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**Research Paper**

# The insect pests of coffee and their management practices in the main coffee growing region in Kenya

**Mugo H. M.[1]* • Mwangi D. I.[2]**

[1]KALRO- Coffee Research Institute, P.O Box 4- 00232, RUIRU, Kenya.
[2]Chuka University, P.O. Box 109-60400, Chuka, Kenya.

*Corresponding author. E-mail: mugohmu@yahoo.com; Harrison.mugo@kalro.org.

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***Abstract.*** Coffee farming in Kenya is a major source of income for over 800,000 farmers. Globally, the Kenyan coffee is renowned for its high quality. Most of the Kenyan coffee is produced in the Mt. Kenya region. Its production faces many challenges that include infestation by a complex of insect pests. A field survey covering eight (8) main coffee-growing counties and 485 households in the Mt. Kenya region was conducted in May 2022. The survey aimed to establish the key insect pests in the region, and their distribution and management practices applied by the farmers. The survey established eight (8) insect pests as of major importance in the region. These included the Coffee Berry Borer (*Hypothenemus hampei*), Thrips (*Diarthrothrips coffeae*), Leaf miners (*Leucoptera* spp), Yellow Headed Borer (*Dirphya nigricornis*), White Borer (*Anthores leuconotus*), Green scales (*Coccus alpinus*), Kenya Meallybugs (*Planococcus kenyae*) and Antestia bugs (*Antestiopsis* spp). Their occurrence ranged from 5 to 66%. The *C. alpinus* (66%) occurred in all the surveyed counties, Agro-Ecological Zones (AEZs) and coffee farms' households. The *D. nigricornis* (57%) was the second most common insect pest. The *C. alpinus*, *D. nigricornis*, *Leucoptera* spp and *H. hampei* dominated the "Lower" coffee zone and were less dominant in Upper Midland 1(UM 1). Farmers used insecticides, plant extracts, and physical, mechanical, cultural, and field sanitation approaches to control the pests. Insecticides at 79% was the most widespread practice used by coffee farmers. This study and its findings are key to Agricultural extension services in providing focused technical advisory services to coffee farmers based on specific insect pests per the Agro-Ecological Zones from the Mt Kenya region.

**Keywords:** Agro-ecological zones, insect pests, infestation, management practices.

## INTRODUCTION

Kenya is globally known for producing some of the world's finest mild Arabica coffees. This is due to its rich volcanic soil, varieties, management practices, well-distributed rainfall, high altitude, moderate temperatures, and the method of processing the coffee that contributes significantly to the quality attributes.

The coffee sub-sector in Kenya is one of the key pillars of the country's economic development accounting for 0.02% of the national GDP. Coffee is grown across thirty-two (32) counties supporting more than 800,000 farmers (Coffee Directorate, 2021). The counties are spread in Western, Nyanza, Rift Valley, Central, Eastern and Coastal regions (Figure 1). Predominantly, Kenya produces Arabica (99%) and Robusta (1%) coffee.

The production of coffee in Kenya is under two distinct categories of producers namely; the smallholders and estates. The smallholders (70%) are the majority organized into 513 cooperatives while 2046 (30%) are estate farmers. Though smallholder farming dominates Kenya's coffee sub-sector, their productivity lags at an average yield of 280 kg/hectare of clean coffee annually while estate yields an average of 556 kg/hectare. Nationally the annual average coffee production is estimated at 302kg/ha. It is estimated that on average, a

