Arabica Coffee Arthropod Pests and Their Management in Ethiopia: Current Status and Future Prospective

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ABSTRACT

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Arabica coffee (*Coffea arabica*) is one of the most important commodities that is cultivated in various agro-ecologies of Ethiopia. The perennial and evergreen nature of the coffee favors attack by several insects, diseases, mites, and some gastropods such as snails and slugs. All parts of the plants are susceptible to be attacked, and damage could appear at different crop growth stages. Coffee insects damage seedling, reduce coffee yield and quality. Many insects found in coffee agroforestry system are not pests; many are even beneficial as they feed upon the coffee pest species. Worldwide over 3000 insects and mites are associated with coffee. In Ethiopia, more than 59 arthropod pests have been identified and documented in coffee from 1966 till the present. From identified arabica coffee arthropods in the country around 30.51% are Hemiptera order whereas 28.81% are Lepidoptera order. Glasshouse orthezia (*Insignorthezia insignis*), mealybugs (*Planococcus* spp. and *Pseudococcus* spp.) and greenhouse whiteflies (*Trialeurodes* spp.) are the pest currently recorded in Ethiopia. Besides, due to changing farm dynamics from time to time and current climate change, some previously uncommon pests are appearing and discussed in this review. Coffee insect pests are more problematic in coffee plantation system. Pesticide-free pest management options under changing climatic conditions are crucial. As future prospective, it is very important to conserve natural enemies through the diversification in the coffee farms. In future, identifying the impacts of climate change on coffee associated insect species, and mass rearing and release of natural control agents could allow for the sustainable production in Ethiopia. Therefore, this review presents the past, current status of coffee arthropod pests and their management options in Ethiopia.

Keywords: Arabica coffee, arthropod pests, cropping systems, Ethiopia, pest management

INTRODUCTION

Arabica coffee (*Coffea arabica*) is the most important commodity and has been growing in various agro-ecologies of Ethiopia as it is an indigenous crop to the country. Arabica coffee is under attack by several insects, diseases, mites, and some gastropods such as snails and slugs. All portions of the plants (root, stem, branch, leaf, flower and fruit) are susceptible to many coffee pests at different crop growth stages. Over 3000 species of insects and mites are associated with coffee worldwide (Waller et al. 2007). In Ethiopia over 46 coffee insect

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species and 3 coffee mites were reported (Abedeta et al. 2015; Abebe 1987; Mendesil et al. 2008). Recently, insects such as mealybugs (*Planococcus* spp. and *Pseudococcus* spp.), greenhouse whiteflies (*Trialeurodes* spp.) and glasshouse orthezia (*Insignorthezia insignis*) are the pests currently recorded in coffee (Shimales 2019; JARC 2023/24; Shimales 2023). Till today, the coffee insect pests infesting coffee in Ethiopia are increased to over 59 insect pests (Table 1).

Different agro-ecologies (low to high altitude), coffee production types (forest-unmanaged wild to plantation, modern farming system), varied shade types and various coffee genotypes found in Ethiopia are opportunities for successful development of integrated coffee pest management strategies. Pests reached outbreaks and are more problematic in the most intensively managed coffee production system than in the forest coffee production system (Asfaw et al. 2019; Burger et al. 2021; Shimales et al. 2023a). This might be due to management practices (pesticide use) that could have impact on biological control, which is the suppression of pest level by natural enemies without human intervention (Diehl et al. 2013; Martin et al. 2013) and also beneficial insects like parasitoids and predators are often more abundant in less managed systems than in intensive farming systems (Medeiros et al. 2019). In addition, the genetic uniformity of coffee cultivars planted in intensive farming may favor the adaptation of insects to the crop (Shimales et al. 2023a). Besides, the study indicated parasitism rate of insect pests was lower, and the parasitoid community was distinct, in absolute managed coffee production systems (Medeiros et al. 2019; Shimales et al. 2023a). The objective of this paper is to discuss the past, current status of coffee arthropod pests recorded in Ethiopia and their management options.

ARABICA COFFEE ARTHROPOD PESTS

In Ethiopia over 56 coffee insect pests and 3 mite pests associated with arabica coffee were documented since 1966 to 2024. In addition to arthropod pests, gastropods (snails and slugs) become serious problem in Gomma district of Jimma zone (Shimales 2019). From identified arabica coffee arthropods in the country, around 30.51% are Hemiptera order (including bugs and scale insects) and followed by Lepidoptera (28.81%) (Table 1). Based on the part of the plant they attack, coffee insect pests are grouped in to berry-feeding insects, stem borers and branch borers, insects that feed on buds, leaves, green shoots and flowers, and root and collar-feeding insects (Waller et al. 2007). Based on the damage they cause to the coffee parts over 59 arabica coffee arthropod pests were indicated in the Table 1.

Leaf feeding insect pests.

