellow at the top of the leaf and remain green at the bottom. The laboratory used 350 lux (underexposed light) so the symptoms become slight. Lack of light intensity made plants etiolated and could not carry out photosynthesis properly. Each experiment consisted of 4 fermentation extract treatments. Each treatment. Overall, all treatments without fermentation and also AUDPC of the disease did not significantly affect the treatment of fermented extract both the incidence and severity of the low pepper yellow leaf curl virus. The treatment by spraying did not significantly affect the population of whitefly, except at 7 days after infestation, inversely proportional to the spraying treatment by means of discharge significantly affected from 14 days after infestation. The increase in plant height spray treatment did not have a significant effect and for spraying treatment with extraction of fermentation did not significantly affect the canopy area of the plant canopy.

Keywords: chili pepper yellow leaf curl virus, whitefly, spraying and drenching

INTRODUCTION

Chilli is a very important vegetable commodity. one of the causes of low production of chili is a plant disease because it can cause a loss in both the quality and quantity of chili (Ramadhani & Purnamaningsih, 2013). The vulnerability of chili to diseases is one of the serious problems for farmers (Sari et al., 2017). Among the diseases that are vulnerable to disrupt the most dangerous chili plants and very detrimental to farmers in the last 5 years in Indonesia since 1999 and 2000 are diseases caused by a virus called the yellow curly virus. As a result of the disruption of the disease occurs loss of results is quite high (Fajarfika et al., 2015). Yellow curly virus disease is the main disease of chili plants. Field observations showed that red chili plantations which were 100 % attacked did not produce any fruit at all (Pahlawan & Wibisono, 2017). Diseases caused by the Gemini virus are not transmitted because plants intersect or are carried by seeds (Ridwan & Prastia, 2015). The incidence of yellow curly leaf disease is always found in chili plantations in Indonesia and it is a major production obstacle. The disease caused by *Pepper yellow leaf curl virus* (PYLCV) is transmitted by vector insects, namely

whitefly (*Bemisia tabaci*) (Adilah & Hidayat, 2014). Many types of symptoms are caused by gemini virus isolates, depending on the genus and species of the infected plant. Transmission by whitefly bug insects is greatly influenced by the length of time of insect acquisition in diseased plants, the number of insects, and the length of the inoculation period that occurs in these healthy plants (Singarimbun et al., 2017). whitefly transmits yellow virus persistently (permanent), which means that once the whitefly take food from plants containing the yellow curly virus, during its lifetime it can transmit the yellow curly virus (Phabiola et al., 2017). The acquisition feeding period (eating diseased plants to obtain a virus) for 48 hours can produce the most efficient transmission rate (Putri et al., 2018) and (Sharma et al., 2014). The severity of gemini virus attacks in the field is influenced by physical factors (temperature and humidity) and biotics (chilli cultivars and cropping patterns) the long dry season strongly supports the development of vector insect populations,

Another name for the disease caused by the yellow curly virus is also called jaundice, downy mildew, and dwarf disease. Yellow curly virus is a unique group of plant viruses because it has a different morphology than other types of

plant viruses. Yellow curly virus particles are isometric in shape and always in pairs (geminata). Yellow curly virus has a genome in the form of deoxyribonucleic acid (DNA) in the form of a single stranded (single stranded (ssDNA)]. Yellow curly virus is a group of plant viruses with particle morphology that is different from other plant virus groups that are commonly known (Gunaeni et al., 2015). Yellow curly virus disease infection there is yellowing around the leaf bone, then vein clearing that appears to develop a very clear yellow color, leaf bone become thick and leaf strands roll up (*cupping*) (Adilah & Hidayat, 2014). Further symptoms of this disease show young leaves into small, bright yellow leaf strands that intersect with the bright yellow and eventually the plant becomes stunted (Imron et al., 2015). To control the virus who conducted by farmers in general is only able to control its vector by pesticides, so this effort is less effective in controlling viruses and not eco-friendly (Inayati & Marwoto, 2015). One way to overcome these problems is to use antiviral or virus inhibitors derived from plants to be more effective in controlling and environmentally friendly. This antiviral can be obtained by extracting certain plants that have a virus inhibiting agent (Azis et al., 2017). One of the plants that is known to have an antiviral role is the flower leaves of Four o'clock flower (*Mirabilis jalapa*). Four o'clock flower extract is known to have the ability to induce plant resistance. Four o'clock flower extract contains antiviral protein that can be used as an alternative to controlling viruses (Supyani et al., 2017). The aimed of this study was to test the fermentation extract to see the development of *bemisia tabaci* which was given a fermentation extract in the laboratory.

