# THE USE OF BOKASHI FERTILIZERS AND BIOLOGICAL CONTROL OF COCOA POD BORER (Conopomorpha cramerella) ON COCOA FARMERS IN LANGKAT DISTRICT, NORTH SUMATERA

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**ABSTRACT**

Cocoa is a source of life for more than 6.5 million smallholder families. The numbers of cocoa farmers in Langkat Regency are around 2081 with an area of 2603 / ha. Langkat farmers' cocoa production is only around 950 kg/ha, but some farmers only produce around 450 kg/ ha/year. One of the problems with the low production of cocoa in Indonesian, especially in the Langkat Regency of North Sumatera was caused by the lack of fertilization as well as the scarcity of subsidized an-organic fertilizer. In addition to attacking by pests and diseases, such as Cocoa Pod Borer (CPB) and VSD (Vascular Streak Dieback) disease. Cocoa Pod Borer, Conopomorpha cramerella is a very serious pest and decreasing of production up to 80%, this is due to the fact that the CPB is difficult to control and has spread throughout the Langkat Regency. Fertilization is carried out with bokashi organic fertilizer from the leaves of cocoa, bran, husk, and manure which is fermented with EM-4 as much as 2 kg/tree. Biological control using Dolichoderus thoracicus Smith ant has been developed as a natural agent for controlling CPB pests by making ants nest from 30-40 dried cocoa leaves and tied with raffia ropes. After 6 months, young fruits aged 1 and 2 months that have been developed by Dolichoderus thoracicus Smith are harvested after ripening, and the result is that cocoa fruit is only severely under 5%. Most of the farmers communicated to apply to their respective cocoa gardens an hoped they could produce organic cocoa in the future.v

**Keywords**: Bokashi, Dolichoderus thoracicus Smith ants, CPB pests, Cocoa

## A. PREFACE

Indonesia, as a World producer Country after Ivory Coast and Ghana, has the potential to become the world's first largest cocoa producer by 2020. This development program has been settled by the government because of the availability of land, labor, and the increasing in farmers' knowledge and the main thing is to increase the farmers' economy (DirJenbun, 2015). Cocoa is the livelihood of more than 6.5 million smallholder families, especially in North Sumatra the area of cocoa plants is 57,029 hectares cultivated by 64718 farmers. Cocoa farmers in Langkat Regency are about 2181 with an area of 2603 Ha. Cocoa production of Langkat Regency farmers only obtained about 950 kg/ha/year (DirJenbun. 2015), although some farmers only produced under 400 kg/ ha/year. One of the low production problems of Indonesian cocoa was caused by the lack of intensive maintenance such as fertilization and crop disturbing attacks, especially Cocoa Pod Borer (CFB) and VSD disease (Vascular Streak Dieback). CPB pests caused by Conopomorpha cramerella were the main pests that reduced the production and quality of cocoa beans dramatically presented 40 - 80% (Day. 1985; USAID. 2007; Wardoyo. 1980). The increase of pest population highly affected by natural balance such as enemy threats and not in accordance with the method of insecticide application. Cocoa pod borer, Conopomorpha cramerella, is a very serious pest because it is hard to be controlled and has spread throughout Indonesia territory (Santoso et al. 2004). The damage caused by CPB attacks on cocoa is the occurrence of a squeeze on the affected fruit, the fruit ripens and the seeds become sticky (Ooi 1987). In the ripe fruits, the cocoa beans stick together and finally hardened (Wardojo 1980, Azhar 1988). The seeds cannot reach the normal size in the fruit and the infested cocoa beans have no aroma and do not produce fermented and dried chocolate (Misnawi and Teguh 2008). These made them have the low quality and difficult in selling. The damage starts when CPB females put egg on the fruit skin. After hatching, the first instar larvae pierce the skin of the fruit and directly get into the fruit (Lim 1987). Once inside the fruit, the larvae feed on the pulp that wraps the seeds and placenta (Lim 1992), resulting in a squeeze inside (Azhar 1995). About 15-18 days after hatching, the larvae go to the fruit surface, making a hole for pupae (Saleh 2011). This action can cause the fruits to remain in many cases the infected fruit can still be ripe, but the their shapes and sizes are not normal (Saleh 2011). The efforts to control CPB attacks have been carried out with the application of broad-spectrum Organochlorine insecticides and Cypermethrin (Wood et al. 1992,). Although chemicals can easily kill the CPB imago (Misnawi and Teguh 2008), this method is not environmentally friendly and efficient in the long term (Saleh 2011). Another strategy is using Dolichoderus thoracicus Smith ant as a potentially good biological agent and it has been successful, efficient, practiced commercially (Saleh 2011). However, it is necessary to have the development study of using Dolichoderus thoracicus Smith ant in the farmers' gardens that the area and location are very diverse. In this study, we will examine the potential sources and techniques of development in intensive farmers’ farms that can controll the C. cramerella population.