Until 2015 a total of 49 coffee insect species reported in Ethiopia (Abdeta et al. 2015; Abebe 1987; Mendesil et al. 2008). Among these pests, coffee blotch miner (*Leucoptera caffeina*) and antestia bugs (*Antestiopsis intricata* and *A. facetoides)* were identified as major coffee insect pests in the country (Abebe and Murmane 1986; Abebe 1987, 2000). However, due to current climate change and change of farming practices, the status of minor insect such as coffee thrips, coffee berry moth, scale insects and stem borers has been increasing (Shimales 2019). Different scholars reported that different parts of coffee are attacked by various insect pests. The leaf damaging insect pests are coffee blotch miner, coffee leaf skeletonize, serpentine leaf miner and other free feeding herbivory damage have been assessed in southwestern Ethiopia (Abdeta et al. 2015; Beche et al. 2023;

Mendesil, 2019; Shimales and Beksisa, 2021; Shimales et al. 2017; Shimales 2019, Shimales et al. 2023a; Samnegard et al. 2014). However, the infestation level of these insect pests in the country varied due to difference in management gradients, shade level, farming practices, altitudinal gradients and seasons. Biology of some insect pests, classification of pests based on plant parts damaged and their management practices were reviewed by Mendesil (2019). However, coffee pests and their management although reviewed at various times by different researchers in the country. Nevertheless, due to the current weather variables and changing farm dynamics from time to time, some previously uncommon pests are appearing and affecting coffee yield and quality. It is important to take into account such compiled information to identify pests and moving towards pesticide free pest management strategies.

Table 1. Arabica coffee arthropod pests in Ethiopia

Common name	Scientific name	Order and family
Berry/fruit/ feeding pests		
Coffee berry moth	*Prophantis smaragdina*	Lepidoptera: Pyralidae
Coffee berry borer	*Hypothenemus hampei*	Coleoptera: Curculionidae
Berry worm	*Cryptophlebia batrachopa*	Lepidoptera: Tortricidae
Berry butterfly	*Deudorix lorisona*	Lepidoptera: Lycaenidae
Natal fruit fly	*Ceratitis rosa*	Diptera: Tephritidae
Mediterranean fruit fly	*Ceratitis capitata*	Diptera: Tephritidae
Fruit fly	*Ceratitis fasciventris*	Diptera: Tephritidae
Fruit fly	*Ceratitis anonae*	Diptera: Tephritidae
Antestia bug	*Antestiopsis intricata*	Hemiptera: Pentatomidae
Antestia bug	*Antestiopsis orbitalis*	Hemiptera: Pentatomidae
Antestia bug	*A. thunbergii ghesquierei*	Hemiptera: Pentatomidae
Antestia bug	*Antestiopsis facetoides*	Hemiptera: Pentatomidae
Soap berry bug	*Leptocoris affinis*	Hemiptera: Rhopalidae
Stem feeder pests		
White coffee stem borer	*Monochamus leuconotus*	Coleoptera: Cerambycidae
Black borer	*Apate monachus*	Coleoptera: Bostrichidae
Black borer	*Apate indistincta*	Coleoptera: Bostrichidae
Asian ambrosia beetle	*Xyleborus xanthopus*	Coleoptera: Scolytidae
Cocoa stem borer	*Eulophonotus myrmeleon*	Lepidoptera: Cossidae
Branch borer	*Ethmia iphicartes*	Lepidoptera: Ethmiidae
Cossid stem borer	*Duomitus* sp.	Lepidoptera: Cossidae

Coffee leaf feeding pests		
Coffee blotch miner	*Leucoptera meyricki*	Lepidoptera: Lyonetiidae
Coffee blotch miner	*Leucoptera caffeina*	Lepidoptera: Lyonetiidae
Serpentine leaf miner	*Cryphiomystis aletreuta*	Lepidoptera: Gracillaridae
Coffee leaf skeletonizer	*Leucoplema dohertyi*	Lepidoptera: Epiplemidae
Giant looper	*Ascotis selenaria reciprocaria*	Lepidoptera: Geometridae
Green tortrix	*Archips occidentalis*	Lepidoptera: Tortricidae
Brown tortrix	*Tortrix dinota*.	Lepidoptera: Tortricidae
Branch, stem, leaf and berry feeding pests		
Green scale	*Coccus alpinus*	Hemiptera: Coccidae
Coffee bark scale	*Avricus arborescens*	Hemiptera: Coccidae
White waxy scale	*Ceroplastes brevicauda*	Hemiptera: Coccidae
Halmet scale	*Saissetia coffeae*	Hemiptera: Coccidae
Citrus mussel scale	*Lepidosaphes beckii*	Hemiptera: Diaspididae
Rufous scale	*Selenaspidus articulatus*	Hemiptera: Diaspididae
Black thread scale	*Ischnaspis longirostris*	Hemiptera: Diaspididae
Coffee cushion scale	*Stictococcus formicarius*	Hemiptera: Stictococcidae
Coffee aphid	*Toxoptera aurantii*	Hemiptera: Aphididae
Coffee thrips	*Diarthrothrips coffeae*	Thysanoptera: Aeolothripidae
Coffee thrips	*Selenothrips rubrocinctus*	Thysanoptera: Aeolothripidae
Cutworm	*Agrotis* sp.	Lepidoptera: Noctuidae
Cutworms	*Euxoa* spp.	Lepidoptera: Noctuidae
Chafer grubs	*Phyllophaga* spp.	Coleoptera: Scarabaeidae
Stinging caterpillar	*Parasa vivida*	Lepidoptera: Cochlidiidae
Systates weevil	*Systates* sp.	Coleoptera: Curculionidae
Lamiine	*Sophronica* sp.	Coleoptera: Cerambycidae
Coffee leaf fly	*Tropicomyia flacourtiae*	Diptera: Agromyzidae
Coffee lygus	*Lygus coffeae*	Heteroptera: Miridae
Coffee capsid	*Lamprocapsidea coffeae*	Heteroptera: Miridae
Dusty brown beetle	*Gonocephalum simplex*	Coleoptera: Tenebrionidae
African silk worm	*Anaphe panda*	Lepidoptera: Notodontidae
*Red crevice mite	*Brevipalpus* sp.	Acari: Tenuipalpidae
*Coffee bronze mite	*Diptilomiopus* sp.	Acari: Diptilomiopidae
*Red coffee mite	*Oligonychus coffeae*	Acari: Tetranychidae
Mealybugs	*Planococcus* spp.	Hemiptera: Pseudococcidae
Mealybugs	*Pseudococcus* spp.	Hemiptera: Pseudococcidae

