The Use of Several Types Of Artificial Diet to Increase Population and Aggressive Behavior of Weaver Ants (Oecophylla Smaragdina F.) in Reducing Cocoa Pod Borer Infestation (Conopomorpha Cramerella Sn

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The Use of Several Types of Artificial Diet to Increase Population and Aggressive Behavior of Weaver Ants (*Oecophylla Smaragdina F.*) in Reducing Cocoa Pod Borer Infestation (*Conopomorpha Cramerella Sn.*)

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ABSTRACT

The aim of this research was to understand the effect on typical artificial diet to enhance ant population and activities. The research was conducted in Belopa district, Luwu Region Province of South Sulawesi from April to November 2012. This study was environmentally designed based on randomized complete block design, consisting of four (4) treatments with five (5) replications per treatment. The treatments included 1g of palm sugar pellet, shrimp pellet, and chicken intestine pellet and another was control. Each trial was tied and hanged on the cocoa pod with 4 m width from nest of ant and 2 m tall from the ground surface. The result revealed that of four treatments, the pods with shrimp pellet hanged were the highest population of rangrang (Oecophylla smaragdina) to visit than other treatments, having the average number of 10.4 individuals per pod. Another trial, palm sugar pellet was the second higher population being visited with the average of 9.7 individuals per pod. Another was chicken intestine pellet with just the average of 8.2 individuals per pod. Meanwhile, the population of rangrang in the pods without pellet treatment leveled off. Differentiation of effect on rangrang population on the all treatments from week 5 to week 8 observations showed that the cocoa pods with shrimp pellet trial were always visited by over whelming population of rangrang. Therefore, there was positive correlation between the trial and reduction of pod damage caused by CPB with 7.44 %.

Keyword: Oecophylla smaragdina, different artificial diet, Conopomorpha cramerella Sn

INTRODUCTION

In particular cocoa growers in South Sulawesi count on cocoa plant growing to earn income but since cocoa pod borrer as known CPB *(Conopomorpha cramerella* Sn.) has seriously attacked, their revenue decreased significantly from time to time. As a consequence, the effect on cocoa pod borrer infestation may be significantly to reduce government's revenue in this region that mainly comes from Agricultural sector about 70%, being contributed by cocoa sector. Therefore, national cocoa bean export affects as well.

The efforts of controlling CPB varied have been implemented such as insecticide, sleeping pods, frequently pod harvested, and eradication but not many succesful applications have been recorded yet. In terms of using insecticide in controling CPB, it appeared less successful and indeed this method enlarges CPB infestation to other cocoa plantation due to actively adult movement (Wardoyo, 1996). In Malaysia, using insecticide derivative piretroid in controlling CPB resulted in CPB resistant phenomenon that used to be applied in dose

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recommended level (Lim, 1992). The use of sleeping pods and regular pruning was less efficiently and economically. Those methods were refused by many farmers.

Predator is one of natural enemies, which has tremendous potential to develop in farming. There are so many predators belonging promises as natural control. One of them is the use of ant colony. The ant predator which is from family of formicidae and genera of Hymenpotera is a successful predator in the environment and plays very crucial role in managing pests of crops. Weaver ant, *Oecophylla smaragdina* F. as known 'rang-rang' commonly predates aggressively larve, pupae, and adult of many insect pests. Their colony usually kill and collect all of host stages and bring to their nest among leaves of tree, aiming to feed their new generation that live inside the nest (Hoy *in* Metcalf, and Lukman, 1994).

Similarly, as Schmutterer (1978) points out, the ant even predates so many insect pests of estate crops. Lim, *et al*. (1982) and La Daha and Ahdin (2003) report that one of the different groups of ant which aggressively predates major pest of cocoa, larvae and pupae cocoa pod borer is rangrang (*O. smaragdina)*. Kalshoven (1981) argues that in Irian Jaya, now West Papua, the rangrang could be applied in controlling palm beetle population (*Promecotheca* spp.). Finding his study in North Sulawesi was vast majority of coconut trees which were occupied by the rang-rang and were more yield production than coconut trees without the rangrang. Next, study of Lim, (1992) found that from many different ant species observed, the rangrang species (*O. Smaragdina)* was found to have aggressiveness to kill the larvae and pupae of cocoa pod borer (CPB).

Ahdin (2002) examines that based on the observation, there were seven (7) spesies of ant which dominated cocoa trees, three of them were black ant (*Dolichoderus thoracicus*), "kripik ant" (*Crematogaster difformis*), and rangrang (*O. smaragdina*) which were found actively to colonize cocoa trees all the time. It could be concluded that their moveable activity around the trees had played important role in pressing CPB population. Another study, Ahdin and Rahmat in 2009 reported that there were positive correlation between severity damage of CPB of cocoa plantation and establishment of ant colony. The least ant colony established in cocoa plantation, the higher severity pod damage caused by CPB occurred. It was proven that in the cocoa trial which was colonized by the rangrang and the black ant, there was the fewest injury pod damage observed. In another word, this cocoa trial was free from CPB infestation. The trial with being occupied by kripik ant showed to have mild infestation of CPB. Meanwhile, the plot without the ant colony seemed to have from mid to high severity damage of CPB.