MATERIALS AND METHODS

Study Area

The study was conducted at the Phytopathology Laboratory, Faculty of Agriculture, Sriwijaya University,

Indralaya. The study was conducted in August until December 2018. The preparation of this research was from July to August 2018 with a laboratory temperature of 25–27 °C. Sampling of whitefly (*Bemisia tabaci*) at the chili field, lowland, Tanjung seteko, Ogan ilir.

Test Plant Preparation

Chilli plants used were derived from chili seeds that free from CMV disease were Lado F1 varieties. And then chilli seeds were sowed in the tray. After the chilli seeds were 1 month old, the seeds were transferred into a plastic pot that contains a mixture of soil and organic fertilizer at a ratio of 10: 1. Place the plastic pot in a tray filled with water and lid it with a 1.5 L mineral water bottle covered with gauze at the end of the bottle. After 4 weeks of age, before the chilli plants were bred in a laboratory room the plants were sprayed with an insecticide (matador) to avoid carrier pests when seedling in the field, chilli plants were bred in the laboratory room and assisted with hydroponic lamps and fluorescent lamps. Fluorescent lights consist of 96 LEDs and each one consists of 6500 K white variations. Fluorescent lights consist of several combinations, namely 22 red LEDs + 12 blue LEDs + 2 white LEDs + 2 IR LEDs + 2 UV LEDs. The red spectrum (630-660 nm) works to increase plant growth, germination, flowers and fruit. The blue spectrum (430–460 nm) increases plant growth and increases plant photosynthesis. The UV spectrum (380 nm) works to stimulate plant growth, increase protein, sugar, synthetic acids, prevent overgrowth, and sterilize disinfection. White spectrum of 6500 K. The intensity of light in the chili canopy of 350 lux, was assessed using the application "Light meter". Temperature during the study was 25–27 °C while humidity during the study was 61%.

Test Insect Preparation

Yellow Curly Virus transmission was carried out by using vector insects namely

whitefly (*Bemisia tabaci*). Whitefly was taken from chilli plants that have been infected with the yellow curly virus in the field. Then whitefly bred in the laboratory for 1 month, so they could adapt to the laboratory condition. The process of moving the whitefly was done by bringing the diseased plants closer to healthy plants, with the aim that the whitefly could move on their own to healthy plants. Every one plant infested with 2 whitefly. So that for 40 plants need 80 whitefly.

Fermented Extract

The fermentation extract used in this study was:

1. TSNGlu: Terasi (5%) + EKKU (95%)
2. BP4: Four o'clock flower (10%) + EKKU (90%)
3. BP4Glu: Four o'clock flower (10%) + EKKU (85%) + MSG (5%)

The amino acid content of fermented extracts (Table 1). The application of fermentation extract was done in two ways, were spraying and drenching into the ground. The formulation was made from

0.5% of fermented extract and 99.5 % of water. For applications with spraying, 3 times the pull of the sprayer was carried out (± 2 ml) while for applications with drenching into the ground as much as 20 ml. Application was done once a week.

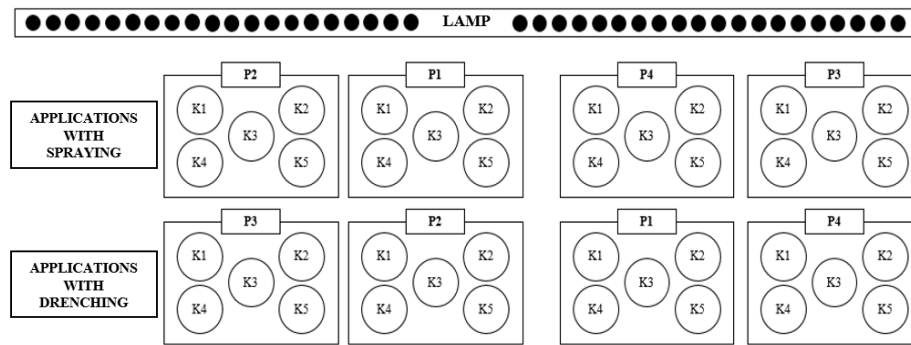
Fermentation Extract Application

The application of this study was divided into 2 experiments, were application by spraying and by drenching it to the ground (Figure 1). As for the details as follows:

