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ECONOMIC IMPACT OF MIRID (*HEMIPTERA: MIRIDAE*) DAMAGE IN COCOA PLANTATIONS IN TOGO (WEST AFRICA)

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Abstract. This study investigates the economic impact of mirid infestation on cocoa production in Togo. Field surveys were conducted across six major cocoa-producing prefectures. A total of 13,142 cocoa pods from 45 plantations selected through a spatial grid covering the study area were examined to identify those that were infested. The percentage of rotten pods was estimated among the infested pods, thus allowing for an assessment of the associated economic losses. The surveys revealed widespread pod damage, with an average infestation rate of 49.24%. Among infested pods, 38–53% were classified as rotten, resulting in an estimated national yield loss of 18.71–26.1%. These losses translate into 94.94–120.4 kg of cocoa lost per hectare, or 2,455–3,114 metric tonnes nationally. The corresponding economic deficit ranges from 2.46 to 3.11 billion FCFA, with the highest per-hectare losses recorded in Danyi, Agou, and Kloto. The study highlights the urgent need for targeted pest management strategies and provides a foundational dataset for future research on mirid dynamics and cocoa resilience in West Africa.

Keywords: cocoa mirids; economic impact; pest damage; togo; yield loss

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INTRODUCTION

Cocoa production has long been recognized as a leading sub-sector driving economic growth and development in West African producing countries (BCEAO, 2014; Randrianjohary, 2016). In Togo, cocoa is cultivated over an estimated area of 25,863 hectares and represents a strategic crop for the national economy (Koudjega et al., 2016; DSID, 2018b). The cocoa sector comprises 12,993 registered producers and supports approximately 30,000 households in the production zones, alongside a substantial network of collectors, transporters, traders, and exporters (DSID, 2018a). Beyond its economic significance, cocoa cultivation also contributes to soil conservation and the maintenance of forest cover (Bekou et al., 2005; ITRA, 2009).

However, the sector faces numerous constraints, among which insect pests pose a major threat to productivity and, by extension, national development (Oro, 2002; Ndoumbe Nkeng, 2002). Among these pests, mirids are of particular concern to producers (Coulibaly et al., 1998; Janny et al., 2003; Mboussi et al., 2018). The two predominant species responsible for damage in Togolese cocoa plantations are Sahlbergella singularis and Distantiella theobromae (Wegbe et al., 2006; Tchassanti, 2014). These Hemipteran insects (family: Miridae) inflict severe damage on nearly all parts of the cocoa plant, significantly reducing yields and farmer incomes (Youdeowei, 1971; Kouame et al., 2014). Lavabre (1977) estimated production losses of 25–30% under severe infestation, while Tong-Kwee et al. (1989) reported losses of up to 50% in Malaysia. Padi (1997) suggested that untreated infested plots could suffer yield reductions of up to 75% over three years. In Ghana, a 2016 survey estimated national production losses due to mirids at 30–40% (Awudzi et al., 2016).

In Togo, no quantitative study has yet assessed the yield losses caused by mirids. However, given that severe infestations can lead to plant mortality, the associated losses are likely to be substantial (Wegbe & Agbodzavu, 2013). Currently, there is a lack of detailed data on the extent of mirid damage and its economic impact in Togolese cocoa plantations. This study was therefore initiated to establish a baseline dataset on the impact of cocoa mirids in Togo. Specifically, the objectives were to determine the infestation rate of cocoa pods by mirids; estimate the yield losses associated with mirid infestation; and evaluate the economic value of these losses.

METHOD

Study Area

The study was conducted in the cocoa-producing regions of Togo. Field surveys were carried out in six prefectures, five of which are located in the Plateaux Region (Agou, Amou, Danyi, Kloto, and Kpélé), and one in the Central Region (Blitta). A total of 45 cocoa plantations were surveyed across the study area (Figure 1), with each plantation separated by a minimum distance of 2 km to ensure spatial independence.

Climatological Conditions

The cocoa-producing region of Togo falls within the forest agroecological zone, corresponding to Eco-floristic Zone IV as classified by the Institut Togolais de Recherche Agronomique (ITRA, 2009). Climatological data for this zone were collected in Kouma-Konda over a sixteen-year period, from January 2010 to December 2025. These data were used to construct the ombrothermic diagram presented in Figure 2.

The climate of Eco-floristic Zone IV is subequatorial, characterized by a distinct seasonal pattern: a prolonged rainy season from March to November, and a dry season from December to February, during which ecological stress is more pronounced. Mean annual temperatures range between 22 °C and 27 °C. The hottest months typically span January to April, while the coolest months occur between July and September (Figure 2).

Average annual rainfall is approximately 1600 mm, providing favorable moisture conditions for cocoa cultivation. The photoperiod remains relatively constant throughout the year, with a light-to-dark cycle of approximately 12:12 (L:D), typical of equatorial regions.

