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SHORT COMMUNICATION

Spatial characterization of common blossom thrips (*Frankliniella schultzei*) in smallholder avocado orchards along slopes of Taita Hills and Mount Kilimanjaro

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Abstract *– Frankliniella schultzei Trybom (Thysanoptera: Thripidae) is an important flower pest of avocado crop (Persea americana Mill) at Taita Hills in South-eastern Kenya and Mount Kilimanjaro in North-eastern Tanzania. However, its geographical distribution is not known in the East African avocado cropping systems. In order to generate the spatial data of the common blossom thrips (Frankliniella schultzei), a survey was carried out in small-holder avocado orchards along altitudinal gradient (900 - 1800m.a.s.l.) of Taita Hills and Mount Kilimanjaro using a white coloured beating tray and camel brush. Once the specimens of thrips were taxonomically verified, the abundance data was tabulated into three altitudinal zones, namely; lowland (900-1199m.a.s.l.), sub-montane (1200-1499m.a.s.l.) and montane (1500-1799m.a.s.l.). Frankliniella schultzei was recorded in all altitudinal zones of both transects with mean abundance being highest at Taita Hills (5.4) compared to Mount Kilimanjaro (0.9). However, abundance of the pest was greater in cooler highlands (>1200m.a.s.l.) than warmer lowland areas (<1200m.a.s.l.) of both transects. The findings of this study contributes significantly towards spatial mapping of Frankliniella schultzei in East Africa and this information is important in developing strategies aimed at controling infestation of avocado flowers by the insect pest at the two study transects.*

Keywords— Avocado, East Africa, Frankliniella schultzei, Mount Kilimanjaro, Taita Hills.

I. INTRODUCTION

Common blossom thrips (*Frankliniella schultzei* Trybom) is anthophilous pest species (Milne *et al*., 1996; Odanga *et al*., 2017b) whose diet is predominantly pollen and floral tissues (Kakkar *et al*., 2012). Being a polyphagous insect pest, it feeds on flowers of various ornamental, vegetable and fruit crop hosts in different parts of the world (Milne *et al*., 1996; Kakkar *et al*., 2012). Palmer (1990), Palmer (1992) and Milne & Walter (2000) reported *Frankliniella schultzei* on 83 species of plants from 35 families with important hosts being cotton (*Gossypium* spp.), groundnut (*Arachis hypogaea*), beans (*Phaseolus vulgaris*) and pigeon pea (*Cajanus cajan*) and avocado (*Persea americana*). In Afrotropical highlands of Taita Hills and Mount Kilimanjaro, *Frankliniella schultzei* is a pest of avocado crop that feeds on floral resources (Odanga *et al*., 2017a; Odanga *et al*., 2017b) thereby contributing to flower abortion and subsequent low fruit-set. This pest, therefore, impacts negatively on livelihood of small-scale farmers as it contributes to low yield of avocado fruits which the local growers depend on as a source of cash and nutritious food. Although, Odanga *et al* (2017b) described in detail temporal fluctuations of the pest abundance at Taita Hills and Mount

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Kilimanjaro, limited information is available on geographical distribution of *Frankliniella schultzei* in the East African highlands. This study was, therefore, initiated to provide first-ever spatial distribution data of *Frankliniella schultzei* in avocado orchards along altitudinal gradient of Taita Hills in South-eastern Kenya and Mount Kilimanjaro in North-eastern Tanzania.

II. MATERIALS AND METHODS

2.1. Study areas

This study was carried out in farmlands at Taita Hills in South-eastern Kenya and Mount Kilimanjaro in Northern-eastern Tanzania as described by Mwalusepo *et al* (2015) and Odanga *et al* (2017b). The study regions were selected because the avocado plant (*Persea americana* Mill) is the major fruit crop cultivated by the small-holder farmers at South-eastern slopes of Taita Hills and Mount Kilimanjaro. Furthermore, farming along the two study transects is rainfed and the small-holder growers do not use chemicals to control insect pests or diseases of avocado crop.

2.2. Study design

The survey was carried out along altitudinal gradient from 900 to 1800 m.a.s.l. in small-scale avocado orchards at the two study areas between August 2012 and July 2014. The common blossom thrips, *Frankliniella schultzei* Trybom, was sampled from avocado trees using a white coloured beating tray and camel brush as described by Palmer (1990). Six hundred avocado trees were sampled at each altitudinal zone, namely; lowland region (900-1199m a.s.l.), sub-montane (1200-1499m a.s.l.) and montane (1500-1799m a.s.l). Geographical coordinates and elevation of every study site was verified using a hand-held Garmin GPS model eTrex 30. Collected specimens of the thrips were mounted and identified at the National Museums of Kenya entomology laboratory in Nairobi using taxonomic manuals; Palmer (1990), Palmer *et al* (1992), Moritz *et al* (2001) and Mound (2010). The fully identified and confirmed thrip species were deposited in the entomology collection at the National Museums of Kenya.