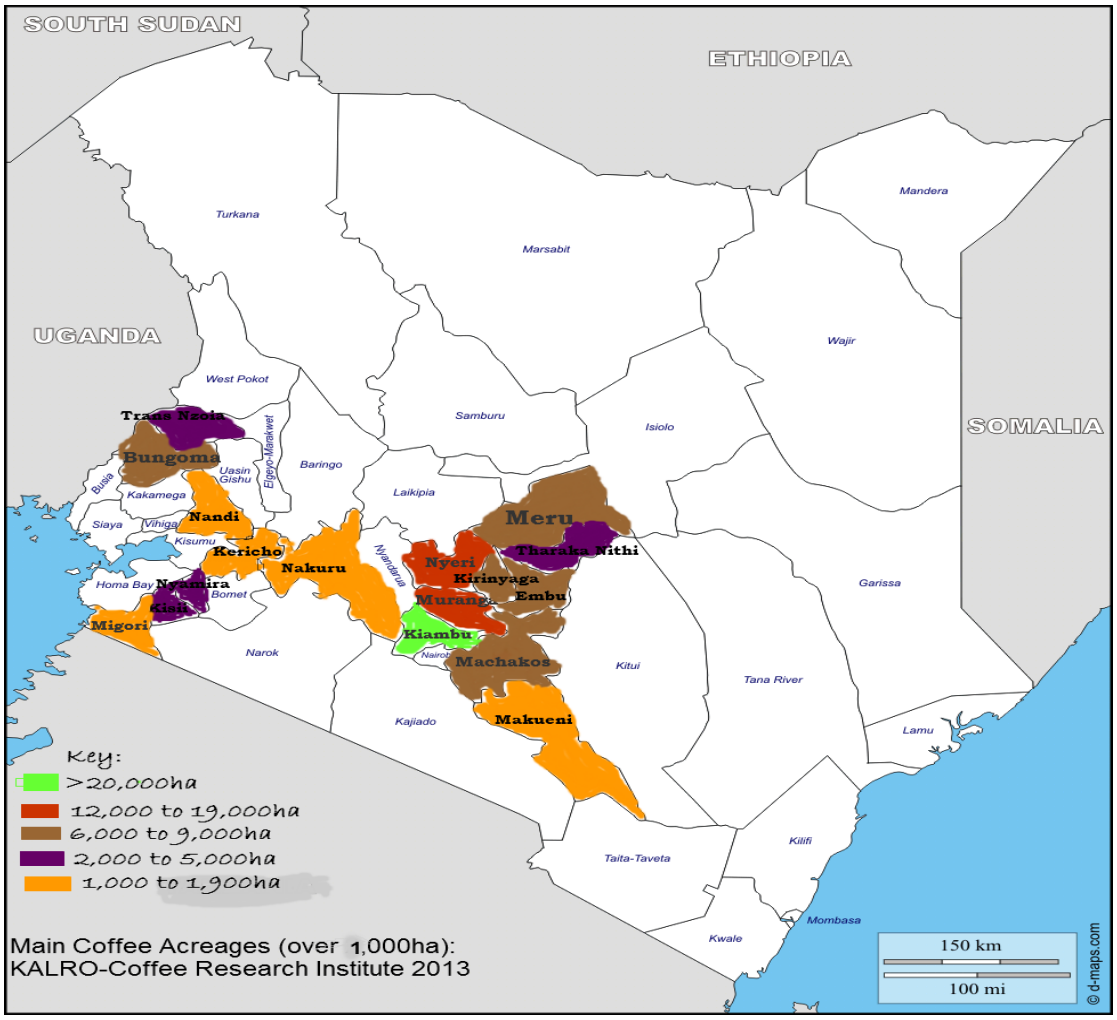


**Figure 1.** Main coffee growing areas in Kenya. Source: Coffee Research Institute.

coffee tree in Kenya yields 2 kg annually against a potential of 30 kg. This is an indication of a decline in production from 4 kg/tree/year in 1987/88 (Coffee Directorate, 2019). In 2017/2018, the country produced 41,375 tons of clean coffee of which 73% came from small-scale farmers (Coffee Directorate, 2019). However, a review of the production trend over the last decade, shows that Kenya's clean coffee production has oscillated between 40,000 and 50,000MT with most of it (75%) produced from Mt Kenya region that comprised of Central (Kiambu, Kirinyaga, Murang'a and Nyeri Counties) and Eastern (Machakos, Embu, Tharaka Nithi and Meru Counties) coffee growing areas. The Mt Kenya region has 70% of smallholder coffee farmers in the country.

Kenyan coffee because of its high quality has consistently continued to attract high premium prices globally. Despite such premium prices, the production of Kenyan coffee has been unexpectedly declining steadily. The decline is attributable to complex interrelated constraints relating to production, processing, and marketing. Specifically, some of the constraints include pests and diseases, low soil fertility, high cost of labor and inputs, inadequate extension services, poor and inefficient institutional governance of coffee cooperatives, underfunding of research, erratic rains, competition from other farm enterprises, and fluctuating international coffee prices.

