AGRIKULTURA CRI Journal 1 (2) **ISSN: 2782-8816 June 2021**

MIRID BUG (*Helopeltis bakeri* P.) DAMAGE ON CACAO (*Theobroma cacao*) IN THE MAINLAND PROVINCES OF BICOL, PHILIPPINES

Jose N. Tormes[1*], and Maria Dulce J. Mostoles[2]

[1]*Department of Agriculture Regional Field Office V, San Agustin, Pili, Camarines Sur, Philippines*

[2] *Central Bicol State University of Agriculture, San Jose, Pili, Camarines Sur, Philippines*

[*]*Corresponding author: josetormes1989@gmail.com*

Abstract — *Helopeltis bakeri* P., cacao mirid bug is one of the upcoming pests in the Philippines which results in the reduction of quality cocoa beans intended for processing. Sustainable pest management is essential for the effective control of this pest. Monitoring of its infestation in the plantations and the extent of pod damage is important information for the success of its control. Thus, the infestation of *H. bakeri* was monitored in selected municipalities in the mainland of the Bicol region, for a period of three months. Percentage-infested trees and damage ratings on cacao pods were recorded. Mirid bug-infested tress in cacao plantation was obtained at Gubat, Sorsogon with 23.85%, Guinobatan, Albay with 35%, Sipocot, Camarines Sur with 34.48%, and Labo, Camarines Norte with 0%. Pod damage on cacao along the three monthly monitoring periods increased in Sorsogon from 70.83% to 87.50%, decreased in Albay with 93.75% to 48.75%, and decreased in Camarines Sur from 87.92% to 85.42%. Zero pod damage in Camarines Norte for the period of 3 months. Continuous monitoring of the cacao mirid bug infestation and cacao pod borer occurrence is recommended as the basis for timely control.

Keywords — **Cacao, Bicol region, mirid bug, pod damage**

INTRODUCTION

Cacao (*Theobroma cacao* L.) today has been raised as a high-value commercial crop with total volume production of 37.98 metric tons throughout the Bicol Region in 2016. A reported average cacao production of 600 kilos per hectare in the Bicol region was while 909 kilos per hectare for the Philippines (DA RFO-5). Recently, production and global market demands for cacao beans are still increasing. However, in 2015, the International Cocoa Organization (ICO, 2015) estimated a 30 to 40 percent loss in cacao production due to insect pests and diseases. These losses pose an impact throughout the cacao supply chain, thereby having the most direct effect on family income.

Gavara (1990) recorded the presence of pests in the Philippines. There are four major pests namely: cacao pod borer, cacao mirid bug, black pod rot, and vascular streak dieback. In Davao 60-80% infestation from cacao pod borer was recorded. The cacao mirid bug was recorded in Quezon, Davao City, Zamboanga del Norte, and Aklan but no concrete data has been recorded on its possible infestation, however, it was claimed that infestation can be as high as 90% is uncontrolled. Recently, it has been identified as a major pest of cacao in Luzon. This mirid species prefers to feed and oviposit on cacao pods causing characteristic feeding lesions through which pathogens such as Phytophthora spp. can easily enter (Amalin, 2017).

There are four (4) species of *Helopeltis* have been reported in the Philippines, among which *H. bakeri* Poppius has most recently been identified as a major insect pest of cacao in Luzon. This particular mirid species prefers to feed and oviposit on cacao pods, causing characteristic feeding lesions damage (Amalin, 2017). The cacao mirid bug completes its life cycle in about 4-6 weeks. The females lay eggs in the stems or pods of the cacao tree. The nymph emerges after 13-18 days and is only about 3 mm long. After feeding for about four days, it is fully grown with its skin splits to the next nymph stage. The nymph passes through 5 instars over a period of 4 weeks before developing into winged adults. The adult female begins to lay eggs 4-11 days after mating and they can lay a total of about 200 eggs over a period of 30 days that are embedded in the bark of stems or inside the pod husk and may live a few weeks afterward, while the adult males live for two or three weeks (ICCO, 2015).