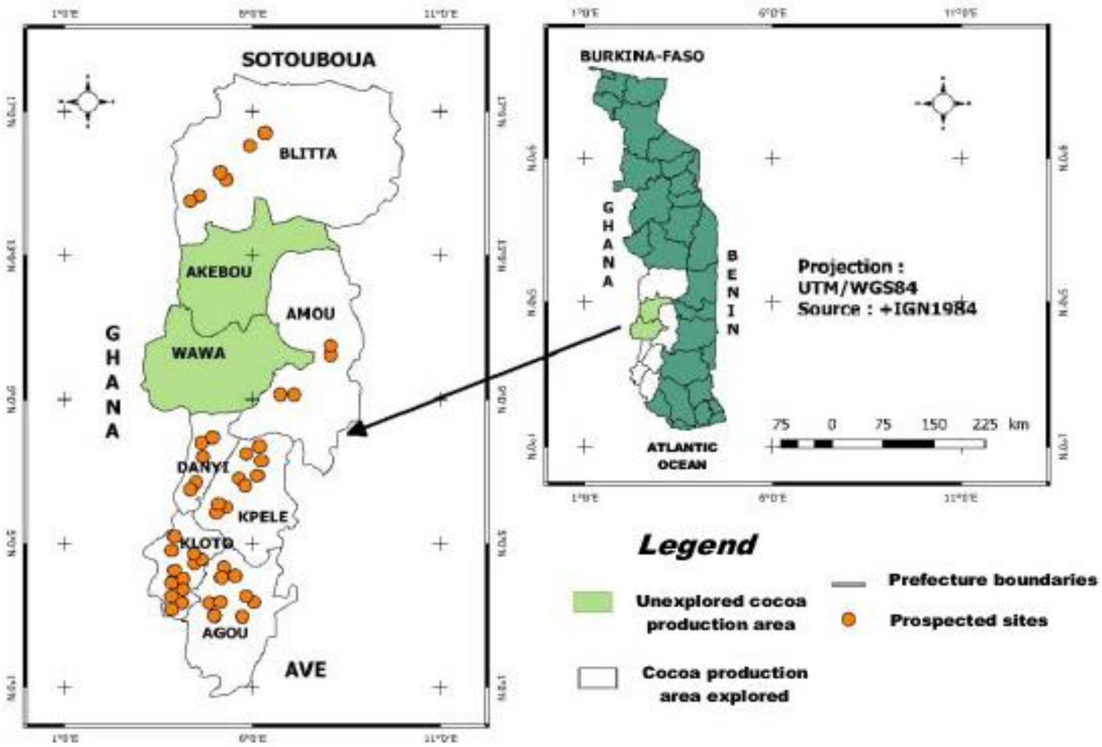

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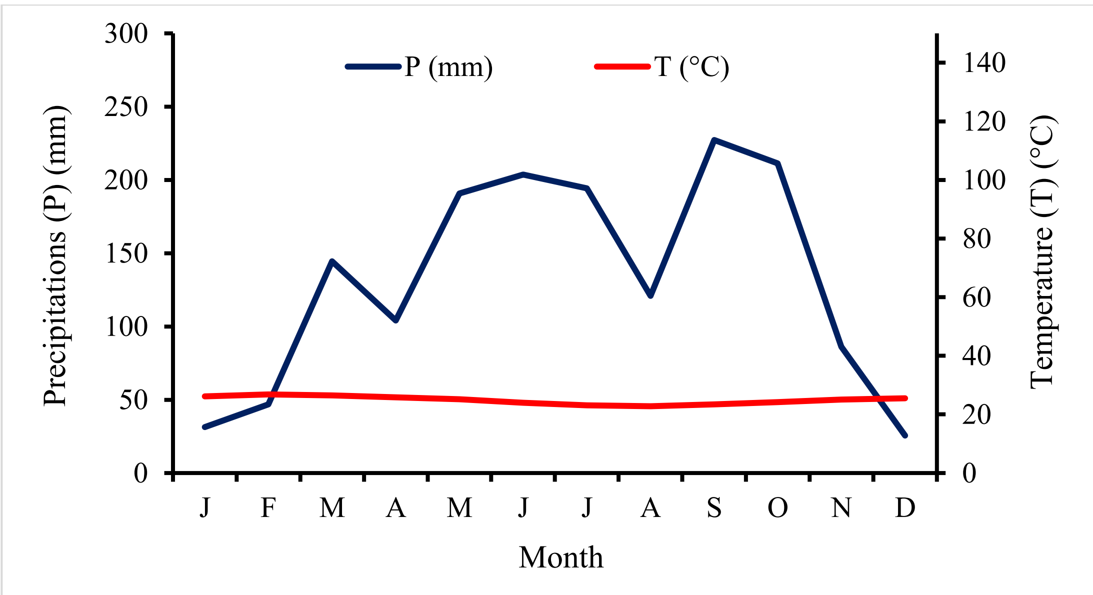
Figure 1. Map of Togo showing the cocoa production zone and the geographic distribution of surveyed plantations



