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Repellent Activity of Bintaro Leaf Extract (Cerbera manghas) against *Spodoptera litura*

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ABSTRACT
The study was aimed at testing the repellency of bintaro plant extracts on the presence of Spodoptera litura pests and studying the utilization of bintaro plant extract repellency for controlling decisions of plant pests. The study used the Painter (1951) plant endurance test approach, namely soybean plants were treated by various concentrations of bintaro leaf extract infested by Spodoptera litura insects. The study design was a Randomized Block Design (RBD) with five replications. The concentration treatment of bintaro leaf extract with six levels, namely: K0: concentration of 0.0%; K1: concentration of 2.5%; K2: concentration of 5.0%; K3: concentration of 7.5%; K4: 10.0% concentration; and K5: 12.5% concentration. The results showed that the treatment of bintaro leaf extract had no effect (having the power of repelence) on the presence of adult, looking for a place to lay eggs, but mess up hatching of Spodoptera eggs. Bintaro leaf extract was able to suppress spodoptera adult 70-80% so that it can be used to make Sopodtera pest control decisions.
Keywords: bintaro leaf extract, repellent, Spodoptera litura.
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INTRODUCTION

The development of technological science in the effort to control plant pests has been running very rapidly, and most people use chemical pesticides. Unwise use of chemical pesticides will cause negative impacts such as the emergence of strains of resistant pests, pest resurgence, killing of natural enemies and non-target organisms, residual problems and environmental pollution (Untung, 1993). Therefore, it is necessary to control alternatives that are environmentally friendly and can be prepared simply. The use of biological material for pest control is called biopesticide.

Cerbera manghas in India is known as poison plant (Gaillard, Y., *et al*. 2004; Eddleston, M & Sapumal H. 2008), in Asia commonly called as Bintaro (Gaillard, et al. 2004) and it has been used widely for greening as well as decorating the city lately (Hashim, et al. 2009; Purwanto, 2011). Yan, et al (2011) states that plants from the Cerbera genus have the potential as antifungi, insecticides, antioxidants and antitumors. While Tarmudi et al (2007) informs that Cerbera manghas can have a significant effect on mortality of soil termites (Coptotermes sp.) with extract concentrations of 10%. Cerbera odollam extract has a significant effect on mortality and developmental inhibition of insect pests Eurema spp. with a concentration of 1%. Cerbera odollam seed extract can affect the biocativity of Pteroma plagiophleps larvae (Utami. 2010) and Spodoptera litura (Kristanti Indah Purwani, *et al.* 2014). Cerbera odollam has secondary metabolite compounds, such as saponins, polyphenols and alkaloids and terpenoids. Essential oil of the fruit of Cerbera manghas contains insecticidal active component and had better fumigation and repellent activity to Tribolium ferrugineum (Zhuang Lie-Kea and Zhu Wenb. 2013).

Studies of biopesticides have been carried out so far on the killing power of insect pests by looking at lethal doses, lethal concentration, death rate, level of resistance or disruption on development, so that the concept is the pests has already existed in the crop. The concept of biopesticides to kill pests is not appropriate in controlling pests of virus vectors and pests by means of very fast attacks (such as the armyworm). If all this time bintaro plants have almost never been attacked by pests, the soybean plants sprayed with bintaro plant extracts will avoid pest attacks like the bintaro plant. This study was intended to obtain biopesticide ingredients which work mechanism is not deadly but reject the presence of insect pests in the planting area.

MATERIAL AND METHODS

The study was conducted in a Green house and a Laboratory of Plant Protection of Agriculture Faculty, Wijaya Kusuma University, Surabaya. The study took 8 months, carried out in 2018. Repellency test of bintaro leaf extract against *spodoptera litura* using Painter (1951) plant endurance test approach, namely soybean plants treated with various concentrations of bintaro leaf extract infested with *Spodoptera litura* insects.

