SEVERITY OF ANTESTIA BUGS, *ANTESTIOPSIS* SPP AND OTHER KEY INSECT PESTS UNDER SHADED COFFEE IN KENYA

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ABSTRACT
Growing coffee under shade trees is a common practice by the farmers' especially in tropical and sub tropical countries where the effect of global warming is heavily encountered. The practice though applied its impact on severity of key coffee insect pests; Antestia bugs (*Antestiopsis* spp), Coffee Berry Borer (CBB) (*Hypothenemus hampei* Ferri), Leaf miners (*Leucoptera* spp) and Coffee Thrips (*Diarthrothrips coffeae* Williams) on coffee is of major concern for effective management. To ascertain this, a study was initiated on coffee grown under shade trees; *Cordia africana* Lam. Results obtained showed that the severity of *Antestiopsis* spp was significantly ($P < 0.05$) higher under shaded coffee as compared to un-shaded ones. The highest (0.97) and the lowest (0.1) mean number of *Antestiopsis* spp per tree occurred under shaded and un-shaded coffee, respectively. The severity of *H. hampei* ranged between 0 - 0.09% while that of *D. coffeae* was 0.11- 0.6 thrips per leaf with significantly ($P < 0.05$) lower infestation observed under shaded coffee when compared with un-shaded coffee for both pests. The severity of *Leucoptera* spp was significantly ($P < 0.05$) higher under un- shaded coffee when compared with shaded coffee. Evidently, the shade effect on severity of insect pests varied with different insect pest species. The implications of these findings are discussed.

KEYWORDS: Shade, Antestia bugs, Key insect pests, Severity.

INTRODUCTION

Coffee is the most important commodity in the international agricultural trade, representing a significant source of income to several tropical and sub- tropical countries (DaMatta, 2004). In Kenya, coffee has been the major prime mover of its economy since independence. It is also regarded as the major source of livelihood for about 700,000 smallholder coffee farmers and over 3000 medium to large scale growers (Kenya Coffee Traders Association, 2006). It contributes about 20% of the revenue from total domestic exports. Growing coffee in Kenya faces a lot of challenges such as climate change resulting sometimes into prolonged dry periods (droughts) and increased incidences of coffee pests. The increasing incidences of these pests and their consequent control and management have significantly constrained the economical production of coffee in the country. Some of the pests include arthropods (insect pests) and pathogenic micro-organisms. The insect pests of economic importance includes; Coffee berry borer (CBB), *Hypothenemus hampei* (Ferrari); Coffee Thrips, *Diarthrothrips coffeae* Williams; Antestia bugs, *Antestiopsis* spp and Leaf miners, *Leucoptera* spp.

The *Hypothenemus hampei* is a major insect pest of coffee that affects coffee productivity in many countries (Baker, 2002). In Africa, Waterhouse and Norris (1989) reported yield losses as high as 96% having resulted from Coffee berry borer attack on coffee. Coffee grown in low altitudes is severely affected than at higher elevation (Murphy and Moore, 1990). *Diarthrothrips coffeae* is the most damaging species of thrips on coffee especially in Africa

(Le Pelley, 1968). It causes yellowing and heavy defoliation of coffee trees that affects the subsequent coffee production by almost one year (Coffee Research Foundation, 1989). The *Antestiopsis* spp are major coffee pests with density of 1-2 bugs per tree considered as the economic threshold level that requires insecticide spraying so as to avoid economical crop loss (Coffee Research Foundation, 1989). They infest coffee beans that lead to low coffee quality. A crop loss of 15-27% in total bean weight has been associated with infestation of 2-4 Antestia bugs per tree (Wanjala, 1979).The Leafminers, *Leucoptera meyricki* Ghesquiere and *L. caffeina* Washbourn are the two most important species that infest coffee. *Leucoptera meyricki* is mainly dominant where coffee is un-shaded with *L. caffeina* most found in shaded coffee (Evans, 1968).

Coffee in Kenya has for long been cultivated as a monocrop. However, growing coffee under shade trees has become a common practice by the farmers' especially intercropping coffee with food crops by small scale farmers (Mukunya and Keya, 1975). The primary reason for shading is to reduce the effect of global warming such as excessively high leaf temperatures (Chege, 2011). Shade also plays an important role in maintaining long-term coffee productivity, soil conservation, water and biodiversity, and improvement of coffee quality. Despite all these, shading produces a micro-climate that enhances or impend pests through ecological balance, both in favour or against the crop. For instance, it is commonly thought that diverse agro-ecosystems are less prone to pest outbreaks because they support a high diversity of natural enemies (Perfecto *et al*, 2004).Thus, this study focused to

establish the severity of key coffee insect pests under shaded coffee farming agro system.

MATERIALS AND METHODS
Study site
The trial was sited at Namwela Demonstration Plot of Coffee Research Foundation on the foot slopes of Mt. Elgon in Bungoma County in Western Kenya. The area is marked by the agroecozone UM_3 where it experiences extended drought between December and April. The soils at Namwela are mainly acrisols which are moderately acid with moderate fertility and for coffee to perform to the expectations, these soils requires organic matter accumulation (manuring) and liming bi-annually to restore the soil reaction to optimum range. The Demonstration plot has K7 Coffee variety that was established at around year 1955 together with shade trees, *Cordia africana* Lam.