Greenhouse whiteflies	*Trialeurodes* spp.	Hemiptera: Aleyrodidae
Biting ant	*Tetramorium aculeatum*	Hymenoptera: Formicidae
Weaver ant	*Oecophylla longinoda*	Hymenoptera: Formicidae
Termite	*Coptotermes*	Isoptera: Termitidae
Lantana bug	*Insignorthezia insignis*	Hemiptera: Ortheziidae

* Sources: Abedeta et al. 2015; Abebe 1987; Crowe and Gebremedhin 1984; Greathead 1968; JARC, 2023; Mendesil et al. 2008; Mendesil, 2019; Shimales 2019, 2023.

Coffee blotch miner *Leucoptera caffeina*.

In Ethiopia, two species of coffee blotch miner are documented: *Leucoptera caffeina* and *Leucoptera meyricki* (Abebe 1987; Abebe and Murmane 1986; Crowe and Gebremedhin 1984). The coffee blotch miner *L. caffeina* oviposit its eggs in rows of 1 to 13 eggs (Notley 1956). However, at field conditions up to 17 eggs (1 to 17 eggs in rows) were recorded at Gomma district of Jimma zone (Personal observation). When the larvae hatch, it feeds inside a leaf just below the upper epidermis, resulting in leaf damage (Crowe and Tadesse 1984, Shimales 2019). Pupation occurs either on the tree or fallen leaf (Crowe and Tadesse 1984; Shimales 2019). According to Crowe and Tadesse (1984) the larval, pupa and adult stages for coffee blotch miner were 20-34 days, 7-14 days, and 14 days (for the female), respectively.

L. caffeina is the most economically important species, attacking coffee leaves in nursery and field conditions (Shimale et al. 2017). The larvae create a distinct blotch mine while feeding gregariously in the upper side of the leaf (Notley 1956, Crowe and Tadesse 1984, Shimales et al. 2023a). Mined leaves by coffee blotch miner become dried and fall, as a result yield and life span of coffee tree could be reduced (Shimales and Beksisa 2021). The coffee blotch miner infestation was studied by various authors in different production systems and seasons (Samnegard et al. 2014, Abdeta et al. 2015; Beche et al. 2023; Shimales et al. 2023a).

Coffee thrips (*Diarthrothrips coffeae*).

Coffee thrips is one of the important coffee insect pests found in Ethiopia. Over 42 phytophagous species in 24 genera were associated with coffee flowers in coffee plantations in Chiapas, Mexico (Infante 2017). However, only two species of coffee thrips, namely *Diarthrothrips coffeae* and *Selenothrips rubrocinctus* were documented in Ethiopia (Mendesil et al. 2008). Level of coffee thrips infestation varies and depends on the production type, shade level, altitude and farming system (Shimales et al. 2023b). The estimated infestation of coffee thrips from southern Ethiopia was ranged from 5 to 50% (Guteta et al. 2017). However, it was ranged from very low to very high infestation (0.04 to 100%) in southwestern Ethiopia (Shimales and Alemayehu 2018). Coffee thrips attack the leaves, shoots, nodes, and green berries, and finally defoliates the coffee leaf in severe infestations (Shimales and Beksisa 2021; Shimales et al. 2023b). The pest can cause up to 100% loss during prolonged drought in sun coffee farming system (Shimales and Alemayehu 2018).

Farming practices had strong impact on coffee thrips population density and damage level. The maximum severity of coffee thrips and population was recorded in full-sun system as compared to shaded farm especially under *Albizia schimperiana* plants (Shimales et al. 2023b). Close spacing in full-sun system resulted in higher coffee thrips populations and damage levels (Fig. 1). This indicted that management practices could have impact on pest population either by enhancing the pest or by reducing their generation span. Different cultural practices like shade tree regulation, moisture conservation and plant diversification (intercropping), could manage coffee thrips population below economic threshold level (Fig. 1).