The experimental treatment was the concentration of bintaro leaf extract sprayed on soybean plants with six levels: K0: concentration of 0.0%; K1: concentration of 2.5%; K2: concentration of 5.0%; K3: concentration of 7.5%; K4: 10.0% concentration; and K5: 12.5% concentration. The Experiment Unit was 3 polybags with a diameter of 25 cm, each consisted of 2 sticks of soybean. The experiment used a Randomized Block Design (RBD), with the basis of making groups was the distance between plants and the source of the inoculum. The source of the inoculum was 30 pupae or adult insects that had just come out of the pupa as many as 30 heads in an open plastic box. Group I was a radius of 100 cm central, group II was a radius of 150 cm, group III was a radius of 200 cm, group IV was a radius of 250 cm and group V was a radius of 300 cm.

Test implementation, bintaro leaf extract with concentration according to treatment was 0%, 5%, 10%, 15%, 20%, 25% sprayed on soybean plants. The source of inoculant was a *Spodoptera litura* insect placed in the center of the circle. The variables measured were: (1) the presence adults of spodoptera insects in each plant; (2) the presence of the number of egg groups in each plant; (3) the number of larvae in each plant, observed every day; (4) the level of damage to leaves in each plant, observed every three days. The data obtained were processed statistically according to the various analysis procedures for knowing the effect of treatment. The Smallest Real Difference Test (BNT) was used for comparing the middle values between treatments with $\alpha = 5\%$.

RESULT AND DISCUSSION

RESULTS

Presence adults of *Spodoptera litura*

Table 1: Amount of Adult *Spodoptera litura* present in soybean plants with the treatment of bintaro leaf extract (at the time after pupae infestation)

Treatmrnt	On the day (after the pupae infestation)						Total
	1	2	3	4	5	6	
K0F1	-	-	1	7	1	1	10
K0F2	-	-	-	-	-	-	0
K1F1	-	-	1	3	2	-	6
K1F2	-	-	1	3	2	1	7
K2F1	-	-	1	-	1	1	3
K2F2	-	-	-	2	2	1	5
K3F1	-	-	-	1	2	1	4
K3F2	-	-	-	1	3	3	7

Adult of spodoptera which was present in soybean crop was detected on the third day after pupae infestation The number of adult that appears more for the control treatment with one-time spraying frequency. The higher the spraying dose of bintaro leaf extract, the lower the number of images present (Table 1

Presence number of egg groups of Spodoptera litura

Table 2: The number of egg groups (cumulative) Spodoptera in soybean plants with the treatment of bintaro leaf extract.

Treatment	On the day						Everage of observation
	2	3	4	5	6	7	
K0F1	1	1	8	11	14	16	3,2
K0F2	0	0	0	2	2	2	0,4
K1F1	0	1	4	5	7	9	1,8
K1F2	0	1	4	8	6	6	1,2
K2F1	0	1	1	2	2	6	1,2
K2F2	0	0	2	4	4	5	1
K3F1	0	0	1	2	3	3	0,6
K3F2	0	0	1	2	3	5	1
Net						14	

The results of the analysis showed that there was no interaction between the concentration treatment and the frequency of the bintaro leaf extract. Data on the number of egg groups between single treatments concentration of bintaro leaf extract was not significantly different, and between treatment frequencies were significantly different. Twice a week the number of egg groups was lower than one-week treatment (Table 2)

Presence number of Spodoptera litura larvae

Table 3: Population of Spodoptera larvae on soybean plant with the treatment of bintaro leaf extract

Treatment	Treatment (day after pupae release)					
	5	6	7	8	9	10
K0F1	243.60 a	143.40 a	125.40 a	90.80 a	76.40 a	28.80 a
K0F2	57.00 bcd	28.80 bc	24.20 cd	51.40 ab	45.80 b	21.00 a
K1F1	122.40 b	67.00 b	56.20 bcd	50.60 ab	45.60 b	26.00 a
K1F2	81.00 bc	78.20 ab	71.40 ab	55.40 ab	56.80 ab	21.40 a
K2F1	17.80 cd	75.60 ab	56.20 bc	44.00 b	48.00 b	20.80 a
K2F2	6.40 cd	8.80 c	7.80 cd	9.00 c	15.40 c	7.20 b
K3F1	3.00 d	4.40 c	5.20 d	4.40 c	20.20 c	8.00 b