Experimental Design
The trial site was marked into two portions, one with shaded coffee and the other un-shaded. The two portions were each sub- divided into five plots (each plot composed of coffee trees under shade or un-shaded) where sampling was regularly carried out after every one month.

Sampling of insect pests
The sampling was done on coffee trees from each plot that were randomly selected for the assessment of severity of different key insect pests:
(a) Coffee Berry Borer
One (1) berry bearing primary branch per coffee tree was picked randomly from three coffee trees that were randomly selected in each plot, and total number of mature berries counted and recorded. All the mature berries with CBB attack from the same primary branch were counted and recorded.
(b) Leaf miners
On the same primary branch used for CBB assessment, all the mature leaves were counted and recorded. The number of leaves with Leaf miner damage was recorded (only leaves with live mines were recorded).

(c) Thrips
Twenty (20) leaves from five (5) trees (four leaves per tree from different directions) in each plot were randomly selected. On each leaf, the number of thrips were counted and recorded.
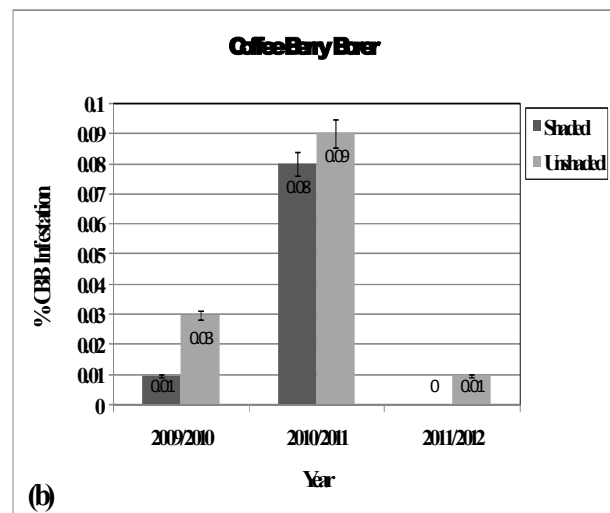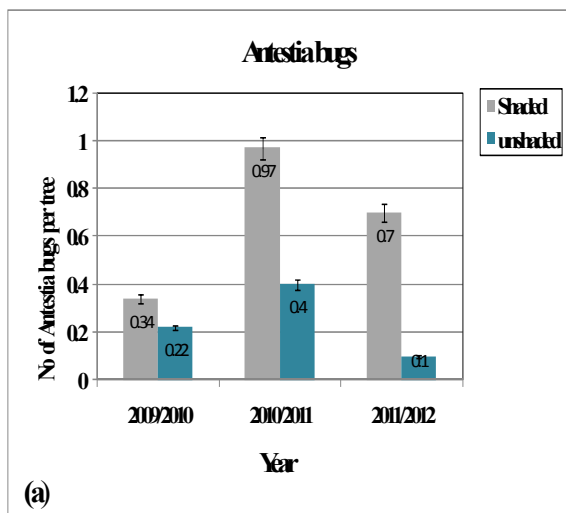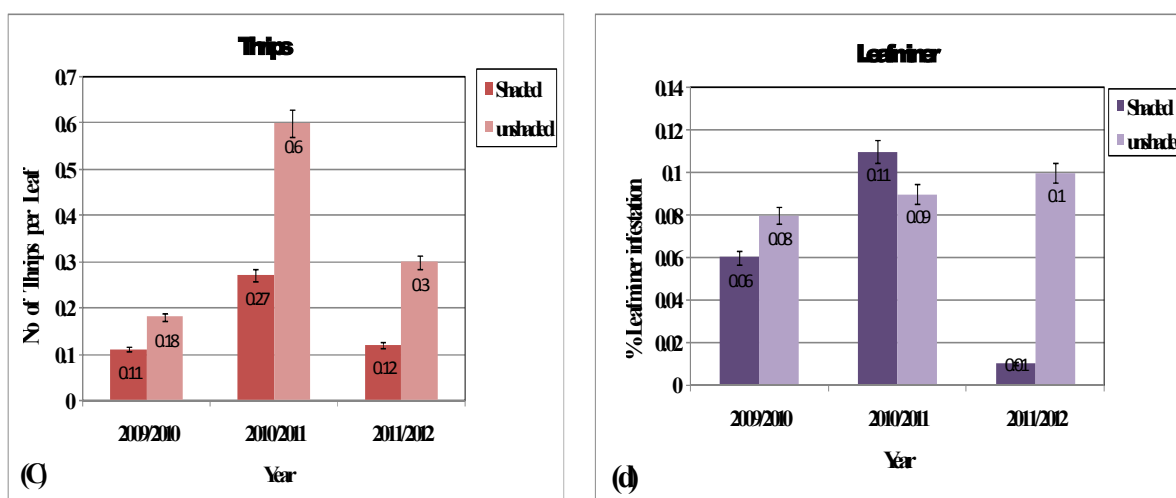(d) Antestia bugs
In each plot, three trees were randomly selected. Using a knockdown method, all Antestia bugs knocked down were counted and recorded.
The collected data was presented as figures.