## B. MATERIALS AND METHODS

The study was carried out on cocoa farmers in Timbang Jaya village, Bahorok district, Langkat North Sumatra. This area includes the Bukit Barisan Mountains cluster that extends from the Northeast to the Southeast of Sumatra Island, has a rainy season and the peak of the rainy season is at the end of December to mid-January, with an average of 3000-4000 mm/year. Farmers' cocoa plants vary widely and are generally planted around the houses with an amount of the appropriate amount of land. Then the plants are maintained intensively with the addition of fertilizer. The plants are grown side by side with other plants such as coconut, bananas, rubber as shade plants. The Observations were made by observing the presence of Dolichoderus thoracicus Smith ants and mealybugs on cocoa plants and surrounding plants. On the harvested fruit, the presence of mealybugs was observed and seen by CFB attacks

## C. RESULTS AND DISCUSSION

From the observations on 10 farmer's farm locations in Timbang Jaya Village, they consist of 50 to 300 tree crops. The condition of the plants is not well maintained and mixed with other plants such as coconut, rubber, areca nut, etc. seen in Figures 1 and 2.

Figure 1: Cacao mixed with coconut and

Figure 2 : Cacao mixed with rubber, etc

Dolichoderus thoracicus Smith ants host plants were found in the cocoa plantation area of the farmers in Timbang Jaya Village, Bahorok District, which can be seen in Table 1.

Table. 1. Dolichoderus thoracicus Smith ants host plants, D. thoracicus, and Mealybug, C. hispidus

| Number | Plants | |
|---|---|---|
| 1 | Randu | *Ceiba pentandra* |
| 2 | Coconut | *Cocos nucifera* |
| 3 | Banana | *Musa acuminate* |
| 4 | Ketapang | *Terminalia catappa* |
| 5 | Soursop | *Annona muricata* |
| 6 | Starfruit | *Averrhoa bilimbi* |
| 7 | Duku | *Lansium parasiticum* |
| 8 | Durian | *Durio zibethinus* |
| 9 | Mangosteen | *Garcinia mangostana* |
| 10 | Jackfruit | *Artocarpus heterphyllus* |
| 11 | Pinnaple | *Annas cosmosus* |
| 12 | Bamboo | *Bambusa vulgaris* |
| 13 | Rambutan | *Nephelium lappaceum* |
| 14 | Areca nut | *Areca catechu* |

The existences of Dolichoderus thoracicus Smith ants and mealybugs, Cataenococcus hispidus on the other plants around cocoa plants are very helpful to develop Dolichoderus thoracicus Smith ants. They exist on the host plant because there are mealybugs/scales that are always on the flowers, Nokta leaves, and leaves. Mealybugs and scales pull out secretions as the main food of Dolichoderus thoracicus Smith ants. they nest on stacked leaves, on the fruits/flowers or hollow parts. Artificial nests of them can be made from the leaves of host plants, such as strands of coconut leaves, bananas, areca nuts, and cocoa leaves. Saleh in 2007 and 2011 suggested, as many as 30 leaf strands tied with raffia rope (A) or could be inserted into a polyester bag (B), white plastic bag (C) and black plastic bag (D) like Figure, 3 then hung on the host plant which lots of smith ants

Figure 3.Various ingrediens of smith ant nest *Dolichoderus thoracicus*. A: non-permanent nest from dried cocoa leaves; B: permanent nest from polyester bag; C: white plastic bag; dan D: black plastic bag (Saleh 2012)

After 1-2 months, artificial ant nests have contained ant colonies and can be removed from cocoa plantations where there are no smith ants. When smith ants already exist in the cocoa plants, an empty artificial nest is enough. The nest usage placed on each cacao tree is to make an available place for breeding smith ants. Saleh 2012, said that permanent nests such as the use of polyester material can last more than 5 years, so that the ant population remains stable on the cacao tree, and is more efficient.

In Table 2, it can be seen that 62% of the cocoa trees in the farmers' garden have been found smith ants. The black fungus moves from adjacent host plants without being developed by farmers. But the population of cacao fruit is very low so that development is needed by laying artificial nests on cocoa plants.