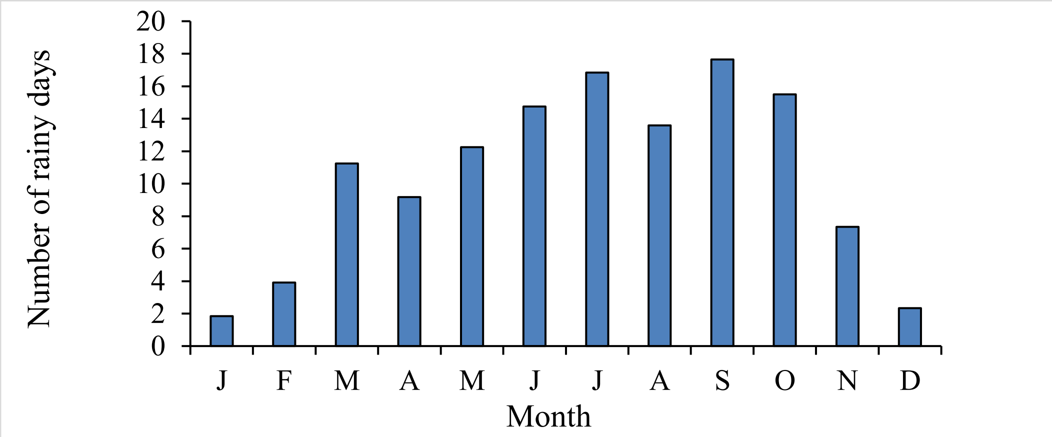
Source: Direction générale de la météorologie nationale (Lomé airport station), 2025

Figure 2. Ombrothermic diagram showing monthly precipitation and temperature trends in the cocoa production zone of Togo (Kouma-Konda, 2010–2025). The blue line represents monthly rainfall (mm), and the red line indicates average monthly temperature (°C)

Rainfall Frequency and Relative Humidity

On average, the region experiences approximately 125 rainy days per year. Rainfall frequency is particularly high between May and October, with precipitation occurring nearly every other day. In contrast, the months of January and December record only about two rainy days each (Figure 3A).

Regarding ambient relative humidity, the air is relatively dry from December to February due to the influence of the Harmattan winds. For the remainder of the year, humidity levels remain consistently high, supporting vegetative growth and agricultural activities (Figure 3B).



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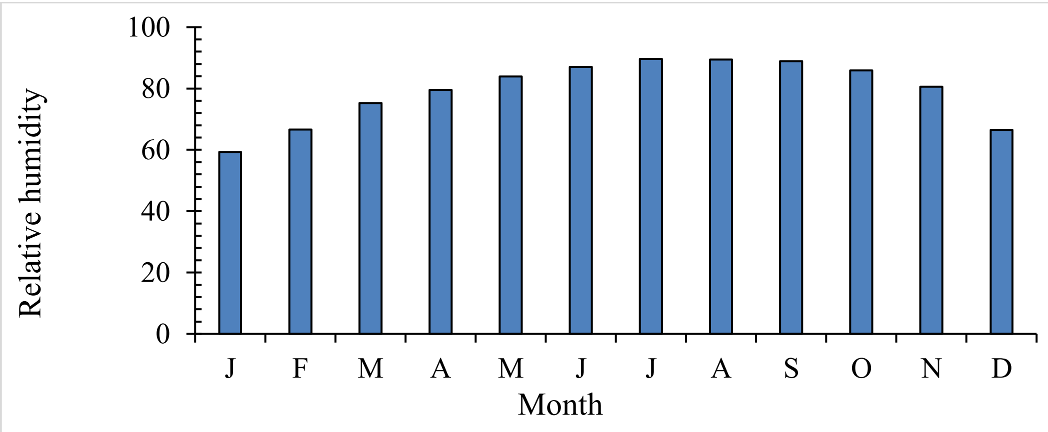

B

Figure 3. Monthly variation in the number of rainy days (A) and relative humidity (B) in Eco-floristic Zone IV (Kouma-Konda), based on twelve-year averages (2010–2025)
Source: Direction générale de la météorologie nationale (Lomé airport station), 2025

Materials

Biological Material

The biological material consisted of cocoa trees (*Theobroma cacao*) and their fruits (cocoa pod). Field surveys were conducted exclusively in cocoa plantations bearing cocoa pod.

Other Equipment

Additional tools included a GPS device for georeferencing surveyed fields, a handheld magnifying lens for detailed observations, a digital camera for photographic documentation, and a data collection sheet for recording all field information.

Sampling

A total of 13,142 cocoa pods were sampled from 45 plantations, selected through a spatial grid covering six of the eight cocoa-producing prefectures. Each plantation was located at least 2 km apart to ensure spatial independence. Within each site, one out of every three trees was selected for observation, with two intervening trees between each sampled plant. On each selected tree, ten pods were examined from the base of the trunk to the upper canopy using a systematic sampling method. If a tree bore fewer than ten pods, all available pods were assessed.

Field Surveys

Surveys were conducted throughout the study area from October 2024 to January 2025, coinciding with the peak season of cocoa mirid infestation in Togo. In each plantation, thirty cocoa trees were selected using systematic sampling : one tree was examined after every two skipped trees. On each selected tree, ten mature and immature pods were inspected from the trunk base to the upper canopy. When fewer than ten pods were present, all available pods were examined.

