

Exploration of Cocoa Pod Pest and Damage Level in Lima Puluh Kota Regency, West Sumatera, Indonesia

Pajri Ananta Yudha ^{a*}, Indra Dwipa ^b and Dedi Azwardi ^c

^a Department of Agrotechnology, Faculty of Agriculture, Riau University, Pekanbaru, Riau, Indonesia.

^b Department of Crop Science, Faculty of Agriculture, Andalas University, Padang, West Sumatera, Indonesia.

^c Assessment Institute for Agricultural Technology of West Sumatera, Sukarami, West Sumatera, Indonesia.

Authors' contributions

This work was carried out in collaboration among all authors. Author PAY writing the manuscript, conducting the research, author ID reviewing and proofing manuscript, author DA reviewing manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAAR/2021/v17i430202

Editor(s):

(1) Dr. Villagomez Cortes Jose Alfredo Santiago, University of Veracruz, Mexico.

Reviewers:

(1) Sujayanand G. K., ICAR-Indian Institute of Pulses Research, India.

(2) Wilson A. Oyange, Kenya.

(3) Godswill Ntsomboh Ntsefong, University of Yaounde 1, Cameroon.

Complete Peer review History, details of the editor(s), Reviewers and additional Reviewers are available here:
<https://www.sdiarticle5.com/review-history/79561>

Original Research Article

Received 12 October 2021
Accepted 20 December 2021
Published 22 December 2021

ABSTRACT

Aims: The study aimed to explore the cocoa pod pests and the damage level of pests in Lima Puluh Kota regency, Indonesia.

Study Design: Purposive random sampling.

Place and Duration of Study: The research was conducted in cocoa field in Lima Puluh Kota Regency, West Sumatera, Indonesia from January to June 2021.

Methodology: Purposive random sampling was used in the research. Three districts that have cocoa fields were chosen as location of the study. One sub district of each district was chosen and two cocoa fields of each sub district were chosen as sampling. The criteria of field sampling were 1) the field area was 0.5 hectare, 2) the plants age ± 4 years and the plants were productive.

Results: The result showed that cocoa pod borer (*Conopomorpha cramerella*) and pod sucking bug (PSB) (*Helopeltis* spp.) were the cocoa pod pest insects in Lima Pulu Kota regency. The percentage of attacked plants by CPB and PSB in Lima Pulu Kota were 21.18% and 56.28% respectively. Attacked pods by CPB and PSB were 10.82% and 79.45%. For attack intensity of CPB and PSB, there were 8.52% and 41.09% respectively.

Conclusion: According to result obtained, the attack intensity of CPB and PSB in Lima Pulu Kota were Slight and Moderate respectively.

Keywords: Cocoa; *conopomorpha cramerella*; exploration; *Helopeltis* spp.; pests.

1. INTRODUCTION

Cocoa (*Theobroma cacao* L.) plays an important role for Indonesian economy. The crop is third place in contributing to foreign exchange of estate sector after palm oil and rubber [1,2]. Cocoa plantations are evenly distributed in almost all major islands of Indonesia. The main cocoa production center is Celebes Island and it contributes 58% of national production. The cocoa production center in Sumatera island is West Sumatera which contributes 8% of national production [3]. Cocoa in West Sumatera was the third best export commodity of estate crops after palm oil and rubber. One of cocoa producer regions in West Sumatera is Lima Pulu Kota regency. It is located in 0°25'28.71"N - 0°22'14.55 S and 100°15'44.10"E - 100°50'47.80" E with the altitude 110 above sea level (asl) to 2,261 asl. There are 4,196 hectares of cocoa plantation in this region which are spread evenly in each district [4].

The main problem in cocoa cultivation is pest attack. There are 130 insect species that were reported to attack cocoa plants [5], but just several insects were reported as main pests in West Sumatera such as pod borer (*Conopomorpha cramerella* Snell. (Lepidoptera: Gracillariidae) and pod sucking bug, *Helopeltis antonii* Sign (Hemiptera: Miridae). These pests commonly attacked the cocoa pods and decreased cocoa beans [6,7].

Abundant pest populations are an obstacle in cocoa productivity enhancement efforts. The populations are affected by environmental factors that differ per region, and this leads to different levels of pest, attack for each region. The information of pod cocoa pest attack in Lima Pulu Kota regency is needed to determine the appropriate controlling technique of the pest. Thus this research aimed to study the cocoa pod pests, and the level of damage they cause in Lima Pulu Kota Regency.

2. MATERIALS AND METHODS

2.1 Materials

The research was conducted in farmer's cocoa fields in Lima Pulu Kota regency, West Sumatera, Indonesia from January-June 2021. The materials were cocoa pods, camera and stationery.