K3F2	2.20 d	11.00 c	9.20 cd	10.80 c	24.80 c	10.60 b

Note: The average value in one column followed by the same letter is not significantly different based on the 5% BNT test. Before being analyzed the data is transformed to VX + 0.5

From table 3 shows that in the observation of day 5, treat K0F1 (control with one-time frequency) bintaro leaf extract was significantly different from treating K1, K2, and K3. However, on observations of the 10th day, the treatment of bintaro K3 leaf extract was significantly different from K2, K1 and K0.

Damage of soybean leave

Table 4: Average Leaf Damage with bintaro leaf extract treatment (%)

\Treatment	Observation day					
	7	11	15	19	23	27
K0F1	1.45 a	6.36 a	31.28	49.32	56.95	63.28
K0F2	0.69 ab	2.41 b	14.15	22.94	25.24	31.28
K1F1	0.36 ab	1.34 b	10.25	23.80	25.21	31.23
K1F2	0.00 b	0.90 b	12.18	25.47	47.24	52.18
K2F1	0.38ab	1.56 b	14.48	31.84	42.75	47.89
K2F2	0.00 b	0.00 b	13.74	38.01	40.73	43.05
K3F1	0.00 b	0.00 b	1.43	3.73	7.00	12.00
K3F2	0.00 b	0.33 b	12.81	17.29	32.97	38.06
			NS	NS	NS	NS

Note: before being analyzed the data is transformed to VX + 0.5

Leaf damage began to occur on the seventh day since pupa infestation, or on the third day since the appearance of Adult. Damage begins in plants where the egg group is located and spreads in line with the adult mobility (Table 4) . On observations of the seventh and eleven days, there were significant differences between treatments, namely the highest damage to K0F1 treatment where the highest egg and adult groups were measured. In line with the movement of spreading adult to other plants around it the damage to plants began to occur in the surrounding plants and from the fifteenth day the data on crop damage did not differ significantly between treatments.

DISCUSSION

Various types of plants had been known to have potential as vegetable insecticides because they contained bioactive compounds including saponins, tannins, alkaloids, flavonoids and terpenoids. The compound content of plant had given an effect on mortality of insects, so that the plant could be used as an alternative to vegetable insecticides. The use of vegetable insecticides could be used as an alternative pest control that was relatively cheaper and safer for the environment (Balfas and Willis, 2009). One of the natural ingredients that had the potential as a botanical insecticide was bintaro (Cebera odollam).

Bintaro (*Cebera odollam*) is a type of plant belonging to the Apocynaceae family that is believed to be used as a vegetable insecticide (Leeuwenberg et al., 1998). Chemical compounds contained in bintaro extract were secondary metabolites such as saponins, polyphenols and alkaloids that were polar so that they could dissolve in polar or semipolar solvents, such as methanol solvents (Utami, 2010). Each secondary metabolite compound had a different working power as an insecticide with various mechanisms. Bintaro could be used as an alternative to vegetable insecticides to reduce losses of agricultural products due to pest attacks, especially in food crops (Ningrum, 2012).

Feeding activity could be inhibited because saponins caused a decrease in digestive enzymes and inhibit food absorption (Haditomo, 2010). In phytochemical analysiswas found several substances that were in bintaro fruit namely saponins, steroids and phenol compounds (flavonoids and tannins). This showed that the bintaro fruit extract had antibacterial, cytotoxic and central nervous system depressants due to the presence of alkaloids and saponins (Ahamed et al, 2008).

The results of the study showed that pupa spodoptera which was defined in the soybean plant environment had emerged as adult since the first day of release (May 7, 2018), and the entire pupa became adult on the third day (May 9, 2018). This could be seen from the puppets that lived on their skin. On the first and second days there were still adult found on soybean plants, and on the third day found adult perched on soybean plants.

