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Response of *Riptortus linearis* towards the aplication of Bintaro (C*erbera manghas*) leaf extract

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Abstract
The aim of this research was to determine the behavioral response of *Riptortus linearis* to the application of organic insecticides (extract of *Cerbera manghas* leaf). The experimental method refers to Garber (1951). Young long bean pods soaked for 10 seconds in the solution of Bintaro Leaf extract with the concentrations of : K0 = 0.0%, K1 = 2.5%, K2 = 5%, K3 = 7.5%, K4 = 10%, K5 = 12.5%. Long bean pods is hung in a rectangular mosquito net lid and inserted in 3-4 of instar of *R. linearis* larvae as many as 20 animals per replicate. The number of insect perched on the pods of each treatment is observed every day. The results showed that the number of dead and perched insects did not differ significantly among the treatments. The conclusion was the application of Bintaro Leaf extract didnot give influence to the presence and death of *R. linearis*.

Keywords: *R. linearis*, Bintaro leaf extract

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INTRODUCTION

The use of plant extracts as biopesticides has been widely recommended to farmers. Information on biopesticides is generally still limited to plant raw materials and target pests. The technology recommended is still conventional or traditional. There are twelve types of plants that are recommended by agricultural extension workers in 20 countries, namely garlic (*Allium sativum*), neem (*Azadirachta indica*), chilli (*Capsicum* spp.), weed (*Chromolaena odorata*), gliriside (*Gliricidia sepium*), *Melia azedarach*, noni (*Moringa oleifera*), tobacco (*Nicotiana tabacum*), *Ocimum gratissimum*), tephrosia (*Tephrosia vogelii*), tree marigold (*Tithonia diversifolia*), and bitter leaf (*Vernonia amygdalina*) (Dougoud et al. 2019, Quarterman 2019).

Studies on biopesticides so far have been carried out on the killing power of plant material toward insect pests by looking at lethal doses, lethal concentrations, mortality rates, levels of inhibition or interference with the development of pest organisms (Rusdy 2009). The concept of biopesticides that kill or inhibit the growth of pest organisms requires contact between the active ingredient and the pest organisms, meaning that the pest organisms are on the host plant even if only for a moment (Guswenrivo et al. 2013, Liu et al. 2019, Nazir et al. 2019, Somsroi and Chaiyong 2016, Yadav and Sharma 2019). This concept is less suitable in dealing with virus vector pests and the fast attacking pests (such as the case of a spodoptera worm attack). Biopesticides can be developed with the concept of repellent or repulsion, namely pest organisms do not come to a host plant due to factors that are not attractive or disliked by pest organisms. The concept of repellent can be inspired by the existence of a type of plant which is known always protected from the pests to be developed into biopesticides that have the repellency.

Bintaro (*Cerbera manghas*) plant which is widely known by the public today is widely used for greening as well as urban ornamental plants. Plant from the genus Cerbera has the potential to be antifungal, insecticide, antioxidant, and antitumor (Chu et al. 2017, Iqbal et al. 2017, Yan et al. 2011), and *Cerbera manghas* can give a significant effect on the mortality of termites (*Coptotermes* sp.) with an extract concentration of 10% (Tarmadi et al. 2007). *Cerbera odollam* extract has a significant effect on mortality and inhibits the development of *Eurema* spp. insect pests by giving a concentration of 1% (Purwani et al. 2007). *Cerbera odollam* seed extract can affect the bioactivity of *Pteroma plagiophleps* larvae and *Spodoptera litura* F. *Cerbera odollam* has secondary metabolite compounds, such as saponins, polyphenols and alkaloids and terpenoids. Secondary metabolite compounds containing N (such as alkaloids and saponins), and the phenol group compounds (such as flavonoids and tannins) are polar so it can be dissolved in polar or semipolar solvent, such as methanol. Each of secondary metabolite compound has a different working power as

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Fig. 1. Rectangular shaped mosquito net with zipper door

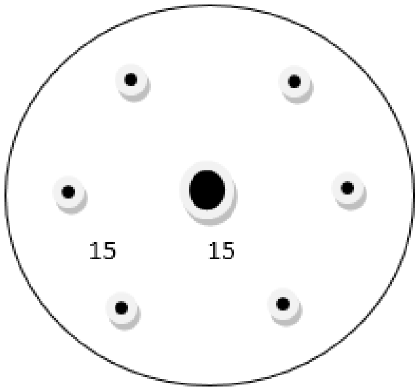
Fig. 2. A series of Riptortus experiments, long bean pods that have been treated, hung in a mosquito net (with an iron frame) that has been infested with Riptortus insects

an insecticide with various mechanisms (Zhuang and Zhu 2013).