1. Application by spraying
 - 4 Treatment of TSNGlu (Terasi 5% + EKKU 95%), BP4 (Four o'clock flower 10% + EKKU 90%), BP4Glu (Four o'clock flower 10% + EKKU 85% + MSG 5%) and Water (control) respectively each repeated 5 replications.
2. Application to the drenching
 - 4 Treatment of TSNGlu (Terasi 5% + EKKU 95%), BP4 (Four o'clock flower 10% + EKKU 90%), BP4Glu (Four o'clock flower 10% + EKKU 85% + MSG 5%) and Water (control) respectively each repeated 5 replications.

Table 1. Content of 15 amino acids (mg/L) in the fermentation extract formulati

Amino Acid	TSNGlu	PB4	PB4Glu
Serin	131	9488	830
Glutamic Acid	26189	667	2173
Phenylalanine	296	1275	799
Isoleucine	259	896	897
Valine	390	1511	1015
Alanin	511	1896	1102
Arginine	186	1344	1234
Glycine	482	4886	1420
Lysine	543	1840	1936
Aspartic Acid	705	717	1419
Leucine	484	1248	1548
Tyrosine	133	1558	549
Proline	312	1106	857
Threonin	324	2939	878
Histidine	4	3446	793
Total	30949	34817	17450



Note :

P = Treatment
K = Group

P1 = Control
P3 = BP4

P2 = TSNGlu
P4 = BP4Glu

Figure 1. Application by spraying and application by drenching it to the ground

Data Analysis

Each experiment used a Randomized Block Design. Each experiment consisted of 4 treatments and each treatment was repeated as many as 5 replications so that the total number of test plants totaled 40 plants.

RESULTS

Symptoms of the Disease

In the first week observations, there were no visible symptoms, and the wages were seen as early symptoms (Figure 2). Later symptoms would then develop to yellow, the bone of leaves become thick, and the leaves curl upwards.

Disease Incidence

Most of the leaves of the test plants in the spraying treatment have shown symptoms of disease since the beginning of the test. The incidence of yellow curly virus disease tends to remain low both spraying treatment (Figure 3) and drenching treatment (Figure 4) fermentation extract until 35 days after whitefly infestation (Figure 5).

AUDPC (Area under the Disease Progress Curve)

The development of a disease that was calculated as AUDPC was not significantly affected by spraying or drenching of fermented extract. The AUDPC

observations show that the percentage of disease curve area relatively low and constant over time or does not develop from 4 treatments are Water, TSNGlu, BP4, BP4Glu (Table 2).

Population Whitefly

The treatment by spraying does not significantly affect the population of whitefly, except at 7 days after infestation (Table 3) where the TSNGlu treatment (Terasi 5 % + EKKU 95 %) causes a larger population. In contrast to spraying, treatment by drenching significantly affected 14 days after infestation (Table 4). The population of whitefly in TSNGlu treatment (Terasi 5 % + EKKU 95 %) and BP4Glu (four o'clock interest 10 % + EKKU 85 % + MSG 5%) were not significantly different between treatment and control.

Height Increase

Based on the results of variance could be seen the growth of test plants by spraying and drenching treatment. The spray application was not significantly different and the drenching application was significantly different (Table 5).

Canopy Area

The results of analysis of canopy area variability in the treatment of spraying or drenching were not significantly different (Table 6).



Figure 2: A. Test plants colonized by the vector (*B. tabaci*) insects. B. Symptoms of an attack from the whitefly (*B. tabaci*)