Artificial nests made as shown in Figure 3 can be placed directly on cocoa plants that already have smith ants which are 62%, while the rest 38% where the trees do not have smith ants, artificial nests must be placed for 1- 2 months on many ant hosts, especially first. Then it was transferred to the cocoa plant. Saleh 2007, recommends that when moving smith ants to the cocoa plant must coincide with developing mealybug. Mealybug can be removed by placing slices of cacao skin with mealybug and placing them on a fruit> 10 cm in size. (Figure 4). The fruit peel is cut in a V shape to make it easy to hang onto the fruit stalk (Figure 4 B).

(A) (B)

Figure 4. Piece of cacao fruit skin with white mealybug (A) and piece of skin placed on the cocoa fruit with 10 cm size (Saleh 2011)

Table 2. The existence of Dolichoderus thoracicus Smith Ants and Mealybug on Cocoa Fruits

| Location Number | Amount of Plants Observed | The existence of Smith ants and Mealybug on Cocoa Fruits | | Plants with ants (%) |
|---|---|---|---|---|
| | | Exist | Not Exist | |
| 1 | 10 | 3 | 7 | 30 |
| 2 | 10 | 8 | 2 | 80 |
| 3 | 10 | 10 | 0 | 100 |
| 4 | 10 | 9 | 1 | 90 |
| 5 | 10 | 7 | 3 | 70 |
| 6 | 10 | 8 | 2 | 80 |
| 7 | 10 | 5 | 5 | 50 |
| 8 | 10 | 2 | 8 | 20 |
| 9 | 10 | 8 | 2 | 80 |
| 10 | 10 | 2 | 8 | 20 |
| Total | 100 | 62 | 38 | **62** |

Smith ants and mealybug are symbioses mutualism, namely, mealybug produces secretions which are the main food of smith ants, while smith ants protect mealybug from their natural enemies. The activeness of smith ants on the fruit that moves at any time will interfere with the CFB's image to lay eggs so that the fruit avoids CFB attacks. The effect of smith ants and mealybug on fruit can be seen in Table 3.

Table. 3. The existence of Dolichoderus thoracicus Smith Ants and mealybug on Cocoa Fruits and Cocoa Fruit Borer attack rate

| Number | Fruits with mealybug/ CPB attacked | | | | Fruits without mealybug/ CPB attacked | | | | Total of Fruits Observed | Severely attacked by CPB |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Free | Light | Severe | Total | Free | Light | Severe | | |
| 1 | 5 | 0 | 5 | 0 | 20 | 0 | 15 | 5 | 25 | 5 |
| 2 | 10 | 7 | 2 | 1 | 3 | 0 | 3 | 0 | 13 | 1 |
| 3 | 12 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 12 | 0 |
| 4 | 9 | 8 | 1 | 0 | 3 | 0 | 2 | 1 | 12 | 1 |
| 5 | 15 | 12 | 3 | 0 | 5 | 0 | 3 | 2 | 20 | 2 |
| 6 | 18 | 13 | 4 | 1 | 10 | 0 | 7 | 3 | 28 | 4 |
| 7 | 8 | 5 | 3 | 0 | 6 | 0 | 5 | 1 | 14 | 1 |
| 8 | 4 | 0 | 2 | 2 | 10 | 0 | 8 | 2 | 14 | 4 |
| 9 | 16 | 14 | 2 | 0 | 8 | 0 | 4 | 4 | 24 | 4 |
| 10 | 7 | 2 | 4 | 1 | 10 | 0 | 6 | 4 | 17 | 5 |
| | **104** | **72** | **27** | **5** | **75** | **0** | **53** | **22** | **179** | **27** |
| % | | **69.3** | **25.9** | **4.8** | | **0** | **70.7** | **29.3** | | **15.1** |

Table 3. Showing that cocoa fruit harvested contained Dolichoderus thoracicus Smith ants/mealybug only 4.8% severely attacked and 25.9% attacked lightly. The fruit was said to be severely stricken if> 50% of the seeds stick to one another so that it is difficult to remove and the seeds sticky because the placenta is attacked by CFB larvae. Whereas in fruits with no smith ants/mealybug, 29.3% were severely stricken and 70.7% were lightly attacked. From Saleh's (2003, 2006a and 2006b) obtained that to control CFB, Dolichoderus thoracicus Smith ants population must be high and indicated by percentage harvested fruit must be> 75% there are Dolichoderus thoracicus Smith ants and mealybug. This can be done by providing Dolichoderus thoracicus Smith ant nests in each cacao tree and harvesting every 7 days.