Bintaro plants are almost never attacked by pests, so it is hoped that host plants that are treated with bintaro plant extracts will be protected from insect pests as bintaro plants. Need to look for biopesticide ingredients with abundant availability so that they are easily available and inexpensive. This study aims to examine the ability of bintaro leaf extract in rejecting the presence of pod sucking pest (Riptortus) in agricultural areas. The results of the study could become information or a reference for the utilization of Bintaro plant waste which abundant in the city of Surabaya as an organic pesticide in urban farming practices.

MATERIALS AND METHODS

Repellency test of bintaro leaf extract towards hemiptera order insects using *Riptortus linearis* infestation test insect with feed media of long bean pods. The test method uses the Painter plant endurance test approach (Garber 1951), ie long bean pods were treated



Information:

: source of test insect release

: host / feed treated

Fig. 3. A series of Riptortus experiments, long bean pods that have been treated, hung in a mosquito net (with an iron frame) that has been infested with Riptortus insects

with various concentrations of bintaro leaf extract, then infested by *Riptortus linearis* insects. Long bean pods that are not visited by insects or the effect of the smallest insects then considered to have a repulsion / repellency power. Experiments were carried out in a mosquito net so that the insects infested did not spread or the bean pods treated were not visited by other insects from the outside as shown in **Fig. 1** and **Fig. 2**. The iron frame with the base size is 50x50 cm^2, and the height is 60 cm. In upper section given the ring with a diameter of 30 cm as the foothold to hang the long bean pods.

The experimental treatment was the given of bintaro leaf extract with six levels of concentration namely concentration of 0.0%; concentration of 2.5%; concentration of 5.0%; concentration of 7.5%; concentration of 10,0%; and concentration of 12.5%. Experiment Unit: a bundle of young pod of long bean consisting of 3 stem of long bean pods with a length of 30-40 cm). Each treatment level was repeated five times so that in total there were 30 experimental units. The experiment was carried out with a randomized block design, each repetition placed in one group in one hood. Five hoods were placed in a laboratory room with adequate ventilation and lighting. The sketch of each group as shown in **Fig. 3**.

Preparation of Test Insects of *R. linearis* . Imago (adult insects) obtained from the field of legumes kept in plastic jars with a diameter of 16 cm and a height of 17 cm covered with gauze. Each jar contains 5 female imago and 3 male imago, fed with young pods of beans 2 pieces, each 20-30 cm length, and in the jar also placed gauze / wool yarn as a place for laying eggs. Feed and gauze / cotton is replaced every 2 days. When changing feed, *R. linearis* eggs that attached to the gauze / thread are taken and replaced with new gauze / thread. The eggs that have been taken are placed in

Table 1. Development of *R. linearis* population per hood (experimental group) with long bean feed treated with various concentrations of bintaro leaf extract

Observation Day	Average number of insects	Insects that are in the long beans		Dead insects	
		total	percentage	total	percentage
1st*)	23.50	4.60	19.57	0.00	0.00
2nd	22.80	6.20	28.18	0.70	2.98
3rd*)	22.00	7.80	34.21	1.50	6.38
4th	21.00	8.20	39.65	2.50	10.64
5th*)	20.20	8.40	41.58	3.30	14.04
6th	18.80	6.60	35.11	4.70	20.00
7th*)	17.20	7.20	41.86	6.30	26.80
8th	16.80	7.80	46.43	6.70	28.51
9th	15.60	9.60	61.54	7.90	33.62