The infestation assessment method was adapted from Mahob et al. (2018). Careful visual inspection of the fruits allowed identification of mirid damage, characterized by typical puncture marks. The infestation rate (Ti) was calculated using the following in equation (1).

$$Ti(\%) = \frac{Number\ of\ infested\ fruits}{Total\ number\ of\ fruits\ observed} \times 100 \qquad (1)$$

Additional information regarding each plantation such as the age of the trees and the origin of the hybrid variety (Togolese or Ghanaian) was obtained directly from the plantation owners.

Assessment of Economic Impact of Mirid Damage

Interviews with producers whose fields were surveyed provided estimates of the proportion of infested fruits that were rotten and thus unmarketable. The fruit rot rate (TP) was calculated in equation (2).

$$TP = Ti \times Cp \qquad (2)$$

Where *Cp* is the rot coefficient estimated by producers.

Yield data (*R*) for marketable cocoa mass per prefecture were obtained from DSID (2018b). These yields reflect post-loss quantities due to mirid damage. The quantity of product lost per hectare (*QPPH*) was calculated using in equation (3).

$$\mathrm{QPPH(kg)} = \frac{\mathrm{R} \times \mathrm{Tp}}{100\% - \mathrm{Tp}} \qquad (3)$$

The total quantity of product lost per prefecture (*QPPP*) was then determined in equation (4).

$$QPPP = QPPH \times SEP \qquad (4)$$

Where *SEP* is the cultivated cocoa area per prefecture.

At the national level, the total quantity of product lost (*QPPN*) was calculated in equation (5).

$$QPPN = QMPPH \times SEN \qquad (5)$$

Where *QMPPH* is the average quantity of product lost per hectare, and *SEN* is the total national cocoa cultivation area.

Given the average selling price of marketable cocoa (PUc = 1,000 CFA francs/kg), the economic losses due to mirids were estimated as follows:

Economic loss per hectare (VEPH):

$$VEPH = PUc \times QPPH \tag{6}$$

Economic loss per prefecture (VEPP):

$$VEPP = PUc \times QPPP \tag{7}$$

Economic loss at the national level (VEPN):

$$VEPN = PUc \times QPPN \tag{8}$$

Statistical Analysis

Mean values were compared using one-way analysis of variance (ANOVA) at a 5% significance level. When significant differences were detected, means were separated using the Student-Newman-Keuls (SNK) test.

RESULT AND DISCUSSION

Infestation Rate of Cocoa Pods by Mirids

A total of 13,142 cocoa pods were examined across the study area. Mirid infestations were recorded in all surveyed locations. The national average infestation rate was 49.24 ± 1.33%. The result presented in Figure 4 reveal significant variation in fruit infestation rates by mirids across the surveyed prefectures. The lowest infestation rate was recorded in Amou (31.92 ± 4.68%), which is statistically distinct from the other prefectures, as indicated by the grouping letter "a". In contrast, the national average (49.24 ± 1.33%) and the rates observed in other prefectures such as Danyi (55.13 ± 4.29%) fall into a separate statistical grouping ("b"), suggesting homogeneity among these zones.

The analysis of variance ($F = 4.353$; $P < 0.001$) confirms that the differences in infestation rates across prefectures are statistically significant. This implies that local agroecological conditions, pest management practices, or varietal susceptibility may be influencing the observed disparities. The notably lower infestation in Amou could reflect more effective control strategies or less favorable conditions for mirid proliferation.

Based on Figure 4, the widespread infestation of cocoa pods observed across all surveyed prefectures confirms the pervasive presence of mirids throughout the study area. This finding aligns with previous research conducted in West Africa, which has consistently documented the broad distribution of cocoa mirids across the continent (Lavabre, 1977; Wegbe et Agbodzavu, 2013; Tchassanti, 2014). In Togo, Tchassanti (2014) identified mirids in the cocoa-growing regions of Kloto and Wawa, while Wegbe and Agbodzavu (2013) reported their presence in all cocoa plantations nationwide.

Quantifying the damage caused by mirids remains challenging due to their impact on multiple parts of the cocoa tree and the influence of compounding factors such as climate stress, disease susceptibility, and plant mortality. Mirids attack all developmental stages of cocoa fruits from cherelles to mature pods making yield loss estimation particularly complex (Lavabre, 1977; Yede et al., 2009; Gidoin, 2013).

These findings underscore the importance of region-specific interventions in pest management and highlight the need for further investigation into the factors contributing to reduced infestation in Amou.

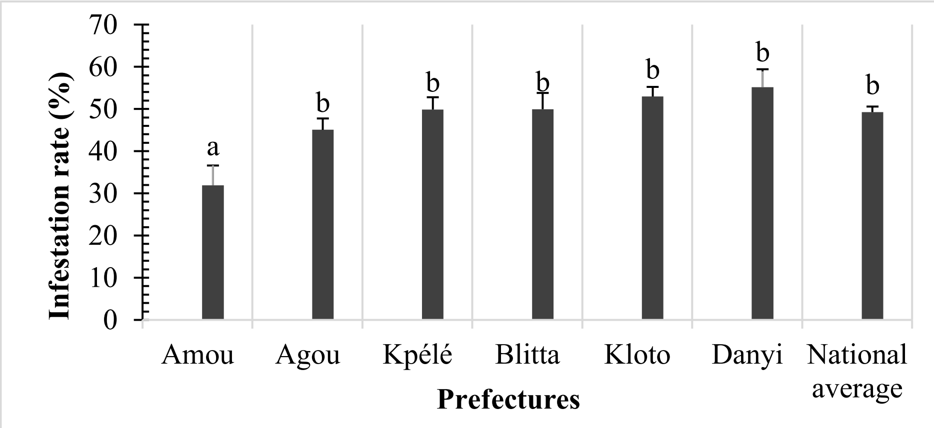

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Figure 4. Fruit infestation rates by mirids across prefectures
(F = 4.353; P < 0.001 at the 5% significance level)

