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The effects of several types of botanical pesticides against whitefly (Bemisia tabaci) on cayenne pepper cultivation in peatlands

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ABSTRACT

Botanical pesticides are supporting sustainable agricultural systems with a focus on the efficiency of pest control and reducing the negative effect of synthetic pesticides. Many plant species such as neem, soursop, and jatropha were found to have the potential to control pests, including whitefly (Bemisia tabaci). B. tabaci is an important pest in cayenne pepper cultivation. This study aims to find botanical pesticides effectiveness against B. tabaci on cayenne pepper growth in peatlands. This study used a one-factor randomized group design method. The factor studied was a pesticide solution (p), p0 as a control we used abamectin, and three types of botanical pesticides, p1 = soursop leaf, p2 = neem leaf, and p3 = jatropha leaf, each treatment is repeated 6 times. The results showed that the application of botanical pesticide solution influenced mortality and intensity of pest attacks. The best treatment in the study was neem leaf pesticide (p2) which caused whitefly mortality of 96.7% and reduced pest attacks intensity to 5,10%.

Keywords: Mortality, Pest Control, Suboptimal Wetland, Sustainable Agriculture

1. Introduction

Cayenne pepper is an important agricultural commodity and has a high economic value. Based on data reported by the Center for Information of Strategic Food Price (2020), the average national price of cayenne pepper in early February 2020 increased by 8.25% from IDR 44,250.00 kg-1 to IDR 47,900.00 kg-1. The existence of cayenne pepper is almost always needed by the Indonesian people in their daily lives, which has been widely cultivated in Indonesia with a harvest area of 167,600 ha spread throughout Indonesia (Statistics Indonesia, 2017). Unlike the people of Europe, America, and some countries in Asia who prefer the spiciness of pepper, Indonesians prefer the spiciness of chili (Cahyono, 2003).

Increasing the productivity of cayenne pepper is important to meet consumption needs and increase the agricultural sector's income. One of the challenges is the attack of plant pest organisms, such as Bemisia tabaci. Whiteflies (B. tabaci) can cause direct and indirect damage to plants. Direct damage as a result of its feeding activity, namely (1) closure of stomata by honeydew released by nymphs, and sooty dew that grows on the honeydew layer, such as Cladosporium spp. and Alternaria spp. (2) formation of chlorotic spots on leaves as a result of partial tissue damage due to stylet puncture, (3) formation of anthocyanin pigments, and (4) leaf fall which can inhibit plant growth (Hoddle et al., 2003).

The whitefly controlled by farmers so far used synthetic insecticides such as abamectin. The massive and prolonged use of synthetic pesticides results in impacts such as pest population explosion and

resistance. There are also non-target effects in the form of loss of natural enemies, residues in plants, water, and soil, and even poisoning in humans, and livestock.

The use of botanical pesticides in Indonesia has promising prospects because the raw materials are abundant in nature. The natural active ingredients of botanical pesticides make them easily decompose so they are relatively safe. They have a broad-spectrum insect pest even the one that has been resistant to synthetic insecticides, but still with low levels of toxicity to mammals (Wiratno et al., 2013).

The most widely used botanical pesticides in cayenne pepper plantations are from soursop leaves, neem, and jatropha. Soursop leaves contain acetogenic compounds, including asimisin, bulatacin, and squamosin. At high concentrations, acetogenic compounds have the distinction of being anti-feedant. In this case, insect pests are no longer eager to devour their preferred plant parts (Sudarmo, 2005). Neem leaves with active ingredients in the form of azadirachtin, which can interfere with the insect metamorphosis process where death occurs during molting or instar so that the time needed to kill is three days (Kardinan, 2010). According to Saenong (2016), jatropha leaves contain saponins, flavonoids, tannins, and polyphenolic compounds, while the seeds contain alkaloids, saponins, and a toxic protein called curcumin that causes decreased activity due to poisoning and death with the role of contact, stomach, and nerve toxins (Banjarnahor, 2006).

Cultivation characteristics in peatlands can affect pest activity, so it is necessary to know how effective botanical pesticides are in controlling pests. This research supports sustainable agriculture by reducing the use of synthetic pesticides. The use of botanical/ plant-based pesticides also supports the safety of plant products with minimal chemical residue. This study aims to find botanical pesticides effectiveness against B. tabaci on cayenne pepper growth in peatlands.