2.2 Research Method

The research was conducted by using survey method with purposive random sampling. The criteria to determine the sampling location was ±0.5 hectare of cocoa field and the plants selected where those that had produced pods and of age > 4 years.

2.2.1 Determination of sampling location

According the cocoa field area, three districts were determined as locations, Payakumbuh, Guguk and Bukit Barisan. Two location were chosen as samplings locations for each district. At each location, the cocoa field area was ±0.5 hectare and the number of cocoa plant was ±400.

2.2.2 Plant sampling and observation

At each sampling location, 10% of the total number of cocoa plants were retained (40 plants). This was done systematically by making a longest straight diagonal lines. At each diagonal line, 15 plants were chosen as samples and at the longest straight line, there were 10 plants. The observations made on these plants included cocoa pod pests, percentage of attacked plant, percentage attacked part and attack intensity. The percentage of attacked plants were determined by using the following formula:

$$P = \frac{a}{b} \times 100\%$$

where : P : Percentage of attacked plants
 a : Number of attacked plants
 b : Number of observed plants

$$I = \frac{\sum (n_i \times s_i)}{N \times S} \times 100 \%$$

The percentage of attacked plant pods was calculated by using formula follows :

$$Pb = \frac{A}{B} \times 100\%$$

Where : Pb : Percentage of attacked pods
 A : Number of attacked pods
 B : Number of observed pods

Where : I : Intensity of attack
 ni : Number of attacked pods at certain score
 si : Certain score
 N : Number of observed pods
 S : Highest score

The attack intensity was calculated by using the following formula :

To calculate and determine intensity score, the determination was accorded to cocoa pods score as follows:

Table 1. Cocoa pod pest score on cocoa pods

Score	Level of attack	Category
0	All cocoa beans are easy to be removed from skin of pod, the beans are not sticky	Free
3	All cocoa beans can be removed from skin of pod, beans are not too sticky (Sticky beans < 10%)	Slight
6	Beans stick together, but they still can be removed from skin of pod (Sticky beans 10-50%)	Moderate
9	Beans stick together and they cannot be removed from skin of pod (Sticky beans > 50%)	Heavy

Source : Sulistyowati (2004) [8]

Table 2. Helopeltis spp. score on cocoa pods

Score	Level of attack	Category
1	If Symptom of sunken blackish brown spot on pod > 0 - ≤ 21 %	Slight
2	If Symptom of sunken blackish brown spot on pod > 21 - ≤ 50 %	Moderate
3	If Symptom of sunken blackish brown spot on pod > 50 %	Heavy

Source : Modified by Asrul (2004) in Mahdona (2009) [9]

3. RESULTS AND DISCUSSION

3.1. Result

3.1.1. Cocoa pod pest insect

According to field observations, there were two cocoa pod pests in Lima Puluh Kota regency, cocoa pod borer (CPB) and pod sucking bug. The pests were found equally in all districts (Table 3). This result indicated these pests was spread in Lima Puluh Kota regency.

Table 3. Cocoa pod pest in Lima Puluh Kota Regency

District	Pest
Bukit Barisan	1. Cocoa pod borer 2. Pod sucking bug
Guguak	1. Cocoa pod borer 2. Pod sucking bug
Payakumbuh	1. Cocoa pod borer 2. Pod sucking bug

According to the result obtained on cocoa pods in the field, the symptoms of CPB on cocoa pods were entry and exit holes and tunneling larvae on the husk and overall premature or uneven ripening (yellowing) of pods. If pods were opened, characteristic tunnels and scarification caused by feeding caused beans to stick together (CABI 2021) [10](Fig. 1). For pod sucking bug, the symptoms were dark, circular lesions on pods, usually hardening as scars on the husk. In severe symptoms, the husk shape changed (Plant Wise Knowledge Bank 2021) [11] (Fig. 2).

3.1.2. Percentage of attacked plants, attacked pods and attack intensity

The results showed that the average of percentage of attacked plants in Lima Puluh Kota Regency for CPB and PSB were 21.13% and 56.28% respectively. The highest percentage of plants attacked by CPB and PSB occurred in Payakumbuh. For percentage of attacked pod, the highest attack by CPB and PSB also occurred in Payakumbuh (Table 3).