Influence of Plantation Age on Cocoa Pod Infestation Rates

Fruit infestation rates by mirids varied significantly according to the age of the cocoa plantations (Figure 5). The highest infestation levels were observed in plantations younger than 10 years and those older than 31 years. In contrast, intermediate-aged plantations particularly those between 11 and 20 years exhibited the lowest infestation rates.

This pattern suggests a non-linear relationship between plantation age and vulnerability to mirid attack. Young plantations may lack structural canopy complexity or established pest management routines, while older plantations may suffer from declining vigor and reduced resistance. The intermediate age group appears to represent a period of optimal resilience, possibly due to balanced agronomic conditions and active maintenance.

The analysis of variance confirms that these differences are statistically significant (F = 11.96; P < 0.001), indicating that plantation age is a key factor influencing mirid infestation dynamics.

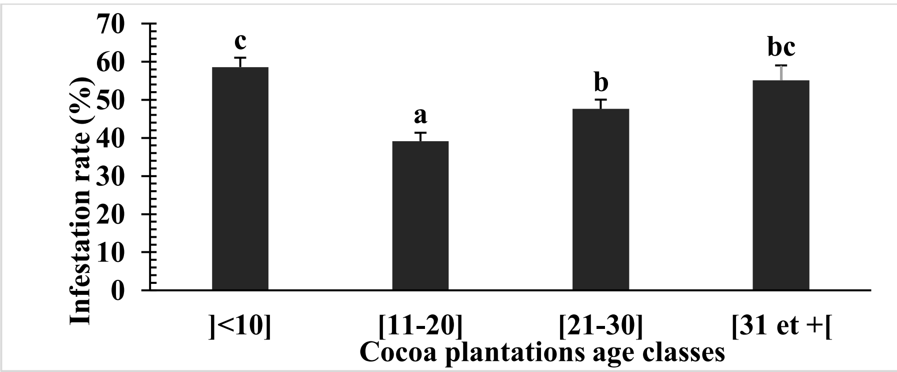

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Figure 5. Cocoa pod infestation rates by mirids across plantation age classes
(F = 11.96; P < 0.001 at the 5% significance level)

Although this study did not extensively analyze factors influencing mirid infestation, preliminary observations suggest that plantations aged 11–30 years experience lower infestation rates. This may be attributed to better maintenance practices such as pruning and pesticide application typically afforded to more productive plots within this age range. These findings are consistent with those of Entwistle (1972), who noted that young cocoa trees are particularly susceptible to mirid attacks due to their tender tissues and lack of canopy cover, which limits natural pest regulation. Similarly, N'Goran et al. (1997) observed that older plantations often suffer from declining vigor and reduced resistance, making them prone to pest resurgence if not properly rejuvenated. The lower infestation observed in intermediate-aged plantations could reflect optimal plant health, active maintenance, and more effective pest control measures. This aligns with the work of Hawkins et al. (2024), who emphasized the importance of agronomic practices in maintaining cocoa productivity and pest resilience.

From an agronomic perspective, these findings underscore the importance of tailored pest management strategies. Targeted interventions such as early canopy structuring, varietal selection, and rejuvenation practices could mitigate mirid pressure in vulnerable age classes. Moreover, integrating ecological principles such as habitat diversification and shade management may enhance natural pest regulation, as advocated by Tscharntke et al. (2011) in their work on agroecological intensification.

In the context of food sovereignty, reducing pest-induced losses is critical for stabilizing cocoa yields and securing farmer incomes. Given that cocoa remains a strategic crop in Togo's agricultural economy, improving pest resilience across plantation lifecycles contributes directly to local consumption, export potential, and systemic sustainability.

Influence of Hybrid Origin on Cocoa Pod Infestation by Mirids

Analysis of the infestation rates based on the origin of the cocoa hybrids revealed no statistically significant differences between plantations established with Togolese and Ghanaian hybrids (Figure 6). The ANOVA results (F = 0.293; P = 0.588) confirm that hybrid origin does not appear to influence susceptibility to mirid attacks under the conditions studied.