Crop losses due to insect pests and diseases are a major threat to the incomes of rural families and to food security worldwide (Yudelman *et al*., 1998; Savary and Willocquet, 2014). Globally, coffee insect pests are estimated to cause crop losses of about 13%, though in Africa under some circumstances the losses tend to be as high as 96% (Abraham, 2016; Oerke *et al*., 1995). The increasing incidences of coffee insect pests and their consequent control and management have significantly constrained the economic production of coffee in Kenya. The Coffee Berry Borer (CBB), *Hypothenemus hampei* (Ferrari); Antestia bugs, *Antestiopsis* spp.; Green scales, *Coccus alpinus* De Lotto and Leaf miners, *Leucoptera* spp are known to be major insect pests of coffee worldwide. However, in Kenya, other insect pests prevail and could

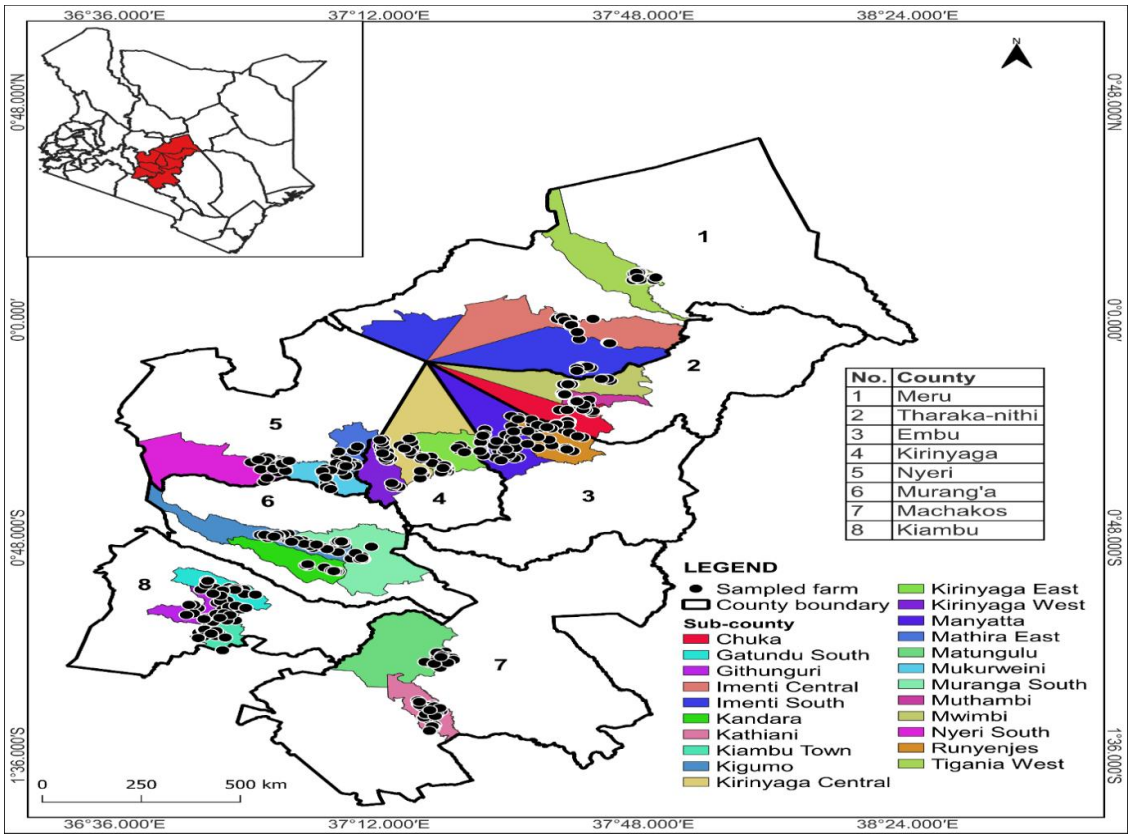


**Figure 2.** Map of the study area and households sampled.

be of economic importance (Mugo *et al.*, 2011).

In this study, a survey was conducted in the main coffee-growing region in Kenya that aimed at establishing the common insect pests of coffee that affect production. It also aimed to determine their distribution along the agroecological zones as well as the management practices practiced by the farmers.

## MATERIALS AND METHODS

### Study area

A field survey was conducted in eight (8) major coffee-producing counties (Figure 2) in Kenya. The counties surveyed produce coffee in the upper midland (UM) agro-ecological zone (AEZ) which included three sub-zones namely coffee–tea zone (UM1), main coffee zone (UM2) and marginal coffee zone (UM3). The three sub-zones vary in their climatic conditions; annual mean temperature, and rainfall.