The damage inflicted on the growing vegetative parts causes the branches to dry out. Losses due to mirids are difficult to estimate, but can reach 30–40% of potential production in other countries (Adu-Acheampong et al., 2014 ; Awudzi et al., 2016).

Mirid adults and nymphs suck the sap from cocoa pods producing 3 mm diameter spots, which are brown at first then turn black. Young pods (cherelles), which are less than 10 cm long are destroyed, more mature pods are deformed and beans are smaller than those in healthy pods. Mirid destruction, if left unattended for three years, can reduce yields by as much as 75%. Cacao mirids pierce the surface of cacao stems, branches, and pods, killing the penetrated host cells and producing unsightly necrotic lesions. Mirids feeding on shoots often results in the death of terminal branches and leaves that vascular causing dieback (ICCO, 2015). Heavy infestations of mirid bugs can result in pod malformation and premature drop. Feeding on young pods sometimes results in pod wilting, since the feeding puncture provides an avenue for the second invasion of microorganisms. Thus, mirid bug can cause a significant loss in yield.

Today, various control measures such as insecticide applications, sanitation, pruning, and the use of biological control agents are being practiced but without complete control of insect pests and pathogens under the farmers' level. Additional productivity costs through unnecessary spraying without knowing the exact information on the pest status were encountered.

This study is taking into consideration some of the problems encountered by cacao farmers/growers on the *H. bakeri* as a major insect pest of cacao. The objective of this study is to determine the extent of pod damage of *H. bakeri* in cacao plantations in the four mainland provinces of the Bicol region. The study was delimited to the determination of the extent of pod damage by *H. bakeri* on cacao in plantations at Sorsogon, Albay, Camarines Sur, and Camarines Norte from October to December 2017.

MATERIALS AND METHODS

Site Description

The field assessment of *H. bakeri* was conducted in municipalities with cacao plantations in the four mainland provinces of the Bicol region. The municipalities identified were the following: Gubat in Sorsogon, Guinobatan in Albay, Sipocot in Camarines Sur, and Labo in Camarines Norte.

The municipality of Gubat is the third-largest town in the province of Sorsogon. The total area planted was 0.5 hectares of pod bearing cacao intercropped with coconut trees. The area is located at Barangay Ariman, Gubat, Sorsogon.

Guinobatan is a municipality in the province of Albay and is located at 13°11′N 123°36′E. According to the Philippine Statistics Authority, the municipality has a land area of 244.43 square kilometers (94.37 sqm) constituting 9.49% of the 2,575.77-square-kilometer (994.51 sqm) total area of Albay. The territory of Guinobatan is bordered by several municipalities: Camalig on the east, Jovellar on the south, Pio Duran on the south-west, Ligao on the Northwest. On the northeast, the town shares with Malilipot, Sto. Domingo, Daraga,Tabaco and Legazpi. Area planted to cacao is more or less 5.0 hectares with pod bearing stage intercropped with coconut trees. The area is located at Barangay Quibongbongan, Guinobatan, Albay.

Sipocot is a municipality in the province of Camarines Sur; its geographical location is 13° 46' 13" North and 122° 58' 52" East. The total area planted is 1.0 hectare with pod bearing stage and intercropped with coconut trees. The cacao area is located at Barangay Impig, Sipocot, Camarines Sur.

The municipality of Labo is geographically located relatively at the center of the province and capital town of the province of Camarines Norte. It is approximately 335 kilometers south of Manila and 15 kilometers away from Daet. It is situated at the coordinates between 14°01'06" and 14°11'00" North latitudes and 122°21'00" and 122°52'20" East longitudes. On the North, it is bounded by the municipalities of Paracale, Jose Panganiban, and Capalonga, on the South, by the province of Quezon, adjoining province of Camarines Sur, on the East by the municipalities of Vinzons and San Vicente, and on the West by the municipality of Sta. Elena. The municipality is generally rugged, rolling hills and mountainous terrain with relatively small rollings and flat terrain. The cacao area is located at Barangay Mapaod, Labo, Camarines Norte.