Information: *) = when the long bean pods are replaced with the new one

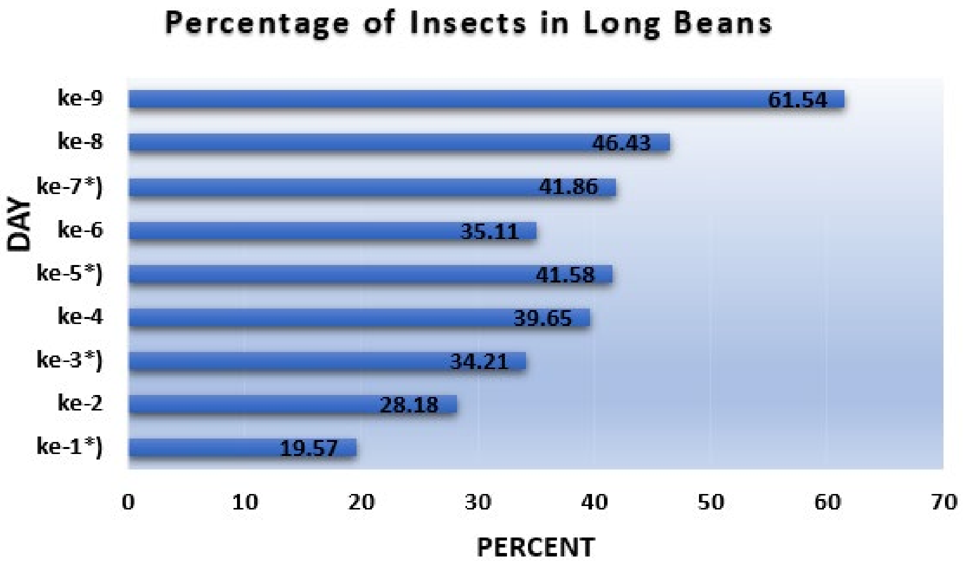


Fig. 4. Percentage of *R. linearis* that comes in long beans as a result of the treatment of bintaro leaf extract

another jar until they hatch and used as stock of test insects. In this study the test insects used nymph *R. linearis* for third instar before becoming fourth instar.

Preparation of Bintaro Leaf Extract. The making of bintaro leaf extracts using water solvents. Fresh healthy bintaro leaves are washed and then air dried. The clean leaves are cut into small sizes and extracted using a homogenizer or blender for 15 minutes. The solution is then filtered with a cloth and the liquid is an extract that will be used for the experiment. To be more effective in the extract liquid need to be added 2 grams of soap per liter of liquid. Concentration uses a ratio of the weight of leaves and water as a solvent, for example to get a concentration of 5%, then as much as 50 grams of bintaro leaves are extracted with 1000 cc of water.

The experimental variable is the number of *R. linearis* insects that are in each long bean pod that has been dyed in the extract according to treatment, number of insects in a mosquito net (one group), the number of insects that die in each hood, and the behavior of *R. linearis* insects.

EXPERIMENTAL RESULTS

Insects that are put in a hood, even though they have been starved for 2-3 hours but do not go directly to the long bean pods for food, mostly move on the bottom of the net or on the walls of the net. Insects need a period of adjustment, initially there is a desire to go outside the net to spread. *R. linearis* insects infested in the lid/hood are 3-4 instar nymphs, their movements are crawling, unable to fly, and only 4 days later entering instar 5 insects could fly. A description of the number of insects that live in long beans compared to those on the walls of the net as presented in **Table 1**. The number of insects in long bean pods tends to increase with the growth and development of nymphs. On the first day, on average only 4.6 or 19.57% lived on long beans and there was a tendency to increase with increasing days of observation, and on the 9th day amounted to 9.6 or 61.54% of insects were on long bean feed. The number of insects in long bean pods tends to increase with the growth and development of nymphs.

The development of *R. linearis* population due to the treatment of bintaro leaf extract is shown in the number and percentage of test insects on long beans per experimental group for all observation periods.. The largest number of *R. linearis* insects that came in long beans was shown in the last observation / 9th day (nine), namely 9.60 tails or 61.54% of the total initial population (**Table 1** and **Fig. 4**).