### Sampling design

An exploratory research design was adopted, and data was gathered using structured questionnaires. The research team in collaboration with county agricultural extension staff and county coffee focal persons assisted in the identification of any two or three coffee growing sub counties per county covering different Agro-Ecological Zones. The sample size (at least sixty (60) coffee farming households per county) was apportioned proportionately to the number of coffee farmers in the identified sub-counties. The sampled coffee farming households were randomly selected by transect walk from lowlands to highlands and vice versa with an interval of approximately two (2) kilometers.

### Analytical framework

Data collected was cleaned before analysis. Descriptive statistics were used, and the results were disaggregated by AEZs.

## RESULTS AND DISCUSSION

The survey conducted, covered eight (8) main coffee counties in Kenya that contribute 75% of the national coffee production. Among the counties surveyed, a total of twenty (21) sub-counties producing coffee were covered with 485 coffee farming households interviewed across the

**Table 1.** Number of interviewed coffee farming households per county and AEZs.

| County | Agro-Ecological Zones | | | | | Total |
|---|---|---|---|---|---|---|
| | UM1 | UM2 | UM3 | Upper | Lower | |
| Nyeri | 9 | 31 | 0 | 20 | 0 | 60 |
| Muranga | 13 | 25 | 18 | 3 | 3 | 62 |
| Kiambu | 16 | 26 | 1 | 20 | 0 | 63 |
| Machakos | 0 | 8 | 46 | 3 | 3 | 60 |
| Meru | 5 | 14 | 36 | 3 | 2 | 60 |
| Tharaka Nithi | 0 | 12 | 40 | 0 | 8 | 60 |
| Kirinyaga | 24 | 13 | 10 | 2 | 11 | 60 |
| Embu | 17 | 35 | 3 | 1 | 4 | 60 |
| Overall | 84 | 164 | 154 | 52 | 31 | 485 |

**Table 2.** Percentage of coffee varieties planted by counties.

| Variety | County | | | | | | | | Overall |
|---|---|---|---|---|---|---|---|---|---|
| | Nyeri | Murang'a | Kiambu | Machakos | Meru | Tharaka Nithi | Kirinyaga | Embu | |
| Ruiru 11 | 60.0 | 77.4 | 52.4 | 5.0 | 58.3 | 91.7 | 56.7 | 58.3 | 57.5 |
| SL28 | 68.3 | 46.8 | 79.4 | 95.0 | 33.3 | 6.7 | 65.0 | 46.7 | 55.3 |
| Batian | 16.7 | 30.7 | 20.6 | 5.0 | 16.7 | 16.7 | 33.3 | 16.7 | 19.6 |
| K7 | 0.0 | 1.6 | 0.0 | 8.3 | 26.7 | 11.7 | 6.7 | 11.7 | 8.3 |
| SL34 | 8.3 | 3.2 | 3.2 | 1.7 | 11.7 | 10.0 | 5.0 | 8.3 | 6.4 |

AEZs (Figure 2). The recommended coffee AEZs include UM1, UM2 and UM3. However, due to climate change, innovative technologies and other factors, coffee production has expanded to higher (>1810 m a.s.l.) and lower (<1330 m a.s.l) altitudes referred to as 'upper' and 'lower' respectively. Overall, 164 (34%), 154 (32%) and 84 (17%) of the sampled farmers were from the UM2, UM3 and UM1, respectively while the rest 81 (17%) were from the expansion zones (Table 1). The pest prevalence varied across the AEZs with a higher pest prevalence in UM3 compared to other coffee-growing AEZs. The UM3 compared to UM2 and UM1 experiences higher temperatures, a factor that can be associated with the pest prevalence. The finding of this survey confirms that increased temperature influences pests' prevalence as stated by Bale *et al.* (2002).

Kenya commercially grows different coffee varieties. A total of five (5) varieties were recorded during the survey. These included the traditional (SL28, SL 34 and K7) and improved (Ruiru 11 and Batian) coffee varieties. The improved varieties are resistant to the two major coffee diseases (Coffee berry disease and Leaf rust) while the other varieties are susceptible to both diseases. The most prevalent varieties were Ruiru 11 (57.5%) and SL 28 (55.3%). Batian variety accounted for 19.6%, while the rest of the varieties had less than 10% each (Table 2). Ruiru 11 (92%) was prevalent in Tharaka Nithi County and SL28 (95%) in Machakos County. The various coffee varieties established to be grown by farmers play a major role in the distribution of both insect pests and diseases. For instance, where Ruiru 11 and Batian are grown, the incidences of both Coffee leaf rust and Coffee berry disease are absent. According to Skendžić *et al*. (2021), crop distribution is one of the key factors that determine the distribution of insect pests.