From the data in Table 1 it can be seen that adult spodoptera which perch on soybean plants was only about thirty-five percent (maximum only found 17 tails) from the existing adult, from 60 infestation, the other perch (stayed) outside of soybean plants because only a small percentage of adult were interested in living on soybean plants, it was not appropriate if the repelence of bintaro leaf extract against the presence of spodoptera pests was measured from adult behavior in finding a host.

The results of variance analysis showed no interaction between the concentration treatment of bintaro leaf extract (K) and the frequency of bintaro leaf extract (F). Data on the number of egg groups between single treatment concentrations of bintaro leaf extract were not significantly different, and between treatment frequencies were significantly different. Twice a week the number of egg groups was lower than one-week treatment (Table 2.). In line with the data on the presence of adult, the data of the presence of many spodoptera egg groups were also outside the soybean plants, among others found in the group of eggs found in the cloth of the mosquito net (14 groups of eggs), and possibly also in other places that were not observed.

Egg groups generally had hatched one untill two days, from one group of eggs appeared many small larvae (about 1 mm long) with greenish white. Egg groups in K2F2, K3F1 and K3F2 treatment were seen to be imperfectly hatched, ie only a few larvae emerged from the egg group. This was probably due to the effect of the presence of bintaro leaf extract on the surface of the soybean leaves where the egg group was located. The eggs that intersect with the leaves leaveed of bintaro did not hatch or the larvae that emerged from the egg then contacted with the extract of bintaro then died so that they did not have time to emerge from the egg group. This was consistent with the nature of bintaro extract containing cerberin toxins (Leeuwenberg et al., 1998; Gaillard et al., 2004; S.S. Prasant, and R. Aiyalu. 2015) so that eggs did not hatch and larvae die.

The power of repellency according to Indiati and Marwoto (2008) is a power that exists in a particular substance / material so that it can control pests by expelling because of certain substances. Mechanisms for repellency included inhibiting egg laying by test insects, because insects wanted to lay eggs in a place suitable for their dependence. If you had not found a suitable place, then the ripe eggs were detained not to be removed or reabsorbed (Atkin, 1980). It was suspected that this obstacle was caused by the smell / aroma that was owned by bintaro leaves including the presence of an essential oil extract (Wirastuti, 2016).

On the fourth day after the pupae infestation, adult (larvae) was found in 4 experimental units where the egg group was. From each group of eggs appeared very many adults and the size was very small so it was very difficult to calculate. The eggs hatched after one day. The adults observed were still the first instar larvae, a very small greenish white size of about one millimeter, the motion was still slow and still clustered around the egg group. The number of adults from an egg was around 175-300.

On the fifth day after the pupae infestation, the presence of adults was expanding, namely in the experimental unit where there was a group of eggs. The number of adults that appeared from the egg group were very large, or there are also a few, only a few tails depending on the treatment. Observed adults have begun to vary. Adults that are 1 day old begin to spread from the leaves where the egg group is towards the tip of the plant, and begin to eat the leaves of shoots and attach one leaf to another, and the newly emerging adult from the egg is still not active. Hatching eggs on the fifth day after infestation seemed to vary greatly.

In the K2 and K3 treatments the number of adults that came out of the egg group was not as much as in the treatment of K0 and K1, even from a group of eggs that appeared only a few. This is likely when the hatching of an egg is affected by the presence of bintaro leaf extract on the surface of the leaf where the egg group is located. This bintaro extract's repellency power not only repels but also kills the newly hatched adult.

The number of adults in an experimental unit appeaeds to be decreasing, but the size of the adult was larger. The decrease in the number of possible adults that emerged from the eggs could all survive because of competition between each other in getting food or because of the space factor. Adult mobility appeared to increase, adults had started to move from one plant to another in one polybag or another in one group (one unit of experiment) where there were several leaves that intersect. Adults had begun eating leaf foliage, but there was no visible wound / leaf damage. On the 6th day after the infestation it became clearer that in the treatment of K2F2, K3F1 and K3F2 there was a disturbance in the hatching of eggs, there were even groups of eggs that did not appear adult at all (not hatched), namely the K3F1 treatment.