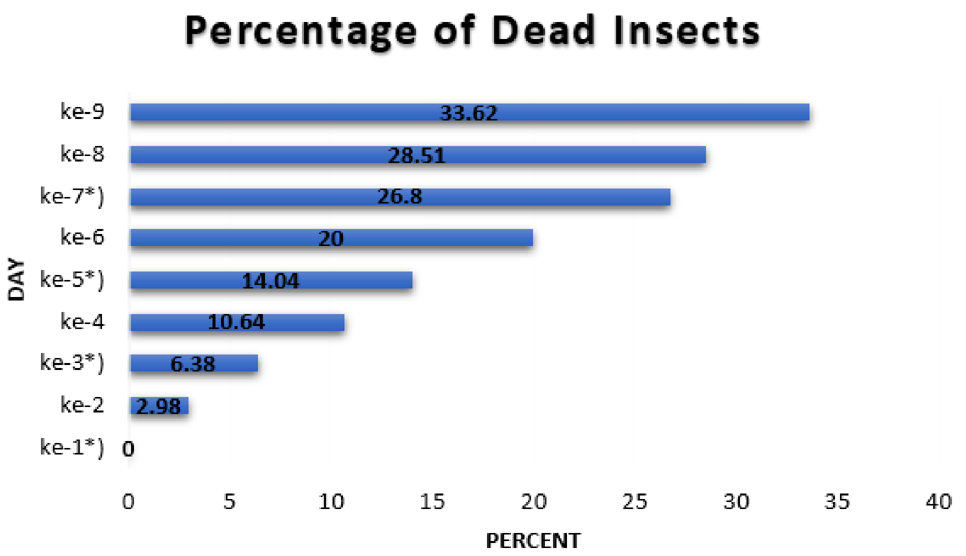


Fig. 5. Percentage of *R. linearis* that died due to the treatment of bintaro leaf extract

Table 2. The average number of *R. linearis* insects on long bean pods which has been given the spraying treatment with various concentrations of bintaro leaf extract

Treatment	The observation day calculated since the infestation of Riptortus insects								
	I *)	II	III*)	IV	V*)	VI	VII*)	VIII	IX
K_0: concentration 0%	0.6	1.6	2.0	1.8	0.6	1.2	2.8	1.6	1.6
K_1: concentration 2.5%	0.8	2.0	0.6	1.4	2.2	0.6	1.0	1.4	1.0
K_2: concentration 5.0%	0.8	1.2	1.8	0.6	2.4	1.2	0.4	1.4	1.2
K_3 concentration 7.5%	0.6	0.6	2.0	1.4	1.0	2.0	1.2	1.2	1.2
K_4: concentration 10.0%	1.0	0.4	0.6	0.2	1.4	1.6	0.6	1.2	3.2
K_5: concentration 12.5%	0.8	0.4	0.8	2.8	0.8	0.0	1.2	1.0	1.4
BNT 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Information: *) = when the long bean pods (feeds) are replaced with the new one
NS = Not Signficant
LSD = Least Significant Difference test

Insect deaths/mortality occur from the second day. The average number of dead insects was 1 per day per hood and at the last day observation (9th day) the number of dead insects was 7.9 or 33.62% of the total initial population. On the 9th day the development of insects in the fifth instar position before becoming an imago (adult). Complete insect mortality data are presented in **Table 1** and **Fig. 5**. The cause of death cannot be detected but is thought to be caused by the effect of bintaro leaf extract, because based on experience during the multiplication of riptortus insects, almost no death occurs after instar four, when the availability of feed is sufficient and the density level is not too high.

The number of insects that are (stay) in each treatment on each observation day presented in **Table 2**. Results of variance analysis of the number of insects in each treatment was not significantly different. The amount for each treatment is inconsistent, changing every day of observation. Insects are actively moving, able to move from one treatment to another treatment or move to the gauze wall, the ratio of one treatment to another treatment is not consistent. On the second day observation the highest number was on the treatment concentration of 2.5%, but on the 3rd day observation the highest number was on the treatment concentration of 0% and 7.5% (**Fig. 6**). The number of insects perched on the pod is increasing, meaning that there is a greater likelihood of contact between the insect's body and the biopesticide ingredients, or the possibility of being sucked while the insect is eating. When viewed as a whole quantitatively the highest amount tends to be at a concentration of 0.0%, however it cannot be concluded that the treatment of bintaro leaf extract has repellent power (**Fig. 6**).

Effect of bintaro leaf extract on *R. liniearis* insects is biased with insect mobility. Insects randomly spreading at first the direction of movement is not related to looking for food but related to the desire to spread. The effect of bintaro extract on riptortus insects is likely to be on its biology (its development and growth). The mechanism of the riptortus insect to eat is by jabbing the stylet then sucking fluid in plant tissue. The bintaro leaf extract ingredients which attaches to the surface of the long bean pods only attaches to the body of insects that intersect with the bean pods, but does not get sucked through the stylet, except when the biopesticide material can enter the tissue so that it is systemic. This is different from chewing bite insects that eat parts of plants that contain biopesticides.