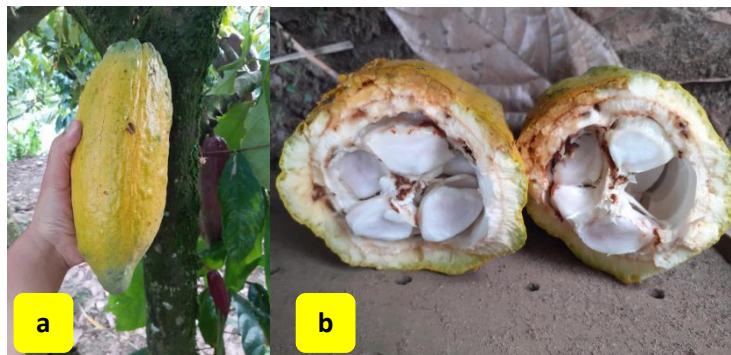


Fig. 1. Symptoms of cocoa pod borer (CPB) on cocoa pod (a. Yellowing of cocoa husk; b. Sticky beans)



Fig. 2. Symptoms of pod sucking bug (PSB) on cocoa pod (a. Slight attack; b. Severe attack)

Table 4. Percentage of attacked plant, attacked pod and attack intensity

Pests	District	Percentage of attacked plants (%)	Percentage of attacked pods (%)	Attack intensity (%)
Cocoa pod borer (CPB)	Bukit Barisan	20.00	17.24	14.30
	Guguak	7.69	3.53	1.17
	Payakumbuh	35.71	11.70	10.11
	Average	21.13	10.82	8.52
Attack category				Slight
Pod sucking bug (PSB)	Bukit Barisan	50.00	92.46	50.00
	Guguak	53.84	63.92	29.83
	Payakumbuh	65.00	81.97	43.45
	Average	56.28	79.45	41.09
Attack category				Moderate

The Percentages of attacked pods by CPB and PSB in Lima Puluh Kota were 10.82% and 79.45% respectively. The highest attack of CPB and PSB were found in Bukit Barisan. For attack intensity, it was 8.52% in Kabupaten Lima Puluh Kota. The highest intensity occurred in Bukit Barisan According to score, the attack intensity of CPB in Lima Puluh Kota was classified as Slight. For PSB, the attack intensity in Lima Puluh Kota was 41.09% and the highest attack occurred in Bukit Barisan (50.00%). According to result, the attack intensity of PSB was Moderate (Table 4).

3.2 Discussion

Cocoa pod borer (CPD) and pod sucking bug (PSB) were the main pests of cocoa plants detected in the study. The observation of cocoa pod borer attacked showed that the attack by pests in Lima Puluh Kota was slight. This condition was caused by several factors such as frequent harvest, pruning and sanitation or generally known as good agricultural practices (GAP). Frequent harvest and pruning were the key to control the cocoa pod infestation [8,12]. Frequent harvest aimed to remove the infested cocoa pods by CPB and PSB by burying the them into the soil [13]. Observations in Guguak showed that the damage level of CPB was the lowest compared with other districts. This result may be attributed to the fact that because farmers conducted frequent harvest, sanitation and pruning regularly (Fig. 3). Pruning and sanitation minimized CPB population in the field. The adults of CPB hid under leaves on the soil surface and lush leaves in horizontal branches [14]. By pruning and sanitation, this condition did not favor the activities of adult CPB. Different results were obtained in Bukit Barisan and Payakumbuh districts. Frequent harvest, pruning

and sanitation were not conducted in these districts. In these districts, the cocoa field was not assessed by farmers (Fig. 4). The CPB development was caused by rainfall, field humidity, shade plants and pod availability. 72% cocoa pod could support one CPB generation, 21% for two generations and 7% for three generations [15]. CPB development was also affected by frequent harvest. Frequent harvest in early pod ripening and followed by sanitation could suppress CPB population because CPB larvae were not yet out from the pods [8]. This condition caused the death of the larvae inside the pod during burning and burial in the soil. It was also observed that The CPB infestation during the rainy season was generally low [16].

The damage level of PSB in Lima Puluh Kota was classified as Moderate. This result could be due to the fact that the cocoa field condition was suitable for PSB development. As CPB, the development of PSB was affected by GAP performed by farmers. Rare pruning and watery buds provided the inhabitable condition for PSB development [17]. Watery bud became an alternative food source for PSB in cocoa plant. No sanitation in cocoa field caused many weeds to grew in field and these weed also became alternative host for PSB [18]. The result showed that the level of damage in Bukit Barisan was highest compared with other districts. The observation showed that many watery buds appeared on the cocoa plants (Fig. 5). Watery bud was a suitable place for PSB adult to lay eggs. Irregular pruning or lack of pruning caused the cocoa field condition to become moist. This condition was inhabitable for cocoa pests and diseases development. The regular pruning by removing watery buds every two weeks could minimized PSB infestation because the PSB eggs in watery buds were removed [19].



Fig. 3. Cocoa field with good agricultural practices (frequent harvest, pruning and sanitation) in Gugak



Fig. 4. Cocoa field without good agricultural practices (frequent harvest, pruning and sanitation) in Payakumbuh



Fig. 5. Watery buds of cocoa plant (red circle)

4. CONCLUSION

Cocoa pod borer (*Conopomorpha cramerella*) and pod sucking bug (PSB) (*Helopeltis* spp.) were the cocoa pod pest in Lima Puluh Kota regency. The percentage of attacked plant by CPB and PSB in Lima Puluh Kota were 21.18% and 56.28% respectively. Pods attacked by CPB and PSB were 10.82% and 79.45% respectively. The intensity of attack by CPB and PSB, there were 8.52% and 41.09% respectively. According to the result, attack intensity of CPB and PSB in Lima Puluh Kota were Slight and Moderate respectively.