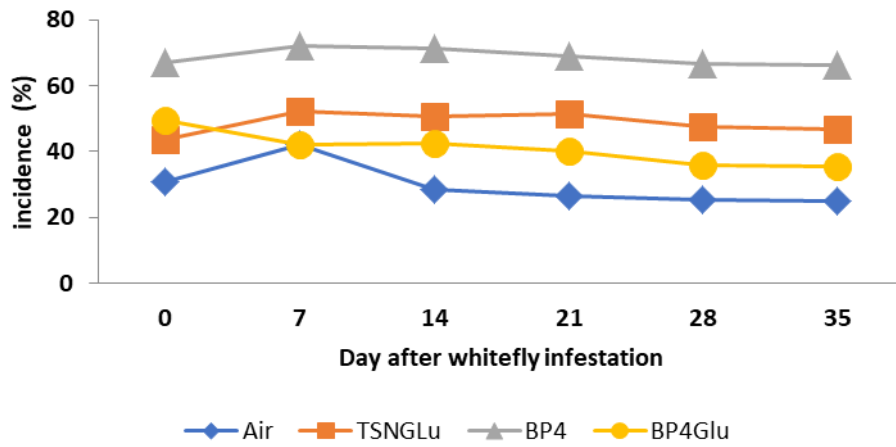


Figure 3. Incidence of yellow curly virus disease in chilli plants treated with fermentation extract spraying

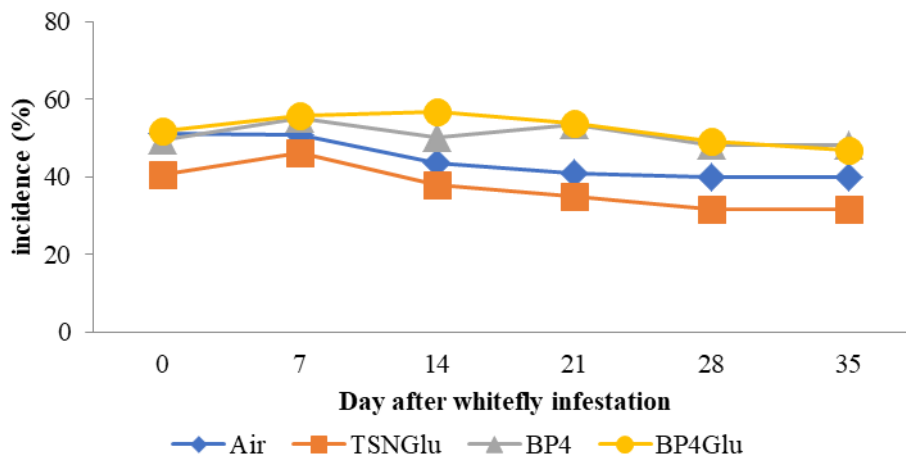


Figure 4. Incidence of yellow curly virus disease in chilli plants caused by the whitefly vector (*Bemisia tabaci*) treated with fermentation extracts

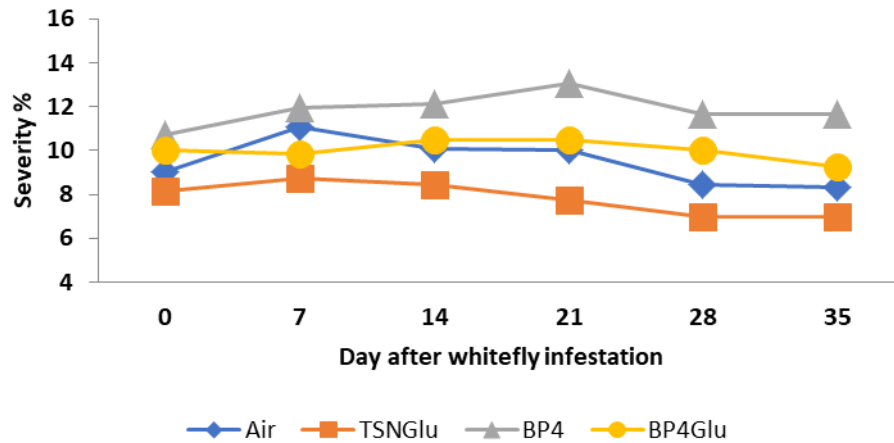


Figure 5. Severity of yellow curly virus disease in chilli plants treated with fermentation extracts

Table 2. (Area under the Disease Progress Curve) the severity of the yellow curly virus which was applied to the fermented extract

Treatment	Applications Methods	
	Spraying	Drenching
Water (control)	52.7 ± 12.8	67.7 ± 14
TSNGLU	84.7 ± 17.4	55.2 ± 18
BP4	94.4 ± 14.6	84 ± 9.8
BP4Glu	53.6 ± 02.1	70.5 ± 8.8
F.Count	2.40 ^{ns}	0.73 ^{ns}
F.Table	3.49	3.49

Note: ^{ns}) non significant

Table 3. Population of whitefly vector insects (*Bemisia tabaci*) in each spraying treatment