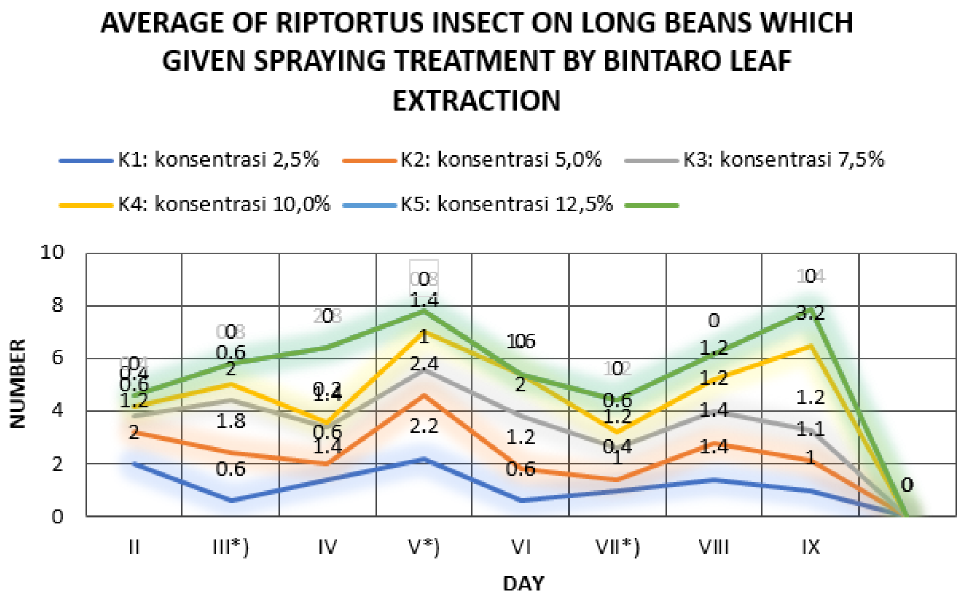


Fig. 6. The average of *R.linearis* insects on long beans which has been given the spraying treatment with bintaro leaf extract

DISCUSSION

The *R.linearis* insect which was put in the lid/hood turned out not to go directly to the long bean pods looking for food, but crept on the walls of the mosquito net trying to get out. This is because there is a desire for insect mobility to spread, not necessarily in the host plant. Insects that at the host, sucking pods that are easily accessible and there is no effect of the bintaro leaf extract treatment. In accordance with research (Oparaeke et al. 2005) the treatment of a mixture of several types of plant extracts (garlic, black pepper) can reduce the population of thrips, pod borer and pod sucking long beans, but not significantly different from control. Insect test on instar 3-4 its mobility is high, so the effect of biopesticide treatment become low. According to research results (Ba et al. 2009) the biopesticidal activity of plant stem extracts of *Cassia nigricans* V., *Cymbopogon schoenanthus* S., and *Cleome viscosa* L. towards the *Clavigralla tomentosicollis* pod-sucking pest influenced by the level of development and the concentration of the test insects. Testing on instar one the mortality until 100% is the same as chemical insecticide, Test on instar three the highest mortality only 17.5%, far below the chemical insecticide 100%, Test on instar five the highest mortality only 10% far below the chemical insecticide 100%, and test on adult insects the highest mortality only 10% far below the chemical insecticides 100%. *Tephrosia vogelli* plant extract contains the rotenoid (rotenon) active ingredient which works as a contact poison or stomach poison. This material has succeeded in decreasing the activity of eating and laying eggs so that drive insect pests to die (because they do not eat) or move (migration) to other places (Olaitan and Abiodun 2011). Botanical pesticides contain antifeedants (reduce appetite) and repelllent. The application of botanical pesticides traditionally / conventionally in the household scale has been widely carried out and many have succeeded with varying effectiveness, even though under synthetic pesticides (Quarterman 2019).