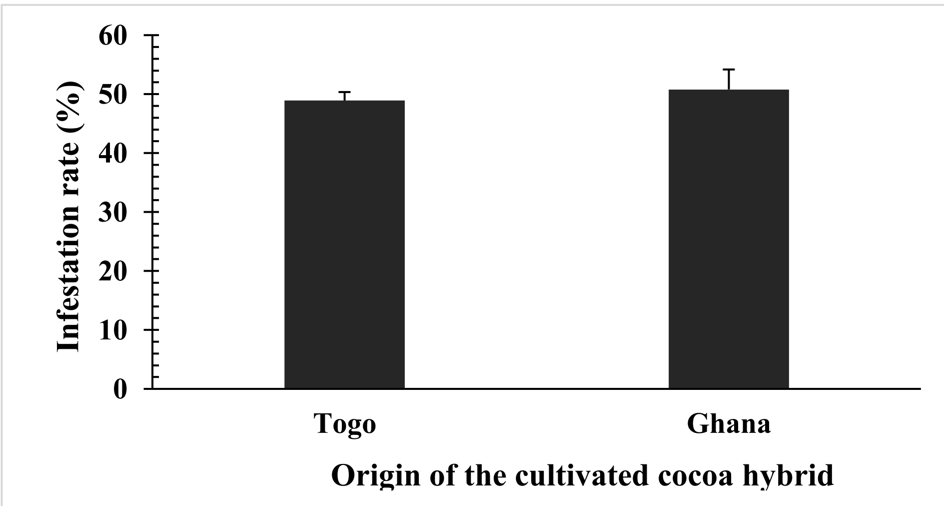

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Figure 6. Cocoa pod infestation rates by mirids across origin of the cocoa hybrids (F = 0.293; P = 0.588 at the 5% significance level)

This finding suggests that, despite potential genetic and agronomic differences between the two hybrid sources, their performance in terms of pest resistance is comparable. It is possible that both hybrid types share similar resistance traits or that environmental and management factors play a more dominant role in determining infestation levels than genetic origin alone. These results align with previous studies such as those by Kébé et al. (2005), who found that mirid infestation was more strongly correlated with plantation microclimate and maintenance practices than with clone origin. Similarly, Lachenaud and Oliver (2007) emphasized that while genetic resistance is important, its expression can be significantly modulated by ecological and agronomic contexts.

From a practical standpoint, this outcome supports the continued use of both Togolese and Ghanaian hybrids in cocoa cultivation, provided that integrated pest management strategies are effectively implemented. It also reinforces the need for further research into genotype-by-environment interactions and the role of agroecological practices in enhancing pest resilience.

Evaluation Of Fruit Rot Coefficients And Rates

Based Table 1, on producer declarations, between 38% and 53% of mirid-infested cocoa pods undergo rot in the study area. These values represent the minimum and maximum fruit rot coefficients (Cp) observed across surveyed prefectures. Regionally, Cp ranged from 30–50% in Amou, 40–50% in Kpélé, Blitta, and Kloto, and 40–60% in Agou and Danyi.

Using these coefficients in conjunction with infestation rates, fruit rot rates (TP) were estimated. Nationally, the average TP ranged from 18.71% to 26.1%. At the prefectural level, TP varied considerably, from 9.58–16% in Amou to 22.05–33.08% in Danyi. Intermediate values were recorded in Kpélé (19.94–24.92%), Blitta (19.98–24.97%), Kloto (21.17–26.46%), and Agou (18.02–27.03%).

Table 1. Summary of Cocoa Pod Infestation, Rot Coefficients, and Estimated Rot Rates by Prefecture

Prefecture	Infestation Rate (%)	Fruit Rot Coefficient (Cp, %)	Estimated Fruit Rot Rate (TP, %)
Amou	31.92	30–50	9.58 – 16.00
Agou	45.05	40–60	18.02 – 27.03
Kpélé	49.85	40–50	19.94 – 24.92
Blitta	49.94	40–50	19.98 – 24.97
Kloto	52.93	40–50	21.17 – 26.46
Danyi	55.13	40–60	22.05 – 33.08
National Average	**49.24**	**38–53**	**18.71 – 26.10**

Souce: Data processed, 2025

Notes:

1) *Infestation Rate* refers to the percentage of cocoa pods affected by mirids.
2) *Fruit Rot Coefficient (Cp)* represents the proportion of infested pods that undergo rot, as reported by producers.
3) *Estimated Fruit Rot Rate (TP)* is calculated by applying Cp to the infestation rate, indicating the expected loss due to rot.

In this study, the rot coefficient was defined as the average proportion of pods exhibiting rot among those showing symptoms of mirid attack. Not all infested pods were considered lost, as some retained marketable value. However, immature pods affected by mirid damage were classified as rotten and excluded from yield estimates. Approximately 50% of pods were found to be infested, with 38–53% of these exhibiting rot. This translate to an average product loss of 18.71–26.1% across the study area, a figure comparable to Lavabre's (1977) estimate of 25–30% under severe infestation. These losses are nonetheless lower than those reported by Awudzi et al. (2016) in Ghana, where mirid-related yield reductions ranged from 30–40%. It is important to note that our estimates were derived exclusively from pod-level assessments, excluding losses due to tree mortality or reduced productivity from branch and stem damage, factors that are difficult to isolate in field conditions.

These results highlight a strong spatial heterogeneity in fruit rot dynamics, likely influenced by local agroecological conditions, plantation age structure, and pest management practices. The relatively low rot rates in Amou may reflect lower infestation pressure or more effective post-infestation handling, whereas the elevated rates in Danyi suggest a critical need for targeted interventions. From a production standpoint, the implications are substantial: with up to one-third of infested pods lost to rot in certain areas, mirid damage translates directly into economic losses and reduced yield potential. These findings reinforce the importance of integrated pest and disease management strategies, particularly in high-risk zones.