Treatment	Days After Whitefly Infestation				
	7	14	21	28	35
Water (control)	3.2 ± 1.2 ^{ab}	6.6 ± 4.6	8.0 ± 5.5	10.2 ± 6.7	13.2 ± 7.8
TSNGLU	4.6 ± 1,6 ^b	2.8 ± 0.5	7.2 ± 3.5	10.4 ± 4.6	13.4 ± 5.8
BP4	2.0 ± 0.0 ^a	2.0 ± 0.0	2.6 ± 0.7	4.8 ± 1.5	7.8 ± 2.6
BP4Glu	2.0 ± 0.0 ^a	2.0 ± 0.0	2.8 ± 0.8	4.6 ± 1.2	6.8 ± 2.0
F.count	4,44 [*]	0.88 ^{ns}	0.64 ^{ns}	0.51 ^{ns}	0.40 ^{ns}
F.Table	3.49	3.49	3.49	3.49	3.49
BNJ 5 %					

Note: ^{*}) significant, ^{ns}) non significant

Table 4. Population of whitefly vector insects (*Bemisia tabaci*) at each drenching treatment

Treatment	Days After Whitefly Infestation				
	7	14	21	28	35
Water (control)	2.8 ± 0.8	4.0 ± 2.0 ^a	6.0 ± 3.1 ^a	8.6 ± 4.5 ^a	11.4 ± 6.2 ^a
TSNGLU	2.4 ± 0.4	2.8 ± 0.8 ^a	3.6 ± 1.6 ^a	4.6 ± 2.6 ^a	6.6 ± 4.6 ^a
BP4	4.0 ± 0.4	10.2 ± 1.2 ^b	21.0 ± 1.6 ^b	27.8 ± 0.8 ^b	34.6 ± 1.2 ^b
BP4Glu	2.0 ± 0.0	2.0 ± 0.0 ^a	3.2 ± 0.5 ^a	6.0 ± 1.6 ^a	10.0 ± 3.4 ^a
F.count	2.52 ^{ns}	7.14 [*]	15.32 [*]	15.32 [*]	09.7 [*]
F.Table	3.49	3.49	3.49	3.49	3.49
BNJ 5 %					

Note: ^{*}) significant, ^{ns}) non significant

Table 5. Increased height of the methods of spraying and drenching

Treatment	Applications Methods	
	Spraying	Drenching
Water (control)	7.4 ± 1.1	5.0 ± 1.3 ^b
TSNGLU	4.6 ± 0.6	8.0 ± 0.7 ^c
BP4	3.8 ± 0.5	2.4 ± 0.6 ^a
BP4Glu	4.8 ± 0.9	4.2 ± 0.6 ^b
F.Count	3.06 ^{ns}	7.16 [*]
F.Table	3.49	3.49

Note: *) significant, ^{ns}) non significant

Table 6. Extensive chili canopy that is applied to the fermentation extract

Treatment	Applications Methods	
	Spraying	Drenching
Water (control)	137.4 ± 59.0	85.9 ± 25.0
TSNGLU	71.9 ± 31.4	129.1 ± 65.5
BP4	38.6 ± 7.8	52.6 ± 8.7
BP4Glu	78.0 ± 20.7	87.5 ± 27.4
F.Count	1.71 ^{ns}	0.86 ^{ns}
F.Table	3.49	3.49

Note: ^{ns}) non significant

DISCUSSION

The incidence or severity of the disease in spraying test plants has been symptomatic since the beginning of the test and tends to be low from the time of initial infestation until the 35th day after whitefly infestation. Thus, in the drenching treatment which also remained low. whitefly infested in this study was obtained from diseased plants. whitefly is a yellow curly virus vector that is persistent so that the whitefly also used is an infective whitefly. In this study, the whitefly infested successfully reproduced. This is indicated by the increasing population in water treatment. Based on the above, disease is not caused by the absence of viruses and ineffective vector insects. This research resulted in curling symptoms in young leaves. The color of the leaves is relatively green. Yellow symptoms that are commonly found when severe are not found in this study. According to Sumardiyono et al. (2003), symptoms of severe disease are marked in yellow at the top of the leaf and remain green at the bottom. It is suspected that the occurrence of mild symptoms due to light in the laboratory is not bright enough, which is only 350 lux. Low light intensity causes plants to not be able to

carry out the process of photosynthesis properly and become etiolation, etiolation is faster plant growth but becomes thinner and does not improve leaf development according to leaf area evolution (Setiasih et al., 2016) (Park JE et al., 2021). environmental factors greatly influence the occurrence of a plant disease, the occurrence of this disease is known as the triangel disease (Akhsan & Palupi, 2015).

