



Field-based Evidence of the Black Coffee Twig Borer infesting *Maesopsis eminii* in Coffee Agro-systems in Kiboga District, Uganda

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Abstract. Despite Ugandan coffee farmers' preference for *Maesopsis eminii* as a shade tree, the species is an alternate host for the black coffee twig borer, *Xylosandrus compactus* (Eichhoff)—a major insect pest of coffee in the country. Wilting and drying of leaves and branches of young *M. eminii* trees (<5 m tall) observed in Kiboga District, Uganda. The branches were trimmed off the trees, separated into primary and secondary branches and then the percentage of those possessing characteristic *X. compactus* entry holes determined separately. Additionally, the number of entry holes on both primary and secondary branches was established to determine the extent of damage of *X. compactus*. *X. compactus* characteristic holes were observed on both primary and secondary branches of *M. eminii* - percentage of branches having entry holes and the number of entry holes higher on primary than secondary branches. Dissecting the branches at the entry holes revealed various life stages of *X. compactus* in the gallery, proving that the damage was due to the pest. Presence of this pest on trees that are inter-planted in the coffee agroforestry systems presents a dilemma in managing it. Therefore, research should be geared towards designing management strategies for the pest in the coffee agroforestry systems. In the meantime, farmers should always trim-off and burn all infested parts from coffee and other plants inter-planted in it.

Keywords: Agroforestry-systems, alternative-hosts, coffee, insect-pests.

Introduction

Traditionally, farmers in Uganda often deliberately plant and/or maintain naturally established trees in their coffee plantations. Similarly, modern research and extension promote and encourage farmers to plant trees in their coffee plantations to form coffee agroforestry systems (Kiyingi and Gwali, 2012; Kalanzi and Nansereko, 2014). These agroforestry systems are particularly for shade (Beer, 1987), but can also be utilized for other socio-economic benefits (Kiyingi and Gwali, 2012). Agroforestry has therefore emerged as a promising land-use option to sustainable agricultural productivity and livelihoods of farmers (Syampunani *et al.*, 2010).

One of the commonest trees inter-planted with coffee in Uganda is the umbrella tree, *Maesopsis eminii* (Engl.), locally known by its Luganda name 'musizi' (Kalanzi and Nansereko,

2014). The popularity of this tree species is attributed to its fast growth, readily available planting materials and ease of propagation. In addition, its leaves decompose easily and it is compatible with existing agricultural practices (Hall, 1995). *M. eminii* also provides additional products such as timber and firewood (Kalanzi and Nansereko, 2014).

Despite farmers' preference for inter-planting *M. eminii* in their coffee, screen-house experiments at the National Coffee Research Institute (NaCORI), Kizuza, Uganda have confirmed an alternate host of the black coffee twig borer, *Xylosandrus compactus* (Eichhoff) (Kagezi *et al.*, 2013, 2016b). *X. compactus* is currently one of the most important pests infesting coffee as well as other commercial crops like cocoa in Uganda (Kagezi *et al.*, 2014; 2016a). The presence of *X. compactus* on *M. eminii* as well as other shade tree species inter-planted in coffee and cocoa (Kagezi *et al.*, 2013) therefore, presents a dilemma in managing this pest.

Though, evidence of *X. compactus* infesting *M. eminii* under screen-house conditions exists (Kagezi *et al.*, 2013), no study has been done to prove this under field conditions. This research note therefore provides for the first time field-based evidence that *M. eminii* is an alternative host of *X. compactus*. This information is vital for designing management strategies for *X. compactus* in coffee agroforestry systems.

Materials and Methods

Data presented herein were collected from a farmer's coffee field located in Kawanda village, Lwamata sub-county, Kiboga district, Uganda. Kiboga district lies between 1° 30''N and 32° 14''E at 1000-1200 m above sea level (a.s.l) (KDLG 2012). The area has a mean annual temperature of about 25°C and receives a total annual rainfall of 1000-1400 mm that is distributed in a bimodal pattern. Its soils are classified as Ferralsols and characterized by soil fertility limitations such as low pH, phosphorus and cation exchange capacity (Musinguzi *et al.* 2015). While conducting studies on the bio-ecology of *X. compactus* in Kiboga district, the NaCORI research team observed wilting and drying of small branches of the young *M. eminii* (<5 m tall) trees (Figure 1).