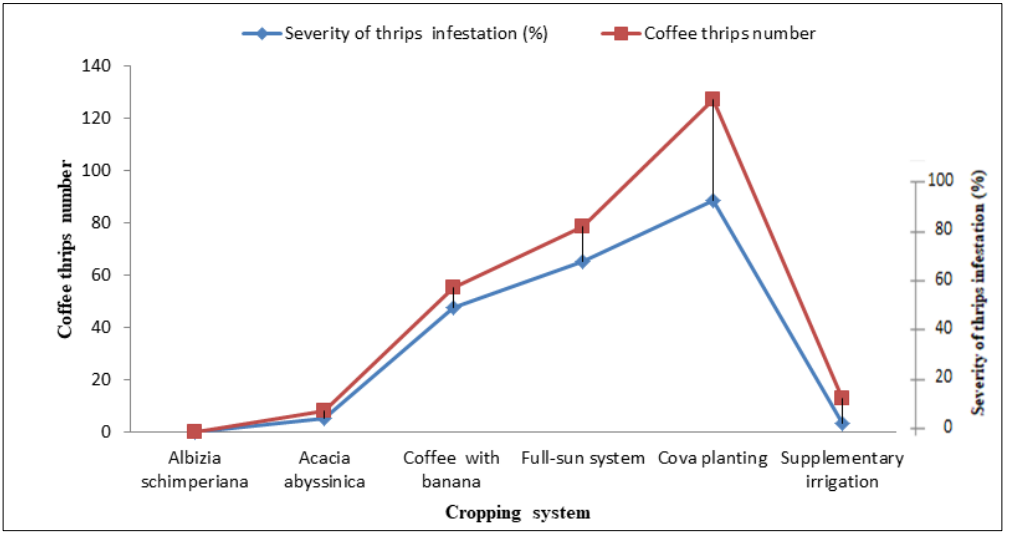

Fig. **1**. Coffee thrips density in different farming systems.

Scale insects.

The scale insects feed on buds, leaves, collars, green shoots, flowers and green berries of coffee plant. Till 2000, only 7 scale insect species were documented and identified in Ethiopia (Mendesil et al. 2008). Nowadays, around 13 scale insect species (both armored and soft boded scale insects) were identified and documented. Out of those species of scale insects recorded in Ethiopia coffee, cushion scale (*Stictococcus formicarius*), white waxy scale (*Ceroplastes brevicauda*), and green scale (*Coccus alpinus*) are potentially important pests (Mendesil et al. 2008). Cushion scale is more important in Welega, Metu, and Mugi areas, while the green scale is common in many parts of western Hararghe causing the death of bearing branches (Abebe 1987; 2000). In addition to mealybugs and whiteflies, greenhouse orthezia (*Insignorthezia insignis*) is the scale insect recently (2024) observed in coffee in Ethiopia.

White waxy scale and helmet scale (*Saisettia coffeae*) (Fig. 2) are common in Jimma and Illubabor zones, which cause up to 100% damage level on bearing branches, nodes, leaves and fruits (Shimales 2023). Besides, white waxy scale infests *Acacia abyssinica* and *Sasbania sesban* shade trees in Jimma areas (Shimales 2023).

Fig. **2.** White waxy scale on coffee stem (A), Red one underneath the wax, photographed under microscope (B), and Helmet scale (C).

Mealybugs (*Planococcus* spp. and *Pseudococcus* spp.).

Over 50 species of scales and mealybugs which attack various parts of the coffee tree in different coffee-producing countries are reported (Kumar et al. 2016). However, mealybugs and whiteflies are the pests currently reported in Ethiopia (Shimales, 2019; JARC 2022/23). Various species of *Planococcus* and *Pseudococcus* were recorded in Gera, Mettu and Bebeka areas (Fig. 3). Mealybugs bugs were the most serious pest at Bebeka and Mettu areas. However, long-tailed mealybugs were common at Jimma, Mettu and Gera areas causing the death of bearing branches and green berries.

Fig. **3.** Coffee mealybugs. A & B: Adult tailed mealybug (*Ferrisia virgata*), C: Mealybug crawlers of *Pseudococcus* sp.

Berry feeding insects.

Many scholars reported that coffee is attacked by various coffee berry feeding insect such as coffee berry moth (Abdeta et al. 2011; JARC, 2023/24; Mendesil and Tesfaye 2009; Shimales 2019; Shimales et al. 2024), coffee berry borer (Abdeta et al., 2011; EARO 2000; Eyasu 2019; Mendesil et al. 2004; 2008; Shimales et al. 2019), coffee fruit flies (Abedeta et al. 2011; Samnegard et al. 2014; Shimales 2019), and Antestia bugs (Abate et al. 2018;; Chichaybelu 2008; Mendesil et al. 2008, 2019; Shimales 2019; Shimales and Beksisa 2021; Shimales et al. 2017a; Shimales et al. 2023b; Tadesse et al. 1993) in southwest Ethiopia. Among berry-feeding insects, the biology and management of coffee berry borer, Antestia bug and coffee berry moth were reviewed by Mendesil (2019).

Antestia bugs *Antestiopsis* spp.