Behavior of weaver ant (rangrang) noted could be highly moveable from one spot to other places in particular when they have either any interference and/or insufficiency of food for their colony and new generation. Therefore, to build up population of the rangrang on the trees which was aimed the availability of food has to be sufficiently. According to Brown (1970) that the rangrang in general had tremendous daily activity when their food was sufficiently. Another report from Kalshoven, (1981) reveals that fruit growers kept the colony of the rangrang by using artificial diet such as rotten meat carcasees on the trees.

Moreover, Van Mele and Cue, (2004) report that tremendous colony of the rangrang was found in their nest which was affected to several factors such as food availability and interference level occurred. A colony can reach amusingly 100 nests which those nests can spread out up to15 trees or conquering 1000 m squire of land.

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As successfully lived, the activity of the rangrang has three main points; first of all, seeking food, maintaining their colony and new generation, and self-defense against enemies and extremely physical exchange and weather. The workers of rangrang have a particular role as foraging, care of, and protection on their new generation such as larva, pupae and nest. Once the workers throughout foraging find larva and adult of insect pest, the food will be directly picked up to their larva inside their nest. As Nugroho (1994) points out, other food was from sugar solution which was directly used to become source of energy in their next activity.

Regarding maintaining their colony, the rangrang will always stand by around the trees colonized which means to automatically functioned in attacking other enemies. From this, this was very interestingly to be understood whether artificial diet was able to be applied as main food. Based on this, the research was conducted to understand the influence on three kinds of artificial diet such as 1) pellet of shrimp, 2) pellet of chicken intestine and 3) pellet of palm sugar. Those sorts of pellet were aimed to develop their population and colony as well as their huge activity.

The aim of study is to understand the effect on the difference among artificial diet to develop their population, colony, and activity as well as being hoped to be reference in doing conservation of ant predator on cocoa.

MATERIALS AND METHOD

The study was carried out at village of Tampumia Radda, District of Belopa, Luwu Regency Province of South Sulawesi from April to November 2012.

Preparation and Implementation of the Study

Artificial diet applied in this study consisted of three materials namely; waste of shrimp steamed as known udang rebon, chicken intestine wasted, and palm sugar solution. The shrimp steamed and chicken intestine wasted were made of pellet formulation. Material of Shrimp pellet consisted of 200g shrimp, 500g flour, 250g sugarcane, and water. For making pellet of chicken intestine, 200g waste of chicken intestine; 500g of flour, 250g sugarcane, and water were mixed together in the same time.

Waste of shrimp and chicken intestine had to be dried previously and then mashed by using mixer. Afterwards, those materials mixed were made of paste shape, moulded on the aluminum cast before heated by oven for 10 minutes. Every pellet was measured 1g of materials and then chopped spherical shape with 10 mm diameter and 5 mm thickness. Palm sugar made of palm tree was chopped into small piece in 1g weight.

Field observations conducted were more or less 1 ha cocoa field owned by local cocoa farmers, growing 1000 trees. Of 1000 trees, 20 samples determined had to be categorized with abundant rangrang population between 51 to 200 colonies or equaled to scoring 3 of ant population according to Khoo and Way (1991). Each tree was signed and labeled.

This study was designed based on randomized complete block design consisting of four (4) treatments with five (5) replications per treatment. Every treatment included 1g of palm sugar pellet, shrimp pellet, and chicken intestine pellet and another was control. Each pod chosen was categorized by pod size with 9-10 cm in length and then tied by sewings in the petiole.

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The artificial diet laid in the pod surface was aimed to attract rangrang throughout foraging in order to visit and protect regularly pod from CPB infestation.Every week throughout two months pellet was replaced.Next, an hour after replacement of pellet, it was then observed and measured the number of rangrang population to visit.

Observation of Population

Initial observation was carried out prior to pellet treatment, measuring the number of ant population every tree. Afterwards, every week the ant population was assessed which being foraged. In the last observation, the number of nests formed each tree sample was observed along with ant population based on category of ant population developed by Khoo dan Way (1991) following by;

Category	*Score*	*The number of ant colony in the cocoa tree*
None	0	No ant population on the tree
Light population	1	less than 20 individuals on the tree and no ant march and nest establishment of rangrang, (*Oecophylla smaragdina*)
Middle population	2	At least 21to 50 individuals with ant march but no nest stablishmentof rangrang (*Oecophylla smaragdina*)
Many population	3	Between 51 to 200 individuals with ant march and an initial nest of rangrang developed
Abundant population	4	Between 201 to 500 individuals with long march ant and several nests developed
Over whelming population	5	Up to 500 individuals with having high density of ant population and long march as many as nest development

To help week observation, the score of population was done and certain criteria of cocoa trees designed such as score 3 (Between 51 to 200 individuals with marching ant and an initial nest of rangrang developed). There were scoring 4 which were between 201 to 500 individuals with long march of ant and 2 to 3 nests developed. In score 5, there were observed up to 500 individuals with having dense population and long march and over 3 nests developed.