The results of Sa'diyah's research, et al. (2013) showed that Cerbera odollam leaf extract concentration of 2% on the eighth day of observation could reduce body weight of S. litura. could inhibit pupa formation. Juliati's research results showed that vegetable pesticides from bintaro leaf extract had the potential to control adult pests in trembesi (Juliati, et al, 2016). Concentration of bintaro leaf extract 20 g / l of water was the best concentration in controlling scraggly adults with the fastest result of test insect death time of 3.00 hours, the fastest time to kill 50% (LT50) of the adult was 11.25 hours and total mortality was 92.50%. The results of the research by Sri Utami, et al (2010) showed that the crude extract of bintaro leaves had a strong insecticidal activity against larvae of S. litura with LC50 of 0.6% against the second instar and 0.28% of the two and three instar larvae. And suppressed larvae from 40% concentration in preventive way 15 HST and 60% concentration as curative way at 17 HST (Kristatnti Indah Purwani, et al. 2017). Further tests proved that in the crude extract of bintaro leaves containing compounds namely flavonoids, steroids, saponins, and tannins, has a toxic effect on insects.

Adult mobility appeared to increase, adults had started to move from one plant to another or from one polybag to another polybag that had even moved to another unit. The experimental unit which initially had no egg group was found to have a adult. Adults had begun eating leaf foliage, and some leaves had begun to show damage in the form of loss of leaf forage, white patches that showed leaves of the leaves due to the greenness of the leaves eaten by adults.

In experimental unit plants almost all adults had been found. Adult mobility appeared to increase, adults had started to move from one plant to another or from one polybag to another polybag that had even moved to another unit. The experimental unit which initially had no egg group was found to have a adult.

In the observation of the ninth day after the pupa infestation, all soybean plants had been found in instar 2 adult and 3rd instar, which plants were not even seen which were the source of adults. The spread of adults from the origin of the egg group occured to all the plants that were around it and there did not appear to be anything that affected the direction of spread, meaning that the effect of spraying the bintaro leaf extract was gone. Instar 2 adult and

3rd instar wetre the age of the adult began to actively eat or move to find food.

Adult population data on each unit of experiment was carried out by analysis of variance and the result was an interaction between the treatment of concentration of bintaro leaf extract with treatment frequency treatment. In treatment K0 and K2, the adult population in F1 was higher than F2, while in K1 and K3 treatment the adult population in F1 and F2 was almost the same (not significantly different). The treatment of K2F2, K3F1 and K3F2 was the lowest number of adult populations compared to other treatments. Based on adult population data, the treatment of bintaro leaf extract could suppress adult populations or could prevent / rejected the presence of spodoptera pests. The larvae would be disrupted during the process of changing the skin or the process of changing from eggs to larvae or from larvae into cocoons or from cocoons to adult. Usually failure in this process would cause death. If the treatment with K2 concentration (5%) then twice spray treatment in one week could suppress adult population / had a repelence power of 80.37%, if the treatment with K3 concentration was enough once a week and could suppress adult population / had a repelence power of 73.6% .

On the tenth day after the infestation the number of adults observed tended to decrease. It was possible that eating activity had decreased and / or adult had entered instar 4 or preparatory instar. In the days leading up to adults the leaves began leaving the leaves looking for places to prepare for form. Leaf damage begins on the seventh day since the pupa infestation, or on the third day since the appearance of adults. Damage began in plants where the egg group was located and spreaded in line with the adult mobility. The observations of the seventh and eleventh days were significantly different between treatments, which were the highest damage in K0F1 treatment where the highest egg and adult groups were measured. In line with the movement of spreading adults to other plants around it the damage to plants began occurring in the surrounding plants and starting on the fifteenth day the data on crop damage did not differ significantly between treatments.

CONCLUSION

The results showed that the treatment of bintaro leaf extract had no effect (having the power of repelence) on the presence of adult, looking for a place to lay eggs, but mess up hatching of Spodoptera eggs. Bintaro leaf extract was able to suppress spodoptera adult 70-80% so that it can be used to make Sopodoptera pest control decisions.

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