The survey established changes in pests' status. Overall, 19.7% and 15.9% of the sampled farmers reported a reduced and increased incidence of insect pests, respectively. The severity of insect pests was reported to have decreased by 22.1% of the sampled farmers while only 5.6% of them reported an increase in severity. The incidence of new insect pests was reported by 1.7% of the sampled farmers. Among the sampled farmers, 0.8% reported a new attack on specific coffee varieties with 34.5% of them perceiving there was no change in the status of the insect pests in all the Counties (Table 3). The changes in pests' status as reported by the farmers were attributed to climate change leading to increased incidences and severity. This confirms according to Prakash *et al*. (2014) that climate change and weather disruptions impact changes in pests' status. Where for instance, temperature rise directly affects pest's reproduction, survival, spread and population dynamics as well as its relationships with the environment and natural enemies. Hence, it is important to monitor the pest's appearance and abundance as the conditions changes.

The survey established that twenty-one (21) insect pests infest and affect coffee production across the AEZs (Figure 3). Eight (8) of them were highly prevalent. These included the Green scales (*Coccus alpinus*), Yellow Headed Borer

**Table 3.** Percentage of sampled farmers reported changes in insect pests' status

| Description | County | | | | | | | | Overall |
|---|---|---|---|---|---|---|---|---|---|
| | Nyeri | Muranga | Kiambu | Machakos | Meru | Tharaka Nithi | Kirinyaga | Embu | |
| Decrease in insect pest incidence | 8.3 | 32.3 | 22.2 | 26.7 | 25.0 | 15.0 | 5.0 | 23.3 | 19.7 |
| Decreased severity | 1.7 | 16.1 | 28.6 | 3.3 | 23.3 | 16.7 | 83.4 | 1.7 | 22.1 |
| Increase in insect pest incidence | 11.7 | 17.7 | 11.1 | 33.3 | 26.7 | 8.3 | 0.0 | 18.3 | 15.9 |
| Increased severity | 3.3 | 4.8 | 4.8 | 8.3 | 5.0 | 6.7 | 8.3 | 3.3 | 5.6 |
| New insect pest | 0.0 | 0.0 | 0.0 | 6.7 | 1.7 | 3.3 | 0.0 | 1.7 | 1.7 |
| New attack on specific variety | 0.0 | 4.8 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 | 0.0 | 0.8 |
| None | 75 | 24.2 | 33.3 | 21.7 | 16.7 | 50.0 | 3.3 | 51.7 | 34.5 |