RESULTS
The major coffee insect pests varied in their severity on coffee as a result of shade. To some, shade depressed their severity while others were positively favoured (Figs. 1a, b, c and d). Coffee under the shade had significantly (P< 0.05) higher infestation by the *Antestiopsis* spp than un-shaded coffee over the three seasons (Fig. 1a). The severity of *Antestiopsis* spp significantly increased from year 2009/2010 to 2010/2011 on both shaded and un-shaded coffee farming systems. Though this was the scenario during the two seasons, the infestation remained below economical injury level (one Antestia bug per tree). In year 2011/2012 lowest infestation of 0.1bug per tree under un-shaded coffee was recorded. The highest infestation of 0.97 bugs per tree which was almost equivalent to economical injury level was recorded in year 2010/2011 on coffee under shade. Shaded coffee significantly (P< 0.05) lowered infestation by the *H. hampei* when compared to un-shaded coffee over the three seasons (Fig.1b). The severity of *Hypothenemus hampei* significantly increased from year 2009/2010 to 2010/2011 under both shaded and un-shaded coffee farming systems. The highest infestation (0.09%) and lowest infestation (0%) respectively occurred under un-shaded and shaded coffee farming systems. During the three seasons, the infestation remained below economical injury level (10%). The shade negatively affected the infestation of coffee by *D. coffeae*. Shaded coffee significantly (P< 0.05) lowered infestation by the *D. coffeae* when compared with un-shaded coffee over the three seasons (Fig.1c).

(a)

(b)

FIGURE 1: Infestation levels of shaded and un-shaded coffee by major insect pests **(a)**Antestia bugs, **(b)** Coffee berry borer, **(c)** Thrips and **(d)** Leafminer

There was significant increase in severity of *D. coffeae* from year 2009/2010 to 2010/2011 under both shaded and un-shaded coffee. During the three seasons the infestation remained below the economical injury level (1-2 thrips per leaf). The infestation ranged between 0.11 - 0.6 thrips per leaf.

The severity of *Leucoptera* spp varied over the first two seasons (2009/2010 and 2011/2012) (Fig.1d). During the first season (2009/2010), there was significantly (P < 0.05) higher *Leucoptera* spp infestation under un-shaded coffee when compared to the shaded ones. The trend reversed during the second season (2011/2012). The *Leucoptera* spp infestation significantly increased from year 2009/2010 to 2010/2011 for both shaded and un-shaded coffee. During the third season (2011/2012) a significantly (P < 0.05) higher *Leucoptera* spp infestation under un-shaded coffee when compared to the shaded ones occurred again. The highest infestation level (0.11%) was recorded during the second season under shaded coffee. During the three seasons the infestation remained low (≤ 0.11%).

DISCUSSION
The cultural control of *Antestiopsis* spp advocate to maintain coffee bushes open through regular pruning. The practice makes the habitat unsuitable for rapid multiplication of the *Antestiopsis* spp but favorable one for parasitoids that cause parasitism. The present findings showed that where coffee was grown under shade trees there was high incidences of *Antestiopsis* spp infestation. This kind of environment depicts a similar habitat where coffee is un-pruned thus promoting rapid *Antestiopsis* spp multiplication and low parasitism level. The effect of shade decreased the infestation of coffee by *H. hampei* unlike where shading was absent. These findings disagree with what has previously been reported by Acland (1971). Such a situation in the present findings is possible because shade contains the rising temperatures or lower the temperatures while the surrounding relative humidity increases. Under such an environment, the presence of fungal pathogens such as *Beauveria bassiana* increases leading to increased infection of *H. hampei*. This then reduces the population of *H. hampei* and its subsequent infestation on coffee berries under the shade. On the contrary, un-shaded coffee is likely to have high surrounding temperatures and low relative humidity that negatively affect the multiplication of *B. bassiana* and their subsequent infection on the Coffee berry borer. The presence of shade on coffee according to the present findings depressed the coffee infestation by *D. coffeae*. This agreed with what Strurdy (1935) observed where coffee appeared to suffer less from deterioration caused by Thrips, when under shade than un-shaded coffee.

Two species of Leafminers infest coffee. One of the species, *L. meyricki* is more common where shade is absent while *L. caffeina* is dominant where coffee is grown under shade (Evans, 1968; Acland, 1971). During the current study, shaded coffee recorded depression of Leafminers infestation. This indicated that *L. meyricki* was the most common species at the trial sites hence shade controlled its severity.

CONCLUSION
Shading coffee differently affected the severity of different coffee insect pests. Shaded coffee significantly lowered the severity of *H. hampei*, *D. coffeae* and *Leucoptera* spp while that of *Antestiopsis* spp was significantly increased. Farmers are therefore encouraged to plant shade trees where *H. hampei*, *D. coffeae* and *Leucoptera* spp occur in order to culturally manage them or maintain them below their respective economic injury levels.

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