ACKNOWLEDGEMENTS

The authors would like to thank to all participants who have participated and supported the research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ghufon WPC, Ratya A, Condro PN. Analysis of cocoa response in Indonesia. *Agricultural Socio-Economics Journal*. 2020;20(1):79-88
2. Ministry of Agriculture Republic Indonesia. *Cocoa in Indonesia*; 2021. Available: https://www.pertanian.go.id/index_en.php
3. Statistics Indonesia. *Cocoa production in Indonesia*; 2021. Available: <https://www.bps.go.id/>

4. Diskominfo Kabupaten Lima Puluh Kota. Profil Kabupaten Lima Puluh Kota; 2021. Available:<https://kominfo.limapuluhkotakab.go.id/>. [Bahasa Indonesia]
5. Enwistle PF. Pest of cocoa. Tropical science series. Longman; 1972.
6. Al KS, Marta D. Identification and observation of cocoa pest in Cubadak, Lima Kaum district, Tanah Datar regency, West Sumatera, Indonesia. *Bio-Lectura*. 2018;5(2):200-205.
7. Sabarman D, Herman. Prospect and strategy of sustainable cocoa development in West Sumatera. *Perspektif*. 2010; 9(2):94-105.
8. Sulistyowati E, Susilo AW, Prawoto A, Mufrihati E. Integrated management of cocoa pod borer (*Conopomorpha cramerella*). *Proceeding*. Prosiding Simposium Kakao. Jember. Indonesia. 2004; 112-130. [Bahasa Indonesia]
9. Mahdona N. Tingkat serangan hama kepik penghisap buah (*Helopeltis* spp) (Hemiptera: Miridae) pada Tanaman Kakao (*Theobroma cacao* L.) di Dataran Rendah dan Tinggi di Sumatera Barat. [Bachelor Thesis]. Faculty of Agriculture, Andalas University, Padang, Indonesia; 2009. [Bahasa Indonesia]
10. CABI. Cocoa pod borer (*Conopomorpha cramerella*) symptom; 2021. Available:<https://www.cabi.org/isc/datasheet/7017>
11. Plant Wise Knowledge Bank. Plant sucking bug (*Helopeltis* spp.) symptom.; 2021. Available:<https://www.plantwise.org/KnowledgeBank/datasheet/26802>
12. Ade R, Merle S, Prakash H, Anita M. Control of cocoa pod borer and phytophthora pod rot using degradable plastic pod sleeves and a nematode, *Steinernema carpocapsae*. *Indonesian Journal of Agricultural Science*. 2010;11(2):41-47.
13. Rubiyo, Dewi YA, Imran, Agus S, Baharudin, Chandra I, Ratule MT. Evaluation of yield and pest and disease resistance of cocoa clones in Kolaka District, Southeast Sulawesi, Indonesia. *Biodiversitas*. 2020;21(12):5698-5707
14. Alam A, Shahabuddin, Folar P. Biological control of cocoa pod borer (*Conopomorpha cramerella* Snell) on cocoa plantation for maintaining cocoa production in Central Sulawesi, Indonesia. *Proceeding*. Malaysian International Cocoa Conference 2013. Kuala Lumpur, Malaysia. 2013;62-68.
15. Sulistyowati. Main pest management, observation technique and controlling on cocoa plant. Cultivation technique and processing of cocoa. ICCRI. Jember, Indonesia; 2003.
16. Baharudin, Alwi MM, Subaeda R, Syamsimar, Syahardi. Cocoa pod borer (*Conopomorpha cramerella* Snell) management. Petunjuk Teknis Rakitan Teknologi; 2004. [Bahasa Indonesia]
17. Mochamad S, Gatot M, Latief A, Toto H. arthropods diversity and population dynamic of *Helopeltis antonii* sign. (Hemiptera: Miridae) on Various Cocoa Agroecosystems Management. *Agrivita*. 2018;40(2):350-359.
18. Atmaja WR. Status *Helopeltis antonii* Sebagai hama pada beberapa tanaman perkebunan dan pengendaliannya [Status of *Helopeltis antonii* as a pest on some plantation crops and its control]. *Jurnal Litbang Pertanian*. 2010;22(2):57–63. [Bahasa Indonesia]
19. Wahyudi T, Panggabean TR, Pujianto. Panduan lengkap kakao, manajemen agribisnis dari hulu hingga hilir. Jakarta; 2008. [Bahasa Indonesia]

© 2021 Yudha et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/79561>