After observation finished, it was repeated to next month, starting from last date observation but without feeding artificial diet in order to know the development of rangrang population.

Observation of Pod Damage Caused by CPB

The purpose of observation was to understand the relationship between the existence of ant population and pod damage caused by CPB. The observation of Severity pod damage was conducted when the pods reached a peak of ripening time by collecting pods both trees of

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trials and control. Initial observation was conducted before the maturity of artificial food and then measurements of pod damage with size 9-10 cm. the pods which would be treated artificial diet were when symptom presented such as several dark spots in the skin surface being indicated attacked by CPB. Moreover, the next observation was done during establishment of artificial food in the field but the data were splitted. For severity pod damage caused by CPB the measurement was conducted by following;

$$Is = \frac{(Ri \times 0{,}093) + (Se \times 0{,}2970) + Be}{JB} \times 100\%$$

IS : Severity damage (%)

So : Health

Ri : Slight (between 1 % to less than 15 % of bean damage), easy to separate bean

Se : Middle (between 16 % to less than 50 % of bean damage), difficult to separate bean

Be : Heavy (up to 51 % of bean damage), very tough to bean separation

JB : Total pods

Regarding health pod (So) in this pattern, there was not involved as component of divider but as a variable of pod number which was assessed.

As observation finished, data collection was repeated after a month later, beginning with the last observation but no feeding artificial diet in order to know their performance.

RESULTS AND DISCUSSION

The Effect Artificial Diet on the Population of Rangrang

Data analyses based on analysis of variance revealed that the population of the rangrang on the whole pod sample which were given artificial diet throughout the observation was significantly higher than other trials of artificial food (Table 1). At the beginning of observation, week 1 to week 4, the number of population of the rangrang was no significantly different among treatments but significantly different with control. However, this difference among treatments occurred from week five (5) to the end of observation.

Table 1. The effect on the artificial diet towards the rangrang population

Sort of artificial diet	*The number of Population of rangrang (individual/pod) from week to week*							
	I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*
Shrimp pellet	6.2b	7.4b	10.6b	10.4b	13.8c	13.8b	13.4c	17.6c
Chicken intestine Pellet	5.2b	6.0b	8.8b	8.0b	8.2b	8.6b	10.0b	11.0b
Palm sugar Pellet	5.8b	6.2b	9.2b	9.8b	11.4c	12.4b	10.8bc	12.2b
Control	0.0a	0.4a	0.2a	0.8a	0.0a	0.4a	0.2a	0.4a

The values of average followed by different word means significantly different based on the test of BNT on α 5%

Regarding all treatments of artificial diet, the average of the rangrang population in the pod surface in all observations showed that in week 1 the average of the rangrang population stood at 5.2 to 6.2 individuals per pod, but then slightly increased to 6.0-7.4 individuals per pod in the week 2, continuing increase of population to 8.8-10.6 individuals per pod in the week 3 and 8.0-10.4 individuals per pod in week 4. All treatments showed significantly different to control, reaching just 0.0-0.8 individuals per pod.

In contrast to the next observation among trials from the week 5 to the week 8, the average of the rangrang population in the shrimp pellet was noticeably higher to 13.8 individuals per pod than chicken intestine pellet with 8.2 individuals per pod. However, in the trial of shrimp pellet the average number of the rangrang population was not significantly higher than population in the palm sugar pellet reaching 11.4 individuals per pod. In control, without pellet, there were no population of the rangrang.

In the week 6 of observation, the average of the rangrang population every pod on the trial of shrimp pellet was 13.8 individuals, chicken intestine was8.6 individuals, and palm sugar pellet was with 12.4 individuals. The average number of the rangrang in these trials on this week 6 observation was higher population than the rangrang in the control, reaching just 0.4 individuals per pod.

In the week 7, the average number of population foraging in the pods with shrimp pellet treatment was 13.4 individuals per pod, having noticeably different population from the average number of the rangrang population in the pods which was given chicken intestine with 10.0 individuals per pod and even the greatest significantly different from the average number of population in control with just 0.2 individuals per pod. However, comparing to palm sugar pellet, there was no significantly different, reaching 12.4 individuals per pod. Meanwhile, comparing to the palm sugar pellet trial, the number of population in pods with chicken intestine pellet had no different population but different population from control.