## D. CONCLUSION

Dolichoderus thoracicus Smith ants have the potential to control cocoa pod borer, C. cramerella in a cocoa farmer's farm in Timbang Jaya Village, Bahorok District. Farmers have the potential to produce organic cocoa in the future.


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## BIBLIOGRAPHY


**A**zhar I. (1988). Host plant resistance to a temporary cocoa pod. Croc. MARDI Senior Staff Conf. Kuala Lumpur. 1 - 26.

Azhar I. (1995). An overview of the cocoa pod major, the Conopomorpha cramerella. The planter. Malaysia 71 (835): 469-480.

Day R. K. (1985). Control of the temporary cocoa pod (Conopomorpha cramerella). Ph.D. Thesis. University of London.300 pp.

Dir. Jenbun. 2015. Indonesian Plantation Statistics 2014 - 2016. Cacao Commodities Directorate General of Indonesian Plantations. Jakarta.

Lim G. T. (1987). Biology, ecology, and control of cocoa pod temporary, Conopomarphacramerella (Snallen). Workshop on the Assessment of Plant Protection Risks for Cocoa Lembang, Indonesia. September, 28 - October, 2: p.1 - 26.

Lim G. T. (1992). Biology, ecology, and control of cocoa pod temporary Conopomorpha cramerella (Snellen). In cocoa pest and disease management in Southeast Asia and Australia. (eds. Keane, P.J and Putter, C.A.J.). 85 - 100.

Madry, B. 1994. Technical policies for crop protection in relation to the control of cocoa fruit borer (CPB) in Indonesia. Proceedings of Workshop on Cacao Borer (PBK) Pest Management in Indonesia, pp. 10-17. Research Center for Coffee and Cocoa.

Misnawi & Teguh W. 2008. Potential uses of cocoa bean infested by Conopomorpha cramerella for polyphenol extraction. ASEAN Food Journal, vol. 15, p. 27-34.

Ooi, P.A.C. 1987. Advances in the biological control of cocoa pod are temporary. In Management of the temporary cocoa pod (eds. Ooi, P.A.C. et al). MAPPS, Kuala Lumpur.103 - 117.

Saleh, A. (2003). Distribution of Cocoa Pod Borer (CPB), Conopomorpha cramerella (Snellen) and Potential of using Cocoa Smith ant (CBA), Dolichoderus thoracicus (Smith) and Cocoa mealybugs (CM), Cataenococcus hispidus Morrison as Biological Control Agent in Lonsum Estates, North Sumatra Indonesia. M.Sc. Thesis. Universiti Sains Malaysia.

Saleh, A., Abu Hassan, A. & Che Salmah, M. R. (2006a). Establishment of Dolichoderus thoracicus (Smith) to control Helopeltis theobromae Miller and Conopomorpha cramerella (Snellen) Lonsum cocoa plantations in Indonesia. IMT-GT Conference. Medan, Indonesia. June, 22 - 23. p.1-5.

Saleh, A., Abu Hassan, A. & Che Salmah, M. R. (2006b). Strategies in Controlling Conopomorphacramerella (Snellen) (Lepidoptera: Gracillariidae) in Lonsum cocoa plantations, Indonesia. IPICEX2006 conference. Kuala Lumpur, Malaysia. November, 26-29. P. 1-6.

Saleh, A. 2011. Establishment of the Biological Control System by Smith ant, Dolichoderus thoracicus (Smith) (Hymenoptera: Foemicidae) And Mealybug, Cataenococcus hispidus (Morrison) (Homoptera: Pseudococcidae) Against The Cocoa Pod Borer, Conopomorpha cramerella (Snellen) (Lepidoptera: Gracillariidae) in North Sumatra, Indonesia. Ph.D. Thesis, Universty Science Malaysia. Pg 204.

USAID. 2007. A Value Chain Assessment of Coca Sector in Indonesia. Jakarta. ISBN 979-002-187-9.Hal 362.

Wardojo S. (1980). The cocoa pod borer- A major Hindrance to Cocoa development. Indonesia Agriculture Research and development 2 (1): 2-4.

Wood B. J., Chung, G. F., Cheong, S. S. & Foh, C. C. (1992). Trials on the control of the cocoa pod temporary Conopomorpha cramerella. (Snellen) in Sabah by regular complete harvesting. Physical Pest Management. 38. 3. 271 - 278.