2. Materials and Methods

Materials

Seedlings of cayenne pepper variety “Bara”, soursop leaf, neem leaf, jatropha leaf, Abamectin, methanol, twin, surfactant, water, blender, tub/bucket, furring cloth, hand sprayer, data collection sheet, net/cover, stationery, and camera. This research was conducted on farmers' land in Landasan Ulin Utara Urban Village, Lianganggang Subdistrict, Banjarbaru City. This research was conducted for three months from March to May 2021.

This study used a one-factor Randomized Block Design (RBD). The factor studied was a botanical pesticide (P) consisting of four levels, namely a p0 = abamectin (control); p1 = soursop leaf; p2 = neem leaf; p3 = jatropha leaf, each treatment consisted of six replications, so there were 24 experimental units.

Pesticide preparation

Chopped neem, soursop, and jatropha leaves 200 g each, then dried in the sun for ± 3 days. 100 g dry material mixed with 500 mL of methanol and stored in a container for 3 nights, then filtered to separate from the dregs. The solution is mixed with 25 mL Twin, 25 surfactants and then added again methanol until it becomes 500 mL. with a concentration of 200 g 500 mL^{-1} taken as much as 200 mL and diluted with the addition of 800 mL of water.

Plant Preparation

Seedlings are sown in a container in the form of a pot tray for approximately 1 month and will be planted after the leaves on the seedlings have approximately 3-4 strands. The required 100 seedlings were then transferred to the blocks that had been prepared for research. The land used was peatland owned by farmers in Landasan Ulin, Banjarbaru City, South Kalimantan. The size of the land used was 1 m^2 per plot. Plant spacing was arranged by forming plots and the plant spacing was 50 cm x 50 cm, resulting in 6 blocks.

Pest Infestation

B. tabaci is ready to be applied to cayenne pepper plants after reaching the nymph phase in approximately 14 days and 21 days. 10 whiteflies were applied per plant. The application of botanical pesticide solutions was carried out every day for seven days. Application is done in the afternoon and is carried out periodically and routinely every week by spraying using a hand sprayer on all parts of the plant leaves.

Mortality was observed every day for seven days after the application of the botanical pesticide, starting when the cayenne pepper plants were seven weeks and then *B. tabaci* was applied and observations were made at eight weeks, the variables observed were whitefly mortality and attack intensity. The effect of botanical pesticide application on the intensity of attack and frequency of attack

on cayenne pepper was quantified using the analysis of variance, continued with the Least Significant Difference (LSD) test at a level of α 5%.

3. Results and Discussion

Pest Mortality

Based on the results of research and analysis of variance, botanical showed a significant effect on the mortality of B. tabaci. The highest B. tabaci mortality value were in the p2 treatment (neem leaf) at 96.7% and the lowest value was in the p1 treatment (soursop leaves) at 73.3%. The mortality percentage can be seen in Figure 1.

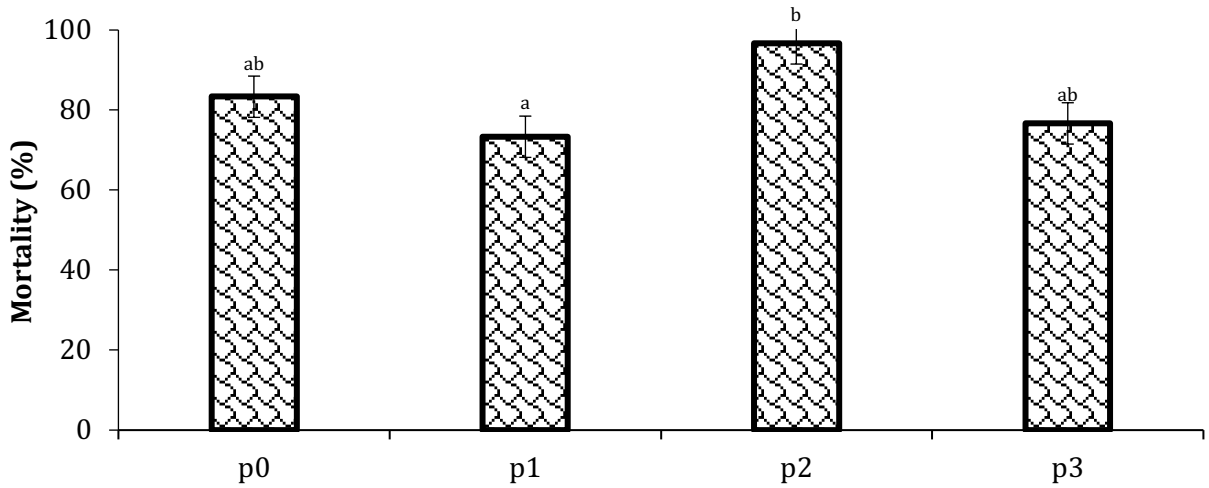

Figure 1. Percentage mortality of B. tabaci. p0 = abamectin; p1 = soursop leaf; p2 = neem leaf; p3 = jatropha leaf. The line above the bar chart is the standard error. The same letter above the line indicates that the treatment does not give a different effect based on the LSD test at the 5% real level.