Among 4 species of Antestia bugs reported in Ethiopia, *Antestiopsis intricata* and *Antestiopsis facetoides* are economically important insect pests (Greathead, 1966; Crowe and Gebremedhin, 1984; and Abebe, 1987). *A. intricata* is the most common bug found in all coffee growing areas of Ethiopia, except at Hararge coffee growing areas. However, *A. facetoides* is found at Hararghe (Abebe 1987; Crowe and Gebremedhin 1984; Greathead 1966; Mendesil 2019) coffee producing areas. *Antestiopsis oribitalis* was recorded in Gomma district (JARC 2023) and its presence was confirmed, 50 years ago in a semi-plantation coffee farm. In addition, marmorated stink and *Agonoscelis* spp. was recorded on coffee trees during dry to rainy transition period at Jimma, but its crop damage was not yet been confirmed (Shimales, unpublished data). Some insect pests like Antestia bugs and coffee berry moth increase its geographical distribution from lowland to highland areas (Shimales 2019; Shimales et al. 2023b). This could be due to farming practices, changes from traditional to modern practices, and the current climate change.

Economically, Antestia bugs (*A. intricata* and *A. facetoides*) are more serious pest when coffee plants are grown under shade trees and at lowland coffee growing areas (Abebe 1987). Antestia bugs affect coffee by sucking green berries, flower buds, and growing tips, which results in blackening of coffee flowers and flower buds, fall of immature berries, and length of the internodes becoming short (Crowe and Tadesse 1984; Le Pelley 1968; Shimales and Beksisa 2021). The infestation by *A. intricata* shows a strong correlation with yield loss which was assessed to 9% (Tadesse et al. 1993). This pest also reduces the coffee quality. Some studies showed that Antestia bugs caused up to 48% darkened coffee beans (IAR 1996). Chichaybelu (2008) reported that four pairs of Antestia bugs per branch might cause up to 54% berry drop and 90% berry damage. Antestia bugs passed the threshold in an intensively managed coffee production system including Limmu Kosa estate farm compared to semi-forest and semi-plantation coffee systems (Shimales et al. 2023b). This could be due to management practices applied in commercial farming system increasing the insect. The detailed distribution, life history, economic impact, and control measures of the pest have been reviewed by Babin et al. (2018).

Soapberry bugs (*Leptocoris affinis*).

The adult *Leptocoris affinis* is reddish-brown and nymphs have a bright red abdomen with a brown-black head. It was recorded in two zones (Jimma and Guji) of coffee growing areas (Fig. 4).

Fig. **4.** Soapberry bugs on coffee leaf (A), Adults and nymphs (B) from left to right.

Coffee berry borer, *Hypothemus hampei*.

In Ethiopia, the first occurrence of *H. hampei* was reported by Davidson (1965). Later on, its incidence was reported from various parts of the country (Abebe 1987, Abedeta et al. 2011; Mendesil et al. 2003, 2004, 2008; Shimales 2019). The biology, population dynamics and impact of coffee berry borer was reviewed by Mendesil et al. (2008) and Mendesil, (2019). The damage caused by coffee berry borer was higher in plantation coffee as compared to forest coffee farms. The study indicated that coffee berry borer was the most detected berry boring insect with mean proportion of 27.8% during wet and 52.88% during dry seasons in commercial coffee production system (Shimales 2019).

Coffee berry moth, *Prophantis smaragdina*.

Coffee berry moth is a minor pest; however, heavy losses of berries have been documented due to severe attacks at low altitudes (Mendesil et al. 2008). Significant berry loss has been recorded at a high-altitude of 1900 m above sea level of the Gera site in the 2023 growing season (JARC 2023).

Coffee berry moth attacks when the berries are in cluster form or webbed together. This insect pest might feed also on the tips of green branches. The berry moth symptom on berries is brown, dry or hollow (Waller et al. 2007; Crowe and Gebremedhin 1984). In the absence of berries, it may also feed on the tips of green branches.

The percentage of infested berries due to coffee berry moth ranged from 1.11% to 54.13% in 2022/23 at the Gera research sub-center (JARC 2023 unpublished data). These data have been not published yet whenever only the summary of the findings has been reported. Significant variation was observed among Limmu coffee genotypes against coffee berry moth at Gera research center (Fig. 5). The difference in infestation level among genotypes might occurred due to the difference in defense mechanism of the genotypes to coffee berry moth; this could be the future research works to develop tolerant coffee varieties against berry moth as one component of integrated pest management.

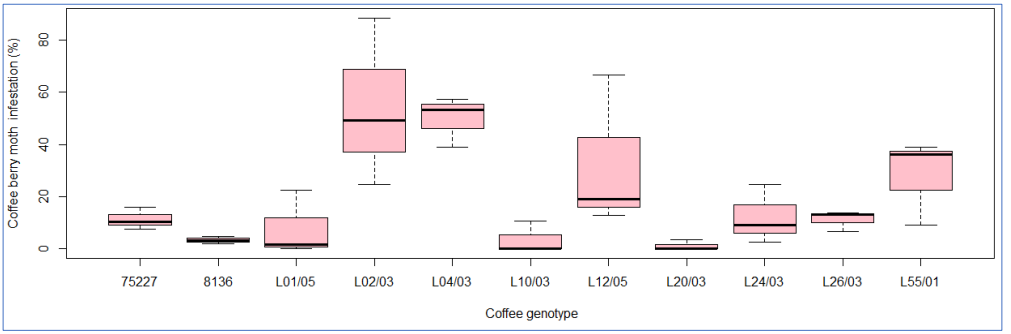

Fig. 5. Coffee berry moth damage variation among different Limu coffee genotypes at Gera in 2022/23 growing season.