Assessment of Cocoa Product Losses Per Hectare in the Study Area

Based on Tabel 2, estimated pod rot rates and commercial cocoa yields per hectare, average product losses across the study area were calculated at 107.67 kg/ha, with a minimum of 94.94 kg/ha and a maximum of 120.40 kg/ha. Losses exceeding the national average were recorded in the prefectures of Danyi (135.70 kg/ha), Agou (126.86 kg/ha), and Kloto (124.71 kg/ha). In contrast, losses below the national average were observed in Amou (59.65 kg/ha), Blitta (86.75 kg/ha), and Kpélé (98.06 kg/ha).

These variations reflect the combined influence of local yield levels and pod rot prevalence. Prefectures with higher infestation and rot rates experienced proportionally greater product losses, underscoring the economic impact of mirid damage and the urgency of targeted pest management strategies.

Table 2. Estimated Cocoa Product Losses per Hectare by Prefecture

Prefecture	Yield (kg/ha)	Min Rot Rate (TPmin, %)	Max Rot Rate (TPmax, %)	Min Loss (kg/ha)	Max Loss (kg/ha)	Average Loss (kg/ha)
Amou	410	9.58	16.00	46.76	72.55	59.65
Agou	440	18.02	27.03	108.66	145.07	126.86
Kpélé	340	19.94	24.92	90.30	105.83	98.06
Blitta	300	19.98	24.97	79.89	93.61	86.75
Kloto	400	21.17	26.46	115.15	134.26	124.71
Danyi	360	22.05	33.08	118.62	152.77	135.70
National Average	**375**	**18.71**	**26.10**	**94.94**	**120.40**	**107.67**

Souce: Data processed, 2025

Various methodologies have been employed to assess mirid damage, including field surveys, experimental trials, and farmer-based observations (Yede et al., 2009; Gidoin, 2013; Mahob et al., 2018). However, no approach has yet yielded a precise quantification of losses attributable solely to mirids, due to methodological constraints and ecological complexity. Our study focused exclusively on fruit-level losses, acknowledging that mirid-induced damage to other plant organs while significant could be confounded by other biotic and abiotic stressors.

Nonetheless, mirid punctures on pods often serve as entry points for opportunistic pathogens, accelerating fruit decay. Even within the scope of this limited assessment, losses of 94.94–120.4 kg per hectare representing 18.71–26.1% of national yields highlight the substantial impact of mirids on cocoa productivity. When broader ecological and agronomic factors are considered, it becomes evident that the true extent of mirid-induced losses is likely far greater.

Estimation of National and Regional Cocoa Product Losses

Based on Table 3, the cultivated area and estimated per-hectare losses, the average national loss of marketable cocoa was 2,784.73 metric tons, with a lower bound of 2,455.49 tons and an upper bound of 3,113.96 tons. At the prefectural level, average losses ranged from 53.21 tons in Kpélé to 364.94 tons in Kloto, reflecting significant spatial variation in the impact of mirid infestation and pod rot.

These disparities are driven by differences in plantation size, infestation intensity, and rot coefficients. Prefectures such as Kloto, Agou, and Danyi characterized by higher infestation rates and larger cultivated areas, recorded the highest absolute losses. In contrast, smaller production zones like Kpélé and Blitta experienced relatively lower losses, despite moderate infestation levels.

Table 3. Estimated Cocoa Product Losses by Prefecture

Prefecture	Cultivated Area (ha)	Min Loss per ha (kg)	Max Loss per ha (kg)	Min Total Loss (kg)	Max Total Loss (kg)	Average Total Loss (kg)
Amou	1,435.8	46.76	72.55	67,137.32	104,167.75	85,652.54
Agou	2,591.6	108.66	145.07	281,598.99	375,974.84	328,786.91
Kpélé	542.6	90.30	105.83	48,995.88	57,423.70	53,209.79
Blitta	636.6	79.89	93.61	50,856.73	59,594.73	55,225.73
Kloto	2,926.4	115.15	134.26	336,969.75	392,909.01	364,939.38
Danyi	618.1	118.62	152.77	73,318.56	94,430.14	83,874.35
National Total	**25,863.0**	**94.94**	**120.40**	**2,455,497**	**3,113,963**	**27,840,730**

Source: Data processed, 2025

At the national level, mirid-induced losses are estimated at 94.94–120.4 kg per hectare, corresponding to 2,455.5–3,113.96 metric tonnes, or roughly one-fifth to one-quarter of total national production (DSID, 2018b). These findings underscore the economic burden of mirid damage on cocoa production and highlight the need for region-specific pest management strategies to mitigate yield losses and protect farmer livelihoods.

Economic Loss Assessment in Cocoa Production

Based on Table 4, at the national level, cocoa producers incur an average financial loss of 107,672 FCFA per hectare, with estimates ranging from 94,942 FCFA to 120,402 FCFA depending on the severity of infestation and pod rot. These losses are directly proportional to the quantity of marketable cocoa lost per hectare, which varies across prefectures.