The mortality of B. tabaci in cayenne pepper plants is affected by the active ingredients in botanical pesticides. The toxicity of active compounds of botanical pesticides on pests is influenced by the way the poison enters the insect's body as well as the aroma of botanical pesticides that contain repellent effects. The content of active compounds in soursop leaves is tannins, alkaloids and phytosterols, with a role as a repellent and antifeedant for B. tabaci insects. The process of entry of active compounds in B. tabaci insects by contact poison.

Neem leaves contain active ingredients azadirachtin, salanin and melintrianol which can affect reproduction and behavior, can act as repellents, attractants, and antifeedants, and inhibit insect development such as stomach poisons and contact poisons. Azadirachtin compounds can inhibit the growth of insect pests, reduce appetite, reduce egg production and hatching then increase mortality (Dewi et al., 2017). The toxins contained in neem leaves will affect the process of food digestion, inhibiting intestinal contractions, so that the process of food digestion cannot take place. According to Naranjo & Ellsworth (2005), apart from botanical pesticides, additional mortality can also occur from host plant resistance, irrigation, soil condition and nitrogen management, and other management (e.g., selective insecticides) and natural enemies can cause an increase in the percentage of B. tabaci mortality.

Environmental temperature is one of the factors of B. tabaci attack, such as the peatland used as the chili planting location in this study. The pest B. tabaci tends to like to stay at a temperature of 26-32 0C such as the state of peat soil which contains a lot of organic material of decayed plant remains (Suharto, 2007). The condition of the research site tended to be humid because the peatland also had the intensity of just one rain that could inundate the area of the field/deck which was suitable for the living conditions of the whitefly pest B. tabaci.

According to Tukimin et al. (2010), jatropha leaves have active ingredients such as curcin and phorbolester that affect the metabolic and digestive processes of insects as contact poisons. This is because the way to enter the insect's body from the insecticide given gives effects by contact or stomach poison, causing B. tabaci insects to refuse to eat and then die of starvation. B. tabaci pests experience death to the disruption of feeding and metabolic processes when applied several kinds of botanical pesticides result in stomach/ stomach poison when toxic pesticides that can damage the digestive

system if ingested by insects. Contact poison is a pesticide toxic material that can kill or interfere with insect breeding, when the material hits the insect's body (Hudayya, 2012). The way botanical pesticides work is different from chemical pesticides that kill instantly, while botanical pesticides work more slowly but the side effects that are caused can be minimized.

Pest Attack Intensity

Based on the results of research and analysis of variance, botanical showed a significant effect on the attack intensity of B. tabaci. The highest intensity of B. tabaci attack was in the treatment p3 (jatropha leaves) with a value of 11.75% nd the lowest percentage was in the treatment p2 (neem leaves) with 5.10%. The intensity of the attack can be seen in Figure 2 below.