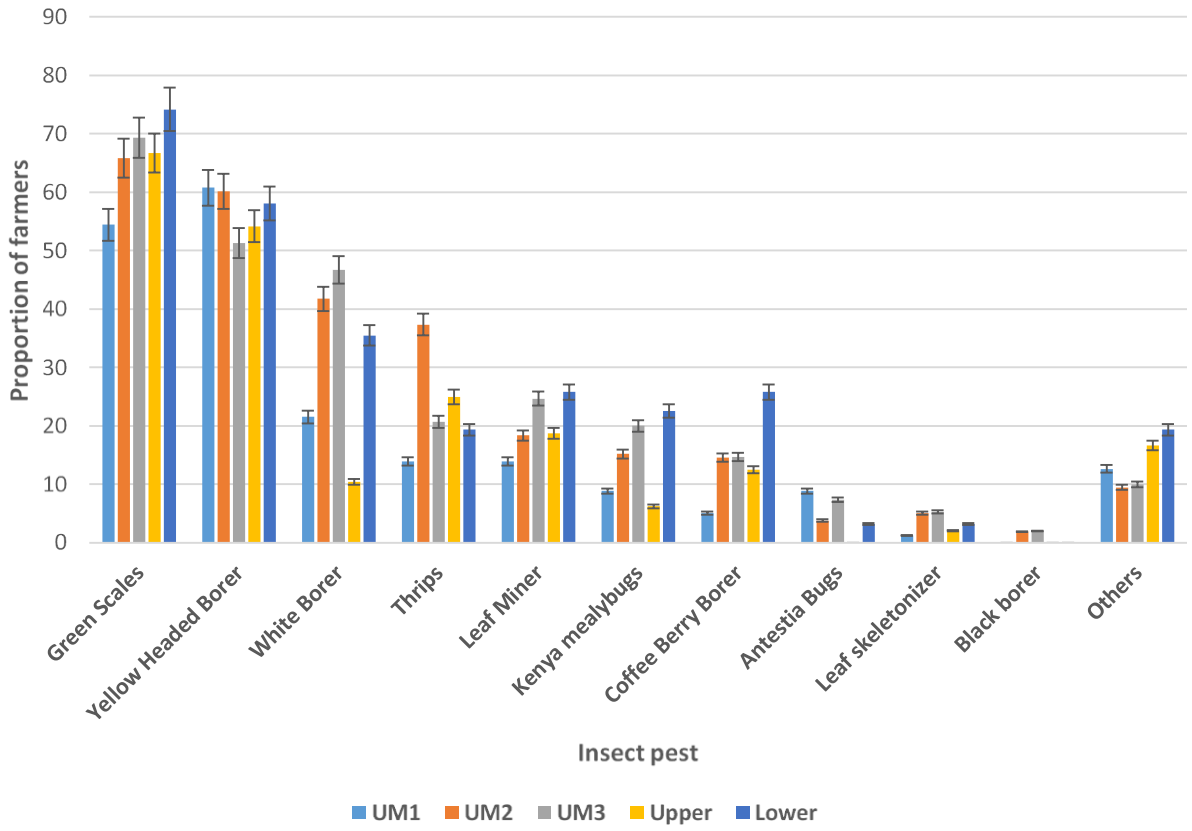


**Figure 3.** Coffee insect pests and their distribution in AEZs.

(*Dirphya nigricornis*), White Borer (*Anthores leuconotus*), Thrips (*Diarthrothrips coffeae*), Leaf miners (*Leucoptera* spp), Coffee Berry Borer (*Hypothenemus hampei*), Antestia bugs (*Antestiopsis* spp) and Kenya Meallybugs (*Planococcus kenyae*). Their occurrence ranged from 5 to 66%. The C. alpinus (66%) was the most common. The *D. nigricornis* (57%) was the second most common insect pest. The highly prevalent insect pests occurred in all AEZs but varied in proportions. The 'lower' zone reported high incidences of common insect pests as compared to other zones. Other insects reported include Stinging caterpillars (*Parasa vivida* (Walker)), Capsid bugs (*Lygus coffeae* (China)), Berry moth (*Prophantis smaragdina* (Butler)), Systate weevil (*Systates* spp), Root mealybugs (*Planococcus kenyae*), Giant loopers (*Ascotis selenaria reciprocaria*), Fried egg scales (*Aspidiotus* sp), Aphids (*Aphis coffeae* Nietner), Brown scale, Chaffer grubs and Red spider mites. The present study confirms the earlier