The Extent of Pod Damage of *H. bakeri*

The extent of pod damage by *H. bakeri* on cacao was conducted in cacao growing plantations in each municipality. The basis for the selection of cacao plantations in the municipality is more or less 1.0 hectare or 500 cacao in the pod-bearing stage. For every farm, only three cacao trees were. evaluated obtaining 10 pod samples per tree. Monitoring and evaluation were carried out for a period of three months. In order to assess the feeding of *H. bakeri*, percentage pod damage was done on the exposed side of the cacao pod, which was divided into four quadrants as testing chambers (Figure 1).

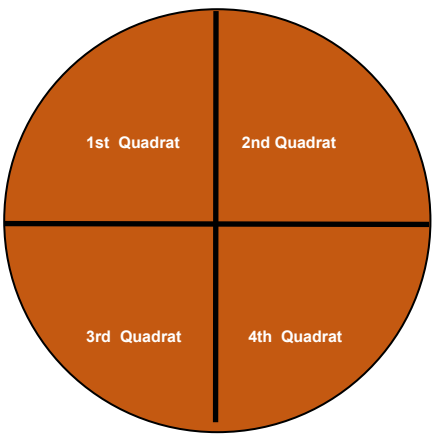

Fig. 1. Quadrats from where damage rating was done.

The damage rating was made using the was based on the number of quadrants with insect feeding, as follows:

0 = no damage (no lesions observed)
1 = 1 quadrant with lesions (1 – 25% damage)
2 = 2 quadrants with lesions (26 – 50% damage)
3 = 3 quadrants with lesions (51 – 75% damage)
4 = 4 quadrants with lesions (76 – 100% damage)

RESULTS AND DISCUSSION

Survey of Mirid Bug-Damaged Cacao Trees

At the Municipality of Gubat, the cacao trees in the area were damaged by the *H. bakeri.* Out of 520 cacao trees, only 124 trees were damaged by H. bakeri with percentage damage of 23.85%. This damage occurred because the farmer did not practice pruning or any control measures. Farmer in the area claimed that they were not aware that cacao pods were infested by *H. bakeri* and they were unable to identify the insect pest as well. Moreover, only *H. bakeri* caused severe damage to cacao and also disease such as pod rot causing 20% damage. Shown in Figure 2A are the pods infested by mirid bugs in the area.

For the Municipality of Guinobatan, Albay, the cacao trees in the area were likewise infested by the *H. bakeri.* Out of 1,000 cacao trees, only 350 cacao trees were damaged by *H. bakeri* at a computed infestation of 35.0%. (Figure 2B). This damage occurred because the farmer did not practice pruning or any control measures. Farmer in the area said that they did not know the control measures of insect pest of cacao and they were unable to identify the insect pest as well. It was observed in the area that even cherelles (young pods) were already infested by mirids which caused black circular lesions to the cacao pod. Aside from *H. bakeri* damage, cacao pods were also infected by pod rot disease at any stage of development and the initial symptoms are mummified on any part of the pod. Internal tissues, including the beans, are colonized and shrivel to form a mummified pod and disease incidence varies with cultivar, pod age, and rainfall. Usually, the greatest production is when rainfall is high (ICCO, 2015).

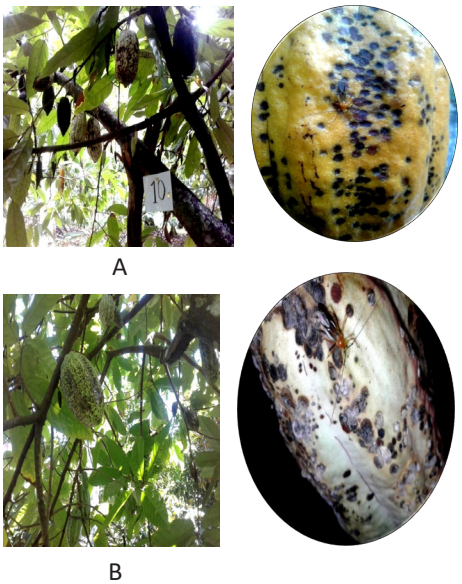

Fig. 2. Cacao pods damaged by *H. bakeri* in cacao farms at Gubat, Sorsogon (A) and Guinobatan, Albay (B).