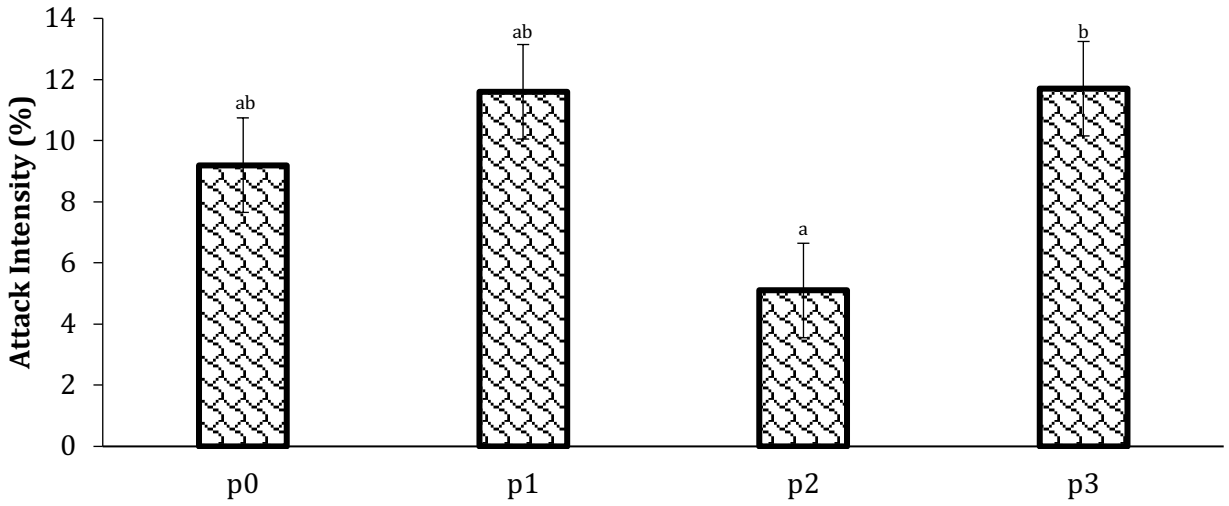

Figure 2. Attack intensity of *B. tabaci*. p0 = abamectin; p1 = soursop leaf; p2 = neem leaf; p3 = jatropha leaf. The line above the bar chart is the standard error. The same letter above the line indicates that the treatment does not give a different effect based on the LSD test at the 5% real level.

According to the Assessment Institute for Agricultural Technology of Bengkulu (2013), judging from its content in neem botanical pesticides, azradichtin causes the metabolic and digestive processes in B. tabaci pests to be disrupted so that attacks on chili plants experience the lowest percentage of other treatments. While the p3 treatment (jatropha leaf) became the highest treatment in this study. According to Tukimin et al. (2010), the active content in jatropha leaves were curcin and phorbolester pesticides which may function as contact poisons and stomach poisons. However, the process of attacking does not occur instantly or periodically.

Damage to chili plants by B. tabaci pests can be in the form of yellowing of plant leaves, there is white dew under the leaves until the leaves become curly and then disrupt the photosynthesis process of cayenne pepper plants. B. tabaci pests attack the leaves of plants by sucking the juice on the leaves of chili plants and leaving dew/white powder under the leaves that can close the stomata of the leaves (Smith, 2014). According to Nugroho et al. (2013), the intensity of B. tabaci pest attack is classified into 5 levels when the value of I = 0% (healthy), 1-20% (very light), 21-40% (light), 41-60% (medium), and 61-80% (heavy). In the treatment of several types of botanical pesticides for cayenne pepper, it shows a percentage of less than 21% and makes the intensity of the attack of B. tabaci pests included in a very mild attack. The application of each of the 10 B. tabaci pests on cayenne pepper plants that have been given a lid makes the intensity of pest attacks less dangerous, considering that B. tabaci pest attacks are usually colonized and cause fatal plant damage.

Research by Kurnia & Suharsono (2014) showed that the low intensity of attacks was also influenced by the application of botanical pesticides (castor leaves, neem leaves, and jatropha leaves). The repellent effect and contact/stomach poison from the active ingredients of several kinds of botanical pesticides affect the metabolic process of B. tabaci pests on cayenne pepper plants. B. tabaci pests also lay eggs under the leaves for their survival. Living in colonies attacks of B. tabaci pests on chili plants to be centered on the host plant before the B. tabaci imago pests look for new plants as hosts. Insect development in nature is influenced by two factors, namely internal factors (breeding ability, sex ratio,

self-defense traits, life cycle, and imago age) and external factors (temperature, humidity/rain, light/color/smell, wind, and topography) (Singarimbun et al., 2017).

Humidity is one of the factors in the development of pests on cayenne pepper plants in peatlands. Peatlands tend to be more with vegetation that stands on the former waste of organic waste which is following with the content of peat soil. According to Suharto (2007) the insect B. tabaci lives at a temperature of 26-32 0C which is very suitable for peatlands where the temperature is not too hot but also humid.

4. Conclusions

The were several types of botanical pesticides (soursop, neem, and jatropha) influence whitefly mortality and attack intensity on cayenne pepper grown on peatlands. Neem leaves were the best treatment that causes 96.7% mortality and reduces the intensity of attack to 5.10%. However, all types of botanical/plant-based pesticides were recommended because they cause more than 50% pest mortality, so they had the potential to be used as pest control.

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