2.3. Data analysis

Wilcoxon signed rank test was employed to test differences between paired datasets sampled at Taita Hills and Mount Kilimanjaro (R Development Core Team, 2012; Crawley, 2007). Sets of variables were normalized for further analysis using Tukey's HSD (Honestly Significant Difference) post hoc test to pinpoint what exact sub-sets within a data that had significant differences from each other (R Development Core Team, 2012). Spatial mapping was generated using kriging method by interpolating mean abundance of *Frankliniella schultzei* along altitudinal gradient of the two transects using QGIS version 1.8.0.

III. RESULTS

Mean abundance of *Frankliniella schultzei* differed significantly between Taita Hills (5.4±0.8) and Mount Kilimanjaro (0.9±0.1) ($V=1726.4$, $P<0.0001$). For both transects, mean abundance of *Frankliniella schultzei* was smaller at lowland zone (900-1199m a.s.l) than the highlands. However, the abundance of *Frankliniella schultzei* at Taita Hills study area was highest at mid-altitudinal range (1200-1499m a.s.l) (Figure 1a). For Mount Kilimanjaro, the abundance was highest at montane zone (1500-1799m a.s.l) (Figure 1b). Tukey's HSD pair wise comparison of mean abundance of *Frankliniella schultzei* between agro-ecological zones at Taita Hills revealed a significant difference in two pairs (lowland and sub-montane, $P<0.0001$; sub-montane and montane, $P<0.0001$) except between montane and lowland ($P=0.344$) (Figure 1a). For Mount Kilimanjaro transect, the mean abundance of *Frankliniella schultzei* between agro-ecological zones revealed a significant difference in only one pair; lowland and montane ($P=0.011$), however, the rest did not show a significant difference (lowland and sub-montane, $P=0.312$; sub-montane and montane, $P=0.317$) (Figure 1b).

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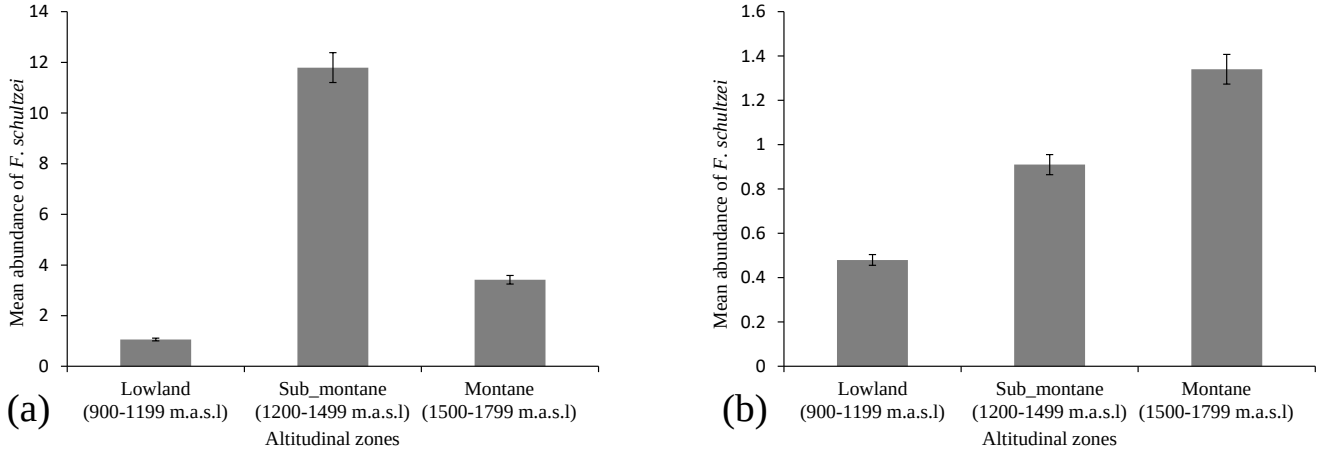

Fig.1: Distribution of Frankliniella schultzei within altitudinal zones of (a) Taita Hills and (b) Mount Kilimanjaro transects. Similarly, spatial distribution pattern for Frankliniella schultzei using kriging method revealed that the pest is highly abundant in highlands above 1200m a.s.l than lowlands of both Taita Hills and Mount Kilimanjaro study areas (Figure 2a & b).