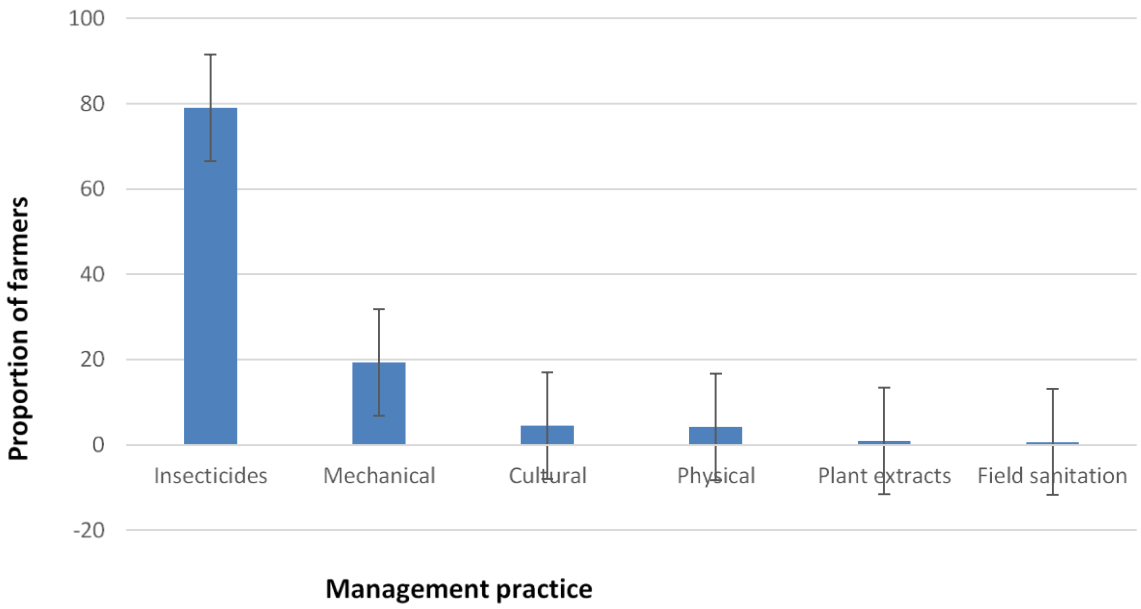


**Figure 4.** Pest management practices by farmers.

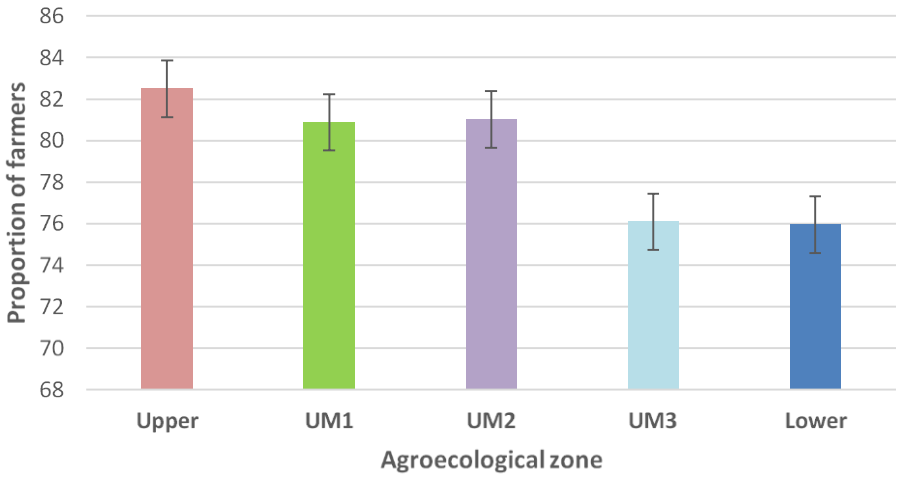


**Figure 5.** Proportion of farmers using insecticides in different AEZs.

findings by Mugo *et al*. (2011) where they established several insect pests attack coffee in Kenya.

## Management of coffee insect pests

Farmers adopted several pest control strategies during coffee production (Figure 4). These included the use of insecticides, mechanical (using the wire), physical (crashing using hand), cultural (cutting affected twigs/pruning, uprooting affected trees, mbuni stripping and ashing), plant extracts and field sanitation. The use of insecticides was the most significant common strategy adopted by 79% of coffee farmers to control various insect pests. A practice, Yudelman *et al.* (1998) also established was commonly used to control pests. The second most prevalent control method was mechanical, where farmers used wire to pierce the Yellow-headed and white borers. Though other control strategies that are environmentally friendly occur, such as integrated pest management and crop nutrition, farmers appeared not to apply.

More farmers in UM 1, UM 2 and 'upper' compared with UM3 and 'lower' significantly used insecticides to manage the insect pests (Figure 5), despite the high incidences of common insect pests being found in the 'lower' zone. This was attributed to affordability by farmers in UM 1, UM 2 and 'Upper' to procure insecticides as a result of income diversification from tea, dairy, and horticultural farming.

## CONCLUSION

Farmers heavily rely on the use of insecticides to manage pests, a strategy that is known to cause contamination of the environment.

The insect pests are key factors affecting coffee production in the Mt Kenya region that need well-designed sustainable pests management strategies for use by extension staff to offer focused technical advisory services to coffee farmers.

## RECOMMENDATIONS

The survey established that farmers though using several methods to manage the insect pests, lack knowledge of the use of strategies that are sustainable and environmentally friendly. Hence, the study proposes farmers be capacity built on the use of Integrated Insect Pests Management (IPM), use of proper crop nutrition, identification, conservation and application of potential local biological control agents.

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