Damaged berries by coffee berry moth may be an avenue for disease infection. Larval damage favors coffee berry disease infection and the silk webbing prevents the efficient use of fungicide (Crowe 2004). At Jimma (Melko), Gera and Agaro coffee research sites, the infection of coffee thread blight is highly observed on coffee berry moth infested berries (Personal observation). This might make coffee berry moth enhances and facilitates coffee thread blight infection (Personal observation).

Stem and branch borers.

Till know, seven insect species of coffee branch and stem boring insects are reported in Ethiopia, namely white coffee stem borer (*Monochamus leuconotus*), black borer (*Apate indistincta* and *Apate indistincta*), cocoa stem borer (*Eulophonotus myrmeleon),* branch borer (*Ethmia iphicartes),* cossid stem borer (*Duomitus* sp.) and *Xyleborus xanthopus* (Abebe 1987). Among stem and branch borer insect pests, branch borer was common at Melko on short internode coffee genotypes, while cacao stem borer has infested coffee at Mettu, Gera and Omonada district (JARC 2023). The infestation of stem borer was higher in western coffee growing areas of Ethiopia in open coffee farm (Shimales et al. 2017). The detail biology of cacao stems borer was reviewed by Mendesil (2019) and Mendesil et al. (2008). Coffee stem borer also dries the coffee stem when the plant is heavily infested. Nevertheless, there are various factors drying coffee stem and branch including over bearing, fungal diseases (coffee wilt diseases and coffee thread blight), coffee thrips and frost.

Biting ant *Tetramorium aculeatum*.

There are diverse ant species in coffee farms in Ethiopia. However, the roles of arboreal ants in coffee ecosystems are not well studied and documented in the country. Ants are a nuisance to humans in the time of coffee farm field management starting from planting to harvesting. Two arboreal ant species, the biting ant (*Tetramorium aculeatum)* and the weaver ant (*Oecophylla longinoda*), were reported from Bebeka and Tepi coffee plantations farms in southwestern Ethiopia (Damte and Minase 2010). The ecological distribution of the biting ant (Kidanu 2019) and that of acrobatic ant (*Crematogaster* sp.) (Stüber et al. 2021) was studied in different management gradients of southwestern Ethiopia. In

Ethiopia, biting ants are more abundant in coffee plantations such as Tepi and Bebeka in southwestern Ethiopia (Damte and Minase 2010).

Ants biting and stinging field workers, hinder harvesting and pruning, reduce picking efficiency, increase the cost of labour, and could reduce coffee quality and yield. Yield loss due to biting ant is estimated to be 15-30% at Bebeka coffee farms (Fisseha 2014; Getachew et al. 2015). Use some insecticides including oxymatrine, nimbicidine and deltamethrin resulted in significant differences in biting ant (*T. aculeatum)* mortality and reduction of active nests (Getachew et al. 2015; Kidanu et al. 2021).

MANAGEMENT AND CONTROL

Cultural method.

Shade-tree management.

A large percentage of coffee in Ethiopia is produced in the shade. In this regard, compared to our country and other coffee producing countries, the damage caused by coffee arthropod pests in Ethiopia is less. Therefore, coffee shade can prevent some insects from multiplying and also facilitate the increase of naturally beneficial insects to control coffee insect pests below economic threshold level (Medeiros et al. 2019, Burger et al. 2021; Shimales et al. 2023a).

For example, above threshold level of Antestia bug has been recorded at Beha Land Agro Industry, commercial coffee farm located in Keffa in sun coffee farm, compared to shaded coffee farm (Shimales et al. 2023b). Shading trees (*Albizia schimperiana* and *Acacia abyssinica*) significantly lowered the severity and population density of coffee thrips, as compared to sun system, with a mean difference of above 60% (Shimales et al. 2023b). The cultural practices shade-tree regulation and pruning of coffee trees are used to minimize the effect of coffee insect pests such as Antestia bug, coffee berry borer, coffee leaf miner, coffee berry moth, coffee thrips and scale insects (Abebe 1987; Chichaybelu 2008; Crowe and Gebremedhin 1984; Mendesil et al. 2008; Shimales 2023b; Shimales and Beksisa 2021).

Conservation of natural enemies through plant diversification.

Conservation of available natural enemies through diversifying coffee farms is very important. There is no need to introduce new species as biological control agents for coffee insect pests in Ethiopia. The coffee production systems had clear impact on the parasitism rate, with a much higher parasitoid diversity in more diversified coffee farms like forests than in intensively managed plantations (Shimales et al. 2023a). For example, beneficial insects like parasitoids and predators (ants and birds) are often more abundant in less managed production systems than in intensively managed systems (Burger et al. 2021; Jonsson et al. 2015; Medeiros et al. 2019; Shimales et al. 2023a; Whitehouse et al. 2018). The Observational? studies conducted at Jimma agricultural research center (Melko), indicated that high level of larval parasitism was recorded in desmodium cover crop, and in shaded coffee farms.

Mechanical method.

Handpicking.