Figure 1. Branches of *Maesopsis eminii* tree species infested with *Xylosandrus compactus*

The cause of this wilting and drying was suspected to be damage due to *X. compactus* (Kagezi *et al.*, 2013, 2016a). These branches were therefore cut off from the trees using secateurs, separated into primary (n=13) and secondary (n=25) branches and then assessed for *X. compactus* damage separately. *X. compactus* infestation was assessed by determining the percentage of those branches that had the characteristic entry holes (Greco and Wright, 2015). In addition, the number of *X. compactus* entry holes on each branch was established in order to determine the extent of the infestation. To prove that this damage was caused by *X. compactus*, the infested branches were dissected at the characteristic entry hole to observe presence of life stages of the beetle in the gallery (Figure 2).



Figure 2. A broken primary branch of *Maesopsis eminii* with adult *Xylosandrus compactus* (circled) inside the galleries

Chi-square analysis using SAS (SAS Institute, 2008) was performed to compare the percentage of primary and secondary branches infested by *X. compactus* as well as the number of characteristic entry holes on the primary and secondary branches.

Results

X. compactus characteristic holes were observed on both primary and secondary branches of *M. eminii*. The percentage of primary branches with *X. compactus* entry holes (92.3%; n=13) was significantly ($\chi^2=53.7552$; df=1; $p<.0001$) higher than secondary branches (16.0%; n=25). Similarly, the number of *X. compactus* characteristic entry holes observed on the wilting branches was significantly ($\chi^2=68.242$; df=1; $p<.0001$) more on primary (2.1 ± 1.9 ; range=1-8; n=13) than on secondary branches (0.2 ± 0.6 ; range=1-7; n=25). Dissecting the *M. eminii* branches at the entry holes revealed presence of various life stages of *X. compactus* (Fig. 2).

Discussion

Our results confirmed that the extensive wilting and drying of leaves as well as primary and secondary branches observed on *M. eminii* was due to *X. compactus* damage. This was evidenced

by the presence of *X. compactus* characteristic entry holes on all the branches assessed as well as the various life stages of the pest observed inside the dissected branches (Kagezi *et al.*, 2016b). These observations provide for the first time field-based evidence that *M. eminii* is an alternative host of *X. compactus*, supporting earlier screen-house experimental studies (Kagezi *et al.*, 2013).

The percentage of branches that had been infested by *X. compactus* and the number of characteristic entry holes were significantly higher on primary than secondly branches. This is probably because most of the secondary branches were smaller than the preferred host plant diameter for oviposition by the female *X. compactus* (Greco and Wright, 2015), although, the diameters of the branches were not determined in this study. Generally, although, *X. compactus* is known to attack small twigs which are less than 20 mm in diameter (Hayato, 2007), the average diameter preferred by the beetle depends on the host plant species in question. For example, Greco and Wright (2015) observed that *X. compactus* had a preference of lateral branches of coffee in the range of 0.48 to 6.47 mm (average 3.09 mm). In *Croton reflexifolius* HBK and *Acacia koa* Gray, the diameter of the branches ranged from 2.5 to 15 mm (Hara and Beardsley, 1979) whereas, diameters of 1–7 mm and 8–22 mm of small and larger branches respectively, were observed on flowering dogwood twigs (Ngoan *et al.*, 1976).

The presence of *X. compactus* on plants such as *M. eminii* which are inter-planted in coffee by farmers (Kalanzi and Nansereko, 2014), presents pest management implications in a number of ways. First of all, the extent of damage on coffee has been reported to be related to its proximity to alternate host plants. This is further complicated by lack or limited sanitation of infested material on alternate within the plantations (Jones and Johnson 1996). Secondly, alternative hosts may influence the ecological dynamics (Tanwar *et al.*, 2010) behaviour and biology of *X. compactus* (Jones *et al.*, 1992; Kagezi *et al.*, 2013). Thirdly, farmers may need to choose between protecting their coffee from *X. compactus* infestation by eliminating the alternate hosts or maintaining them for other purposes (Kagezi *et al.*, 2013) such as timber and firewood (Kalanzi and Nansereko, 2014). Lastly, the big size of some alternate plant hosts like *M. eminii* might complicate managing *X. compactus* by using the current recommended option of trimming-off and burning of infested plant materials (Kagezi *et al.*, 2016a).

Conclusion

This is the first field-based evidence that *X. compactus* infests *M. eminii*, adding to the existing list of alternative hosts of this pest that have been confirmed in the coffee agro-systems. This presents a management dilemma of this pest in these systems. Research should therefore embark on designing management strategies for this pest in such an agroforestry system. However, in the meantime, farmers should always trim-off and burn all *X. compactus*-infested parts from not only coffee but also other plants inter-planted in it.

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