In the last observation, week 8, the average number of the rangrang population every pod was which shrimp pellet treatment was 17.6 individuals. It seemed to be the greatest significantly different population from any other treatments and control (0.2 individuals).The average number of population every pod sample in the chicken intestine pellet was 11.0 individuals, having no different population from palm sugar pellet with 12.2 individuals but noticeably different population from control, having very rare population to visit pod sample.

As Untung, (1993) points out, an organism whose ability of high production new generation was when had sufficient food and help of optimal physical environmental condition assisted to maximize development of population so that the organism enabled to multiply their population with regard to their genetic ability. The field study on the ant population conducted by Tamrin *et. al*. (2010) revealed that the implementation of artificial diet led to develop optimal population of ant so that their population developed rapidly.

Food for ant varied and those could be classified into two main groups namely; sugar and protein which protein can be found on the red and white meats, shrimp, chicken intestine, body of rat and insects. The rangrang preferred protein to sugar but they needed less sugar to fulfill their diet. Finding sugar for their diet, the rangrang preferred honey dew produced by

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either hemypteran and homopteranor nectar of flowers. In terms of reservoir energy, honey dew was required on the earlier period of their nest development (Van Mele et al. 2004). The study conducted by Subiadi in 2001 emphasized that the population of the rangrang attracted overwhelmingly to sort of artificial diet made from chicken intestine, small piece of meat, and palm sugar.

Regarding the benefits of ant behavior on this research in controlling cocoa pest, abundant number of population especially on the cocoa pods with shrimp pellet treatment might be caused by huge complexity of such pellet composition. The protein value was categorized as protein sufficiency due to enormous amino acid so that 85-95%of protein could be digested easily by the rangrang. Performance of amino acid from each 100 gr of shrimp pellet contained 3465mg glutamate acid, 2100 mg aspartate acid, 1775 mg arginine, 1768 mg lysine, 1612 mg leucine, 1225 mg glycine, 985 mg isoleucine, and 956 mg valine. In addition, due to complicity of shrimp pellet composition, preference of the rangrang might be affected to flavor.

The Effect on Various Artificial Diet Against Severity Pod Damage Caused by CPB

The result of observations revealed that of all pods determined were not found heavy pod damage.There were only healthy pod to middle pod damage.The lowest severity pod damage was observed on the pods which were given shrimp pellet, reaching at 7.44% from health to middle pod damage. Nevertheless, all pods observed without treatment showed that there were as three times high as severity pod damage with shrimp pellet treatment, having 21.54 %with middle to heavy pods (Table 2).

Table 2. The effect on the kinds of artificial diet towards severity pod damage caused by CPB

Treatments	*Pod damage caused by CPB*	*Category of pod damage (%)*				*Total pods*	*Severity damage (%)*
		health (So)	*slight (Ri)*	*middle (Se)*	*Heavy (Be)*		
Shrimp pellet	13	1	4	0	0	5	7.44
Chicken intestine Pellet	10	0	2	3	0	5	21.54
Palm sugar Pellet	14	0	4	1	0	5	13.38
Control	13	0	2	3	0	5	21.54

Fewer severity pod damage caused by CPB on the pods which was given shrimp pellet was predicted due to the number of rangrang population foraging such pods so that every observation their population had a tendency to increase gradually. Also, their abundant population in the pod sample correlated to their role of predation for CPB. The population of rangrang had aggressive behaviour in seeking food and sent back to their nests for their colony and next generation purposes. They could predate aggressively many different insect pests such as moths which were nocturnal activity or other insects which were diurnal activity living behind the leaves of trees (Anonymous 2011). Once again, Rangrang has become the

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greatest natural enemy of 16 species of insect pests recorded which attacked various trees such as cocoa, coconut, palm tree, mangoes, eucalyptus, andcitrus. Together with their relatives, *Oecophylla longinoda*, rangrang (*O. smaragdina*) gave protection those trees mentioned fromthe infestation of crop pests (Khoo and Way1991).

CONCLUSION

Regarding the result of this study it could be strongly emphasized that of four trials assessed, pods with trial of shrimp pellet was the highest population of rangrang foraged, making up the average of 10.4 individuals per pod. Following by Palm sugar pellet, there was the second higher population to visit with the average of 9.7 individuals per pod and then trial with chicken intestine pellet was the average of only 8.2 individuals per pod. In contrast to the control (without pellet on the pod surface) the population of rangrang remained stable. The difference population among the effect on artificial diet beginning with week five (5) to week eight (8) was always the highest population on the pods with trial of shrimp pellet so that the reduction of pod damage caused by CPB about 7,44 % achieved.

SUGGESTION

This study interested should be extended to understand the optimum performance of ranrang population for coming pod season.

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