The treatment of bintaro leaf extract on long bean pods as insect feed did not significantly affect the preference of riptortus insects. However, long bean pods which dipped in bintaro leaf extract solution with a concentration of 0% tend to be visited by more pest insects. This is consistent with studies of leaf extract of *Chromolaena odorata*, *Azadirachia indica* and *Ricinus communis* can cause low pod sucking pest populations in long bean plants (Degri et al. 2013). In plants which sprayed with leaf extract, the pod sucking population at 2 days after the highest application is only 0.72 tails/plot (plot size 12 m^2) almost the same as the chemical insecticide treatment of 0,01 tails and far below the control of 3.06 tails. In line with that, research with the treatment of plant extracts of *Piper guineense* Schum, *Aframomum melegueta* (Roscoe), *Xylopia aethiopica* (Dunal) A. Rich., *Zingiber officinale* L. and *Capsicum annum* can reduce pest populations and the level of damage of long bean plants after flowering (Oparaeke et al. 2005). Pests that appear during testing are Maruca *vitrata* Fab. (Lepidoptera: Pyralidae) and *Clavigralla tomentosicollis* Stal. (Hemiptera: Coreidae). Application of plant extracts of *Spondias mombia, Momordica charantia, Mitrocarpus villosus* and *Chenopodium ambrosioides* can reduce pest populations of *Acanthomia tomentosicollis* Stâl (Hemiptera: Coreidae) on long beans, with varying levels of population decline (Adesina 2014). Extract of Mindi, garlic, and melon have a lower compressive power on *R.linearis* population compared to chemical pesticides, the cause is the active ingredients of azadirachtin in mindi, seed oil, triterpenoids and saponins in garlic, and saponins-glycosides in melons its poison power is not as strong as chemical pesticides (Degri et al. 2013). The compounds contained in babandotan leaf extract can be effective in poisoning insects through the digestive tract compared with contact. Research with papaya leaf extract (water) treatment on *R. linearis* found that the highest mortality at observation 7 days after application equal to 17.41% occurred at extract concentration of 40%, and mortality was lower at concentrations of 50%, 60%, and 70%. The highest mortality of *Spodoptera litura* larvae amounted to 90% in less than 10 days occurred in the application treatment of babadotan leaf extract with the concentration of 15%. Whereas in testing on this *R. linearis* nymph, the highest mortality up to 7 hsa only reached 21.57% at the 60% babadotan leaf extract concentration (Amalia et al. 2017).

The treatment of bintaro leaf extract is estimated to cause *R.linearis* insect mortality, although the mortality rate is relatively low namely equal to 33.62 % (percent) on the ninth day observation. In a situation covered with mosquito nets insects are “forced” to contact with feed that has been dipped in a bintaro leaf extract solution. The results of the study (Dewi et al. 2018, Sa’diyah et al. 2013) bintaro extract treatment can influence the development of insects through stomach poisons. Bioinsecticides will enter the digestive organs of larvae and absorbed by the intestinal wall and then circulate with the blood in the form of the haemolymph system. Haemolimfa which has been mixed with bioactive compounds will flow throughout the body by carrying food substances and bioactive compounds contained in insecticides. Bioactive compounds that enter through the digestive system will interfere with the physiological process of larvae, including interfering with the working system of enzymes and hormones. Bioactive compounds contained in bintaro leaves enter the body of twig caterpillar as stomach poisons because in the test method, tamarind leaves are dipped in a bintaro leaf extract solution so that the active compounds contained in the extract solution enter the digestive tract with food (Juliati et al. 2016, Legawati et al. 2018, Sholahuddin et al. 2018, Wahyuni et al. 2018). Research results bintaro leaf extract is able to kill caterpillars because the active ingredients enter the insect digestive system and work as stomach poisons (Purwani et al. 2014). The treatment of neem leaf extract up to a concentration of 70% has no significant effect on the mortality of *R.linearis* insects, the deaths occur from the fifth day since treatment and not yet certain to be caused by the concentration of neem leaf extracts as evidenced by increasing concentration is nonlinear with increasing mortality. Extracts on the surface of plant organs are less effective can be sucked by *R.linearis* insects. The way the active ingredient works in plant extracts is the contact on the surface of the plant, not systemic in the plant tissue (Amalia et al. 2017). The study results by mixture extract treatment of several plants types (garlic, black pepper) can reduce the population of trips, pod borer and long bean pod sucker but were not significantly different from controls. This is due to the mobility of these ladybug insects, they eat pods that are easily accessible, there is no effect of the existence of extract treatment of vegetable insecticide (Oparaeke et al. 2005).

CONCLUSION

The application of Bintaro (*Cerbera manghas*) Leaf Extract did not significantly affect the behavior response of the Brown Ladybug (*Riptortus linearis*, Hemiptera) Insect in obtaining a host, however there is a tendency for the repellency of the Bintaro (Cerbera manghas) Leaf Extract to the presence of the Brown Ladybug (*Riptortus linearis*) (Hemiptera) Insect. It can be concluded that the repellency power of bintaro leaf extract is not suitable for insects with a type of mouthpiece sucker. Need to be conducted further research in the field with the environment in accordance with the demands of insects and host plants to avoid bias among the treatments.

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