The most economically affected regions per hectare are Danyi (135,697 FCFA/ha), Agou (126,866 FCFA/ha) and Kloto (124,705 FCFA/ha). These prefectures exhibit higher infestation rates and larger average losses per hectare, likely due to a combination of aging plantations, inadequate pest control, and climatic stressors. In contrast, prefectures such as Amou, Blitta, and Kpélé report below-average economic losses, though still significant in terms of local livelihoods.

Table 4. Estimated Cocoa Losses and Economic Impact per Hectare

Prefecture	Min Loss (kg/ha)	Max Loss (kg/ha)	Avg Loss (kg/ha)	Min Value (FCFA/ha)	Max Value (FCFA/ha)	Avg Value (FCFA/ha)
Amou	46.76	72.55	59.65	46,760	72,550	59,655
Agou	108.66	145.07	126.87	108,658	145,074	126,866
Kpélé	90.30	105.83	98.06	90,298	105,831	98,064
Blitta	79.89	93.61	86.75	79,888	93,614	86,751
Kloto	115.15	134.26	124.71	115,148	134,264	124,706
Danyi	118.62	152.77	135.70	118,619	152,775	135,697
National Avg	**94.94**	**120.40**	**107.67**	**94,942**	**120,402**	**107,672**

Source: Data processed, 2025

National Economic Losses From Cocoa Pod Infestation

Based on Table 5, at the national scale, the economic losses attributed to mirid infestation and subsequent pod rot in cocoa plantations are substantial. The estimated average loss is 2,784,730,678 FCFA, with a lower bound of 2,455,497,615 FCFA and an upper bound of 3,113,963,741 FCFA. These figures reflect the cumulative impact of infestation rates, rot coefficients, and yield reductions across all surveyed prefectures.

The most affected localities in terms of total economic loss include Kloto (364.94 million FCFA), Agou (328.79 million FCFA), and Danyi (83.87 million FCFA). These regions combine high infestation intensity with relatively large cultivated areas, amplifying the financial burden on producers. Conversely, Kpélé (53.21 million FCFA) and Blitta (55.23 million FCFA) report lower total losses, though still significant in relation to local production capacity.

Table 5. Estimated Cocoa Product and Economic Losses by Prefecture

Prefecture	Min Loss (kg)	Max Loss (kg)	Avg Loss (kg)	Min Value (FCFA)	Max Value (FCFA)	Avg Value (FCFA)
Amou	67,137	104,168	85,653	67,137,324	104,167,750	85,652,537
Agou	281,599	375,975	328,787	281,598,987	375,974,837	328,786,912
Kpélé	48,996	57,424	53,210	48,995,884	57,423,698	53,209,791
Blitta	50,857	59,595	55,226	50,856,729	59,594,734	55,225,732
Kloto	336,970	392,909	364,939	336,969,747	392,909,014	364,939,381
Danyi	73,319	94,430	83,874	73,318,557	94,430,138	83,874,347
National Total	**2,455,498**	**3,113,964**	**2,784,731**	**2,455,497,615**	**3,113,963,741**	**2,784,730,678**

Source: Data processed, 2025

Economically, the cocoa loss observed equates to a revenue loss of 94,942.5–120,402 FCFA per hectare, and a total national deficit of 2.46–3.11 billions FCFA. These figures underscore the significant financial burden borne by producers, many of whom operate with limited resources. Moreover, broader regional trends in West Africa show that cocoa productivity is increasingly threatened by climate variability, aging plants and pest pressure. According to Chocolate Affairs Magazine (2025), cocoa output in West Africa is projected to decline by 10% in the 2025/26 season due to erratic rainfall, prolonged dry spells, and the resurgence of plant diseases. Similarly, Bekele (2025) emphasizes that aging cocoa trees and land degradation are eroding the resilience of smallholder farms, leading to reduced yields and income instability.

The economic implications are profound. Cocoa remains a cornerstone of rural livelihoods and national export earnings in Togo. Without targeted interventions such as replanting programs, integrated pest management, and climate-adaptive farming practices producers risk further income erosion and reduced capacity to invest in sustainable production systems. As Tscharntke et al. (2011) argue, agroecological intensification and landscape-level resilience are essential to safeguarding both productivity and farmer welfare.

The economic losses observed in Togo reflect a microcosm of these regional dynamics. Without targeted interventions such as replanting programs, integrated pest management, and climate-resilient farming practices producers may face worsening income instability and reduced capacity to invest in sustainable production systems.

CONCLUSION

This research, aimed at assessing the economic impact of cocoa mirids on smallholder farms in Togo, confirms that these pests pose a serious threat to the sustainability of the national cocoa sector.. The quantified losses, both agronomic and economic, underscore the pest's impact on national productivity and farmer livelihoods. The data generated offer a critical reference point for future studies on mirid ecology, infestation drivers, and integrated control strategies. Moreover, the economic implications should prompt immediate attention from stakeholders across the cocoa value chain, encouraging coordinated efforts to mitigate losses and secure the future of the sector. Given their impact, it is essential to implement integrated management practices against cocoa mirids by combining agronomic methods such as shade regulation and regular pruning and biological methods that encourage natural enemies, while using plant protection products judiciously and in compliance with environmental and health standards.

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