At Sipocot, Camarines Sur, the cacao trees in the area were infested by *H. bakeri.* Out of 580 cacao trees, only 200 cacao trees were damaged pegged at an infestation of 34.48%. Shown in Figure 3 are the damaged pods with lesions covering the entire pods. This damage occurred because the farmer did not practice pruning or any control measures. Farmer in the area said that they did not know the control measures of insect pest of cacao and they were unable to identify the insect pest as well. Other despite observed in the area that even cherelle or young pods were already infested by *H. bakeri* which caused black circular lesions to the cacao pod. The damage done by mirids is thought to be mechanical destruction of the cells around the stylets or feeding tubes, the loss of cell sap, as well as damage caused by chemicals in the saliva injected as the mirids feed.

It has been shown that the saliva of cacao mirid bug can remove cell contents without mechanically damaging the cells and this can happen up to 3.5 mm from the stylet. It is presumed that this occurs by osmosis. Aside from the *H. bakeri* damage, the cacao pods were also infected by pod rot disease.

Fig. 3. Cacao pods damaged by *H. bakeri* in cacao farms at Sipocot, Camarines Sur.

At the Municipality of Labo, Camarines Norte, the cacao trees in the area were found to have no damage by *H. bakeri.* Out of 650 cacao trees, there was no indication of pod damage (0%). Shown in Figure 4 are the cacao trees and pods without indication of the presence of mirid bugs. It was obtained that *H. bakeri* is not present in the area instead a few pods were infected with pod rot.

Cacao was intercropped with banana and the farmer said they practice the proper pruning measures and fertilizer management on the cacao tree that learned from training.

Fig. 4. Healthy cacao pod tree in cacao farm at Labo, Camarines Norte.

Extent of Pod Damage by Mirid Bug

Mirid bugs cause an adverse effect on the physical appearance of the cacao pods. During the early stage of its infestation, the cherelles fall off while more mature pods exhibit a variety of symptoms. There are however cases wherein inner parts of the cacao pods are spared from damage thus cacao beans are still marketable.

For Gubat, Sorsogon, the extent of pod damage is shown in Figure 5 and samples with lesions of *H. bakeri* damage in Figure 6. The percentage of pod damage for the 1st monthly sampling (October) was 70.83%. There was an increase in the pod damage for the succeeding months with 83.75% for November and 87.50% for December. This increase in pod damage from 1 to 3 months occurred because the farmer never practiced control against the pests and regular monitoring was not done.

The cacao trees were fully shaded by a canopy that caused a higher incidence of *H. bakeri.* Overshading is the favorable breeding site for mirids resulting in higher populations in the cacao area (personal observation). In plantations, mirids gather in open canopy zones, known as mirid pockets. Population densities, although fairly low overall, reach maximum during the pod growth period.

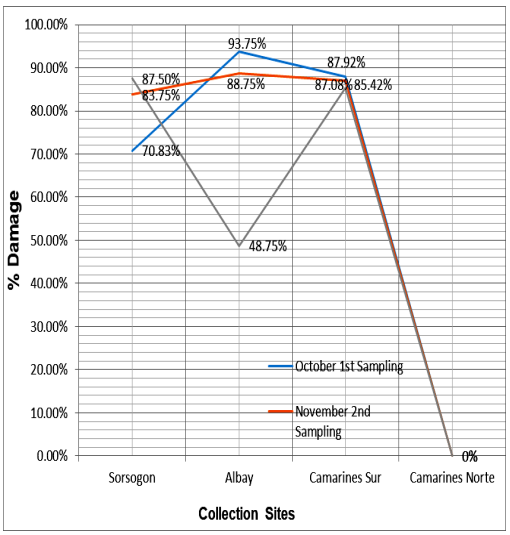

Fig. 5. Extent of pod damaged by *H. bakeri* in cacao farms in the four mainland provinces in the Bicol Region.

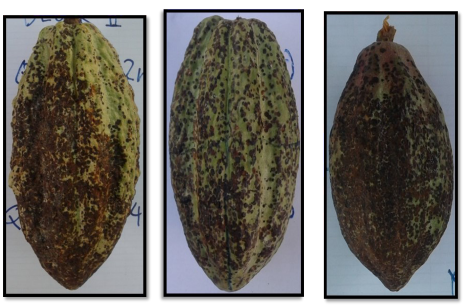

Fig. 6. Pod damaged by *H. bakeri* in the province of Sorsogon.