Handpicking of Antestia bugs and removal of their eggs from coffee parts has been recommended for Antestia pest management (Crowe 1984; Shimales and Beksisa 2021). In addition, among leaf feeder coffee, blotch miner and serpentine leaf miner are serious pests at seedling stage, especially in green house and lath house (JARC 2023). Therefore, hand squeezing of larvae at seedling stage has

been recommended for control of coffee blotch miner (Shimales and Beksisa 2021).

Supplementary irrigation/Moisture conservation practices.

Irrigating coffee plants during dry periods can manage the population and severity of coffee pests. The incidence and severity of coffee thrips were higher under a full-sun system than supplementary irrigated coffee at Melko, with a mean difference of 54.55% (Shimales et al. 2023b). Shimales et al. (2021) observed a significant reduction in the severity of coffee blotch miner under well-watered than water-stressed Limmu coffee genotypes. Besides, moisture-conserving practices including mulching materials (vetiver grass and brachiaria grass), cover crop (*Desmodium* spp.) and permanent shade trees are some of the cultural practices recommended for the management of coffee thrips and coffee blotch miner (Shimales and Beksisa 2021; Shimales et al. 2021).

Proper harvesting and drying.

For berry feeding insects including coffee berry borer, proper harvesting is recommended for coffee pests (Abebe 1987; Mendesil 2019; Mendesil et al. 2003; 2004).

Biological control.

Coffee insect pests parasitoids are already present in different coffee production systems in the country, regardless of their abundance from one production system to another production type (Shimales et al., 2022). Therefore, it is necessary to conserve the already available natural enemies through diversifying coffee farms. In Ethiopia, two economically important pests, Antestia bug and coffee blotch miner, might be controlled by natural agents (Table 2). Shimales et al. (2023a) also reported different parasitoid families parasitizing coffee blotch miner larvae, with the majority of parasitoids belonging to the families of Encyrtidae.

Chemical control.

Several insects found in the coffee agroforestry system are not pests, and many are even beneficial (parasitoids, predators, beneficial fungus like entomophatogenic fungi), because they feed upon the coffee pest species. This control options might be used only when it is indispensable to be applied according the advice of a plant protection specialist. Recently, there were some recommended insecticides for insect pests of seedlings and field pests. Two botanical insecticides, oxymatrine and nimbicidine, and one synthetic insecticide deltamethrin resulted in significant differences in ant (*T. aculeatum)* mortality and reduction of active nests (Getachew et al. 2015; Kidanu et al. 2021). The two botanical insecticides i.e., oxymatrine and nimbicidine have been recommended and effective against coffee thrips control at field conditions (Shimales and Alemayehu 2018). These insecticides were also tested and recommended for control of seedling pests including coffee leaf skeletonizer, coffee blotch miner, serpertine leaf miner, giant looper caterpillar and cutworms (Shimales 2024, unpublished).

Future prospective.

A number of insects found in coffee agroforestry system are not pests and many are even beneficial as they feed upon the coffee pest species. Identifying important areas for natural enemy is key element in ecological pest management method. Hence, creating welcoming environment for natural enemies through agroforestry system (permanent shade tree), using cover crops (e.g., desmodium) and soil moisture conservation practices

like mulch and supplementary irrigation could help the role of biological control agents in pest management strategies. It is essential to conserve the already available natural enemies through diversifying coffee farms as arabica coffee is originated in Ethiopia, various natural enemies could co-evolve with coffee pests. Chemical control should be used only when essential and preferably with the advice of a plant protection specialist. In future, identifying the impacts of climate change on coffee associated insect species, and mass rearing and release of natural control agents could allow for the sustainable production of coffee in Ethiopia. Besides, development of tolerant or resistant coffee varieties against economically important insect pest should have priority as an important option in the integrated pest management. Further studies are recommended especially on ecological pest management (pesticide free pest management option) strategies.

Table 2. Biological control agents (parasitoids and pathogens) of coffee pests

Natural enemies	Parasitize insect stage	Source
Asolcus suranus	Antestia eggs	Abebe 1987
Hadronotus antestiae	Antestia eggs	
Anastotus antestiae	Antestia eggs	
Corioxenos antestiae	Antestia adults	
Bogosia rubens	Antestia adults	
Entomopathogenic fungi (*Beauveria bassiana* and *Metarhizium anisopliae*)	Antestia adults and nymphs	Abate 2018; Kidanu et al. 2023; Shimales et al. 2017
Aphidencyrtus aphidivorus	Coffee blotch miner larvae	Mendesil et al. 2011
Pediobius caffeicola		
Chrysocharis lepelleyi		
Apanteles bordaget		
Achrysocharis ritchiei		
Elasmus johnstoni		
Cirrospilus afer		
Bathyaulux sp.	Coffee stem borer adults	Abebe 1999

RESUME

Shimales, T., et Alemayehu D. 2024. Arthropodes ravageurs du caféier arabica et leur gestion en Ethiopie: Etat actuel et perspectives d'avenir. Tunisian Journal of Plant Protection 19 (2): 69-85.