The area of the disease development curve in this study was not significantly affected by spraying treatment and drenching of fermentation extracts treatment. In this research, the treatment of fermented extract material which is expected to work as a suppressor of the development of yellow curly virus disease and whitefly on chili plants and its expected to improve plant physiology so that it can withstand disease attacks. Fermentation liquid organic matter containing amino acids can actively increase plant growth (Popko et al., 2018). Evidently in this study no response was seen to increase the resistance of test plants to the yellow curly virus. This fermentation extracted material has not been able to work optimally which is allegedly due to the low light intensity. Nonetheless, the potential of the active compound, the amino acid contained in the

fermentation extract in suppressing the yellow curly virus disease, can be explained by the persistence of severity even though the population of whitefly increases in the treatment of BP4 (four o'clock flowers 10% + EKKU 90%).

The increase in plant height during the 35 days of the experiment was not significantly different between the treatments of spraying the fermentation extract, but it was significantly different between the treatments of the drenching of the fermentation extract. It was suspected that the amino acids contained in the fermented extract can be absorbed in an optimum amount by the drenching treatment because it was first absorbed by soil particles and then absorbed by the roots. Unlike the case with direct application of spraying on the leaves which was thought to cause a dose of amino acids that are absorbed in amounts that further inhibit growth. Excessive amino acids can cause growth inhibition.

In the population of whitefly after infestation in the test plants the observation of spraying treatment on day 14 water treatment increased compared to other treatments, but the TSNGlu treatment (Terasi 5% + EKKU 95%) decreased. However, the TSNGlu treatment (Terasi 5% + EKKU 95%) experienced an increase so that it was the same as the water treatment on the 21st day observation. On the BP4 treatment (Flowers at four 10% + EKKU 90%) and BP4Glu treatments (Flowers at four 10% + EKKU 85% + MSG 5%) the lowest vector insect population compared to water treatment and TSNGlu treatment (Terasi 5% + EKKU 95%). On the drenching treatment, the whitefly population on the 14th day, there was an increase in the number of colonies and BP4 treatment (interest at four 10% + EKKU 90%) was the treatment with the highest number of population of the whitefly and the other treatments increased the number of whitefly population in a balanced and relatively equal. The low disease attack was thought to be due to the lack of light

intensity at the chili planting site at the low chili planting area which was 350 lux (light intensity from the scorching heat that was 37856 lux). Meanwhile, to develop viruses need enough light. Viruses can develop at high temperatures and humidity. When the light intensity was low, humidity and temperature are low. The virus needs a light intensity of 6458.35 lux, while this study the available light intensity of 350 lux. Therefore, plants placed in a dark place, the symptoms of the virus that arise are slightly compared to plants placed in a bright place (Bawder & Kleczkowski, 2018).

The conclusions of this study explain the incidence of yellow curly virus disease tends to remain low in both spraying and drenching treatment, this was due to the lack of light intensity in the laboratory, disease development which was calculated as AUDPC was not significantly affected by spraying treatment and drenching treatment of fermentation extract, the treatment by spraying does not significantly affect the population of whitefly, except at 7 days after infestation. Different with spraying treatment, drenching treatment has a significant effect since 14 days after infestation. and The spraying treatment does not affect the height increase, but the drenching treatment affect the increase in plant height and the canopy area is not significantly affected by the spraying treatment and drenching treatment of fermentation extract extraction.

CONCLUSION

The incidence of yellow curly virus disease tends to remain low in both spraying and drenching treatment, this is due to the lack of light intensity in the laboratory. Disease progress which is calculated as AUDPC (Area under the Disease Progress Curve) is not significantly affected by spraying treatment and drenching treatment of fermentation extract. The treatment by spraying does not significantly affect the population of the

whitefly, except at 7 days after infestation. In contrast to spraying, drenching treatment significantly affected 14 days after infestation. The spraying treatment does not affect the height increase, but the drenching treatment affects the increase in plant height and the canopy area is not significantly affected by the spraying treatment and drenching treatment of fermentation extract.

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