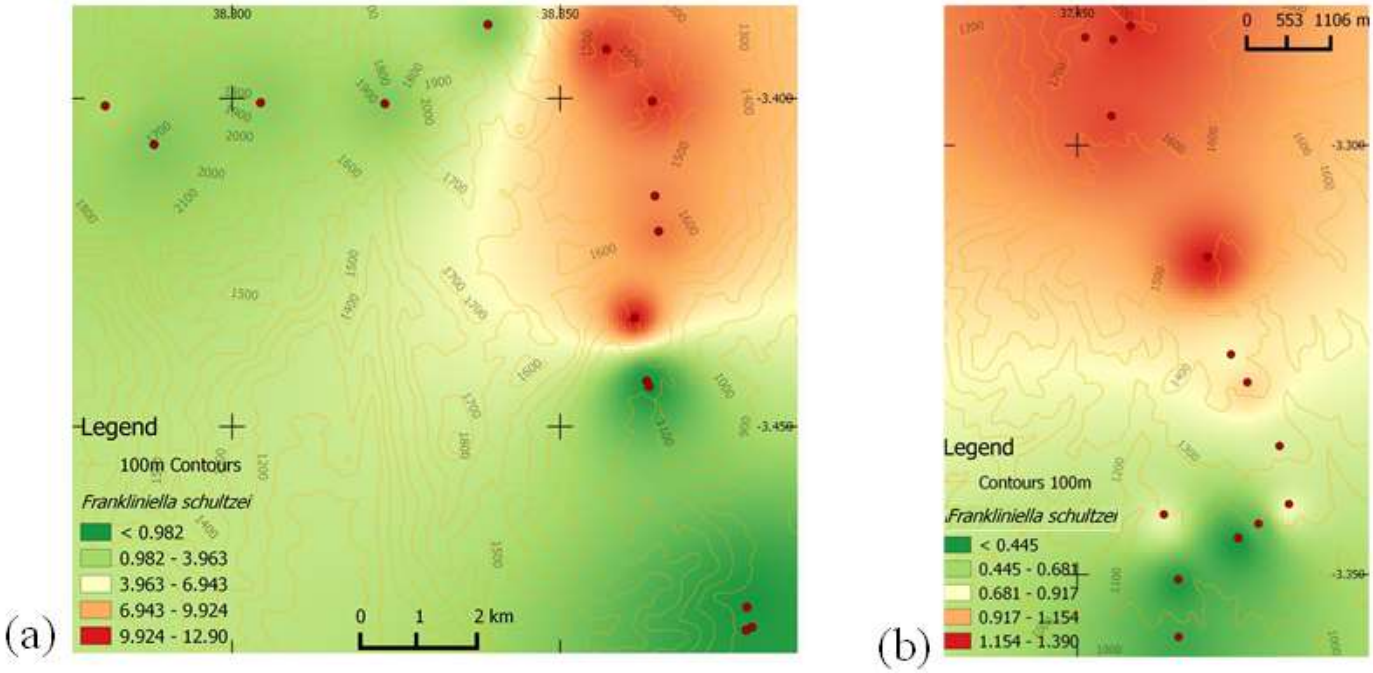

Fig.2: Geographical distribution of Frankliniella schultzei based on its mean abundance along altitudinal gradient of (a) Taita Hills in South-eastern Kenya and (b) Mount Kilimanjaro in North-eastern Tanzania. Red pattern shows highest whereas green reveals least mean abundance of Frankliniella schultzei. Dotted red points are the sampling sites along each study transect.

IV. DISCUSSION

Mean abundance of common blossom thrips (*Frankliniella schultzei*) was greater in highlands above 1200m.a.s.l because these zones had plentiful host avocado trees with abundant floral resources at both study transects. Availability of productive host trees at highlands provided the pest with enough food and habitat (Palmer *et al*., 1992). Consequently, the abundance of *Frankliniella schultzei* was very low at the lowland zone (1200m.a.s.l.) because the region is warmer compared to ever cold highlands. Generally, the common blossom thrips thrives well in areas with mild temperatures (Milne *et al*. 1996; Kakkar *et al*. 2012; Palmer *et al*., 1992) which were available in sub-montane (1200m – 1600m a.s.l) and montane (1500-1799m a.s.l) zones at both Taita Hills and Mount Kilimanjaro agro-ecosystems. However, distribution patterns of *Frankliniella schultzei* along altitudinal gradient of Taita Hills and Mount Kilimanjaro may shift drastically in future with changing climate and associated agricultural activities.

V. CONCLUSION

The common blossom thrips (*Frankliniella schultzei*) is major flower pest of avocado crop and the insect species is well established along altitudinal gradient of Taita Hills and Mount Kilimanjaro. In order to enhance productivity of the avocado trees, control measures for the pest should be focused in all altitudinal zones at both transects. However, applied research is required to develop a universal protocol for indexing floral infestation levels by *Frankliniella schultzei* in East African avocado orchards. Regional studies that integrate biogeographical approaches to predict shifts in distribution and exact pest status of *Frankliniella schultzei* as a function of future climate change are highly recommended.

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