Le caféier arabica (*Coffea arabica*) est l'une des denrées les plus importantes qui est cultivée dans diverses agroécologies d'Éthiopie. La nature pérenne et persistante du caféier favorise les attaques de

plusieurs insectes, maladies, acariens et certains gastéropodes tels que les escargots et les limaces. Toutes les parties des plantes sont susceptibles d'être attaquées et des dégâts peuvent apparaître à différents stades de croissance des cultures. Les insectes du caféier endommagent les semis, réduisent le rendement du caféier et la qualité du café. De nombreux insectes trouvés dans le système agroforestier du caféier ne sont pas des ravageurs; beaucoup sont même bénéfiques car ils se nourrissent d'espèces de ravageurs du caféier. Dans le monde, plus de 3000 insectes et acariens sont associés au caféier. En Éthiopie, plus de 59 arthropodes nuisibles ont été identifiés et documentés dans le caféier de 1966 à nos jours. Parmi les arthropodes du caféier arabica identifiés dans le pays, environ 30,51 % appartiennent à l'ordre des hémiptères, tandis que 28,81 % appartiennent à l'ordre des lépidoptères. L'orthezia des serres (*Insignorthezia insignis*), les cochenilles farineuses (*Planococcus* spp. et *Pseudococcus* spp.) et les aleurodes des serres (*Trialeurodes* spp.) sont les ravageurs actuellement recensés en Éthiopie. En outre, en raison de l'évolution de la dynamique des exploitations agricoles et du changement climatique actuel, certains ravageurs auparavant peu courants, commencent à apparaître et sont discutés dans cette revue. Les insectes ravageurs du caféier sont plus problématiques dans le système de plantation de caféier. Les options de gestion des ravageurs sans pesticides dans des conditions climatiques changeantes sont cruciales. En tant que perspective d'avenir, il est très important de conserver les ennemis naturels par la diversification dans les plantations de caféier. À l'avenir, l'identification des impacts du changement climatique sur les espèces d'insectes associées au caféier, ainsi que l'élevage en masse et la libération d'agents de lutte naturels pourraient permettre une production durable en Éthiopie. Par conséquent, cette revue présente l'état passé et actuel des ravageurs des arthropodes du caféier et les options de leur gestion en Éthiopie.

Mots clés: Caféier arabica, arthropodes ravageurs, systèmes de culture, Éthiopie, management des ravageurs

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ملخص

شيماليس، تاميرو وديساليغن وأليمايهو. 2024. الآفات المفصلية للبن العربي وإدارتها في إثيوبيا: الوضع الحالي والآفاق المستقبلية. Tunisian Journal of Plant Protection 19 (2): 69-85.

يعد البن العربي (*Coffea arabica*) أحد أهم المحاصيل التي تتم زراعتها في مختلف البيئات الزراعية في إثيوبيا. إن الطبيعة المعمرة والمستديمة لشجرة البن تسهّل هجمات العديد من الحشرات والأمراض والعناكب وبعض بطنيات الأقدام مثل الحلازين والرخويات. جميع أجزاء نبات البن معرضة للهجوم ويمكن أن تظهر الأضرار خلال مراحل مختلفة من نمو المحصول. تلحق حشرات البن الضرر بالشتلات، وتقلل من إنتاجية المحصول وجودة القهوة. العديد من الحشرات الموجودة في نظام زراعات البن الغابية ليست آفات؛ بل إن الكثير منها مفيد لأنها تتغذى على أنواع من آفات البن. في جميع أنحاء العالم، ترتبط أكثر من 3000 حشرة وعنكبوت بنبات البن. وفي إثيوبيا، تم تشخيص أكثر من 59 آفة مفصلية وتوثيقها على البن منذ عام 1966 حتى الوقت الحاضر. من بين مفصليات البن العربي التي تم تحديدها في البلاد، ينتمي حوالي 30.51% إلى رتبة نصفيات الأجنحة، في حين ينتمي 28.81% إلى رتبة حرشفيات الأجنحة. تعتبر أورثيزيا البيوت المحمية (*Insignorthezia insignis*)، والبق الدقيقي (*Planococcus* spp. و*Pseudococcus* spp.) والذباب الأبيض للبيوت المحمية (*Trialeurodes* spp.) هي الآفات المسجلة حاليًا في إثيوبيا. بالإضافة إلى ذلك، وبسبب تطور ديناميكيات الزراعة وتغير المناخ الحالي، بدأت بعض الآفات غير الشائعة في الظهور وتمت مناقشتها في هذه المراجعة. تعتبر آفات حشرات البن أكثر إشكالية في نظام زراعة مزارع البن. تعد خيارات إدارة الآفات بدون مبيدات حشرية في ظل الظروف المناخية المتغيرة أمرًا بالغ الأهمية. كمنظور مستقبلي، من المهم جدًا الحفاظ على الأعداء الطبيعيين من خلال التنويع في مزارع البن. في المستقبل، تحديد آثار تغير المناخ على أنواع الحشرات المرتبطة بالبن، إلى جانب التربية الجماعية وإطلاق عوامل المكافحة الطبيعية، يمكن أن يؤدي إلى إنتاج مستدام في إثيوبيا. لذلك، تعرض هذه المراجعة الوضع السابق والحالي لآفات مفصليات البن وخيارات إدارتها في إثيوبيا.

كلمات مفتاحية: إثيوبيا، إدارة الآفات، آفات مفصلية، بن عربي، نظم زراعية

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