For Albay, the extent of pod damage by *H. bakeri* is shown in Figure 7. The percentage of pod damage for October was high at 93.75% which decreased in November (88.75%) and further decreased in December (48.75%) (Figure 5). The high pod damage occurred only in the 1st and 2nd samplings since the farmer did not apply control against the pest. Likewise, the fully shaded condition in the plantation with low hanging branches was favorable for the increase in population, thus, inflicting more damage. Though the farmer conducted regular monitoring of the pods in the cacao area, there was still high damage on to pods recorded. Shade and canopy management should be designed to attain a balance between mirid bug control, flowering, and black pod management. Another host should not be used as shade trees on cacao farms (ICCO, 2015).

Fig. 7. Pods damaged by H. bakeri in the province of Albay.

Mirid bugs usually occur on trees visible to sunlight since such trees tend to bear more fresh shoots and pods. Though the insect is attracted to trees exposed to sunlight, after tracing their source of food they inhabit shady areas on trees. Some native plants grown with cacao have been identified as alternative hosts for some species of mirid bug. In the 3rd sampling month, there was a sudden decrease in the percentage pod damage. During the first two sampling months, the researcher had the chance to discuss with the farmer some pest management strategies against the mirid bugs. One of the recommendations is corrective pruning measures to reduce the *H. bakeri* feeding activities to regulate the populations of the *H. bakeri* in the cacao pods. The farmer stated that pruning is a very effective method to control *H. bakeri* including the reduction in disease infestation (personal interview). It was reported in DropData (2014) that when pruning is done too severely, this will result to inflicting stress the cacao trees and cause the growth of new chupons, which increases the mirid feeding.

For Camarines Sur, the extent of pod damage by the mirid bug is shown in Figure 8. The percentage extent of pod damage in October was 87.92%, with a slight decrease in November (87.08%) and December (85.42%). The high percentage of pod damage for the three sampling months could be attributed to the pruning practices employed by the farmer. Improper pruning was done wherein the branches are thinned but the infected pod was left on the tree. This resulted in an increase in the incidence of pod rot.

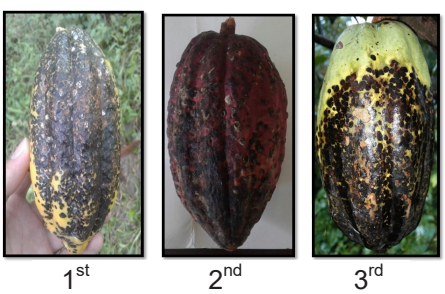

Fig. 8. Pods damaged by H. bakeri in the province of Camarines Sur.

The continuous feeding *of H. bakeri* on the pod lesions further caused the spread of the causal organism of pod rot. Thus, there was increased pod damage not only due to the mirid bugs but also due to pod rot.

There was no pod damage by *H. bakeri* in the cacao plantation at Labo, Camarines Norte for the entire duration of the study (October to December 2017) (Figure 9). The zero damage could be attributed to the absence of natural populations of *H. bakeri* since the plantation was just established. For a period of 4 to 5 years, there has no record of the incidence of the *H. bakeri*. It was also observed that the farmer practiced pruning and keen monitoring of pests.

In almost all the sites, the damage on pods by mired bugs appeared as dark, circular lesions usually hardening as scars on the husk. During heavy infestations, it results in pod malformation and premature drop. When young fruits are infested, pod wilts resulting from feeding on very young fruits. It was also observed that mirid bugs feed on cacao shoots occurs particularly on the midribs of leaves and on the stems. Thus, severe infestations result to shoot die-back (Amalin, 2017).

1st 2nd 3rd

Sampling Periods

Fig. 9. No pod damage by *H. bakeri* in the province of Camarines Norte.

The biology and control of this pest were carried out. Likewise, the infestation of this mirid bug in Camarines Sur has been done and among the farms surveyed by Ablitea (2017), cacao at Lupi area was entirely affected by mirid bugs with percent damage of 68% followed by Caroyroyan (Pili) (62.5%), San Juan (Del Gallego) (50.5%) and Carolina (Naga City) (50%). The lowest damage was found in Nabua with 42.8%. The farmers perceived that a symptom of mirid bug damage is not due to biotic but environmental factors. Farmers control the pests by using insecticides such as cyhalothrin and methomyl. Infected fruit is removed and piled in compost pits. Other cacao farmers just leave infected pods under the tree and wait for it to rot.

CONCLUSION

Infestation of *H. bakeri* , a major insect pest of cacao was observed in selected municipalities in the mainland of the Bicol region. Cacao plantation in Gubat, Sorsogon had a recorded mirid bug infestation of its trees at 23.85% while 35% of trees in a plantation at Guinobatan, Albay. For the plantation at Sipocot, Camarines Sur , 34.48% of the trees were infested while 0% for the cacao plantation at Camarines Norte. Monthly data obtained for the pod damage in the different plantations covering the months of October to December (2017) showed different trends. In Sorsogon, it increased from 70.83% to 87.50%, decreasing for Albay with 93.75% to 48.75%, and likewise decreasing for Camarines Sur from 87.92% to 85.42%. No infested pods were found in Camarines Norte for the period of 3 months.

RECOMMENDATIONS

Continuous monitoring of the occurrence and infestation by the cacao mirid bug must be done in the Bicol region and sustainable control strategies must be employed.

Considering that numerous plantations are being established in the entire region, surveillance of these pests particularly the Cacao pod borer as well as the mirid bugs should be done. Training of cacao growers must be intensified granting that this study has identified the lack of knowledge on the biology, behavior, and control of the different pests of cacao. With these, there is an assurance of sustainable production of cacao in the region.

ACKNOWLEDGMENT

The authors extend their heartfelt gratitude to the cacao farmers in the Bicol region.

REFERENCES

Ablitea, MM. 2017. Incidence And Control of Mirid Bug (*Helopeltis sp.)* In Cacao-Growing Areas of Camarines Sur. Undergraduate Thesis, Central Bicol State University of Agriculture . 35 pp.

Adu-Acheampong, R., Jiggins, J., VanHuis, A., Cudjoe, A. R., Johnson, V., Sakyi-Dawson, O., Jonfia-Essien, W. 2014. The cocoa mirid (Hemiptera: Miridae) problem: Evidence to support new recommendations on the timing of insecticide application on cocoa in Ghana. International J. Trop. Insect Sci. 34: 58-71.

Amalin, DM. 2017. Life history and host range of *Helopeltis bakeri* Poppius (Hemiptera:Miridae), a major pest of *Theobroma cacao* L. in Luzon, Philippines. In 49th Anniversary and Annual Conference of the the Pest Management Council of the Philippines, p 4129.

Awudzi, G. K., Asamoah, M., Owusu-Ansah, F., Hadley, P., Hatcher, P. E., & Daymond, A. J. 2016. Knowledge and perception of Ghanaian cocoa farmers on mirid control and their willingness to use forecasting systems. International J. Trop. Insect Sci. 36, 22–31.

DROPDATA 2014. Cocoa Pest & Disease Management: Best Known Practices. Ver. 9/4/2012.

Department of Agriculture RFO-5. Cacao production in Bicol region. Philippines.

Ebewore S., Egho, O. and C. Enujeke. 2013. Effect of Farmer Field School Training on the Management of Cocoa Mirids (*Saghbergella singularis*) by Famers in Edo State Nigeria. Asian J. Agric. Sci. 1: 6-10.

Gavarra, M. 1990. Laboratory screening of some insecticides for the control of cacao pod borer. Phil. Ent. 8(2):731-736.

ICCO 2015. What are the effects of intensive commercial production of cocoa on the environment? Westgate House Ealing London W5 1YY, United Kingdom. 22 pp.

International Cocoa Organization. 2010. Cocoa pest and disease. 34 pp.

Smith ES. 1979. Descriptions of the mature and adult stages of the cocoa mirid bug, *Helopeltis claviper* (Miridae). Pac. Insect 20: 353-361.