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Research Application Summary

Occurrence and distribution of *Tuta absoluta (*Gelechiidae) in Tanzania

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Abstract

Thirteen regions were surveyed for the presence and abundance of the tomato leafminer (*Tuta absoluta*) in Tanzania. The survey was conducted in 2015, 2016 and 2017 across selected agro-ecological regions of Tanzania. Monitoring was conducted with pheromone traps in randomly selected tomato fields. The trapped adult *T. absoluta* were counted once per week for four months in each season. We found that *T. absoluta* was present in all thirteen regions surveyed. Pest population differed significantly between regions. Regions with the highest pest populations were Iringa, Arusha and Morogoro, with trap catches of 503.8 ±17, 292.9 ± 28.9 and 239.4 ± 24.2 adults/trap/week, respectively. Regions with the lowest populations were Dodoma and Mwanza, with trap catches of 16.2 and 13.3 adults/ trap/week, respectively. The highest densities of *T. absoluta* and tomato damage occurred in Tanzania's most productive tomato regions (Iringa, Arusha and Morogoro), which reflects the close relationship between this pest and its preferred host plant, tomato. These alarming findings inform farmers and the government about the distribution and intensity of the pest invasion and call for the development of effective and sustainable management strategies for *T. absoluta* in Tanzania.

Keywords: Population density, tomato damage, *Tuta absoluta,* Tanzania

Résumé

Treize régions ont été étudiées pour la présence et l'abondance de la mineuse de la tomate (*Tuta absoluta*) en Tanzanie. L'enquête a été menée en 2015, 2016 et 2017 dans de régions agroécologiques sélectionnées de la Tanzanie. La surveillance a été effectuée avec des pièges à phéromones dans des champs de tomates sélectionnés au hasard. Les *T. absoluta* adultes piégés ont été comptés une fois par semaine pendant quatre mois à chaque saison. Nous avons constaté que *T. absoluta* était présent dans les treize régions étudiées. La population de ravageurs différait considérablement entre les régions. Les régions avec les populations de ravageurs les plus élevées étaient Iringa, Arusha et Morogoro, avec des prises de pièges de 503,8 ± 17, 292,9 ± 28,9 et 239,4 ± 24,2 adultes / piège / semaine, respectivement. Les régions avec les populations les plus faibles étaient Dodoma et Mwanza, avec des captures de pièges de 16,2 et 13,3 adultes / piège / semaine, respectivement. Les densités de *T. absoluta* et de tomates les plus élevées se sont produites dans les régions de tomates les plus productives de Tanzanie (Iringa, Arusha et Morogoro), ce qui reflète la relation étroite entre ce ravageur et sa plante hôte

préférée, la tomate. Ces résultats alarmants informent les agriculteurs et le gouvernement sur la répartition et l'intensité de l'invasion des ravageurs et appellent à l'élaboration de stratégies de gestion efficaces et durables pour *T. absolut*a en Tanzanie.

Mots-clés: densité de population, dommages aux tomates, Tuta absoluta, Tanzanie

Background

Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae) is a pest moth native to South America (Desneux *et al*., 2011; Megido *et al*., 2012; Chailleux *et al*., 2013). It is commonly known as tomato leafminer, South American tomato pinworm, and tomato borer (Zappala *et al*., 2013;). Tuta absoluta is rapidly spreading across continents worldwide including Europe, Mediterranean, Middle East, South Asia and Africa (Abbes *et al*., 2014; Brévault *et al*., 2014). In Tanzania, the pest was reported first in 2014 in tomato fields at Ngarenanyuki, Arumeru District (Chidege *et al*., 2016). Since then, the pest has spread very fast and is threatening tomato production and related aspects of the economy in sub-Saharan Africa at large (Brévault *et al*., 2014). The pest is thought to spread by the transport of contaminated tomato and other solanaceous crops across different locations and by wind (Desneux *et al*., 2010; Tonnang *et al*., 2015). Success of *T. absoluta* in new regions is also facilitated by a number of crop and non-crop host plants within and outside of Solanaceous crops (Megido *et al*., 2014). Management of *T. absoluta* by farmers in Tanzania is challenged by lack of awareness of the pest's presence and appropriate control measures for it. Efforts by many farmers to control the pest by conventional pesticide sprays have not been successful because *T. absoluta* feeds within galleries inside leaves, stems and fruits (Guedes and Picanço, 2012).This feeding behavior makes *T. absoluta* unmanageable by non-systemic insecticides (Siqueira *et al*., 2000 Guedes and Picanço, 2012). Knowledge on pest identification, population density and management of *T. absoluta* is urgently required by farmers for effective management in Tanzania. This study was done to characterize the occurrence of *T.absoluta* in 13 regions of Tanzania.

Study description

The study was conducted in farmers' fields in thirteen key tomato producing regions namely: Arusha, Iringa, Morogoro, Tanga, Kilimanjaro, Manyara, Singida, Dodoma, Zanzibar, Dar es Salaam, Pwani, Mwanza and Mbeya from September to December 2015. Delta traps (Tuta absoluta-Optima, Russell IPM Company, London, UK) that attract male moths by releasing a synthetic female sex pheromone (3E, 8Z, 11Z)-3,8,11-tetradecatrien-1-yl acetate (TDTA) and (3E, 8Z)-3,8-tetradecadien-1-yl acetate (TDDA) (0.5mg per lure) (Chidege *et al*., 2016) were set up in farmers' fields. Two sets of traps were hung 30 cm above ground in locations north, center and south of selected tomato fields (each about 0.40ha). Delta traps (sticky cards) were changed after 7 days. Samples of trapped adult T. absoluta were preserved in alcohol and archived at the National Herbarium of Tanzania for future studies.

Factorial analysis of variance (ANOVA) was used analyze trap catch data. Pairwise differences were evaluated with Tukey's test of honestly significant difference (HSD) at 5% significance level.

Results

Tuta absoluta was present in all 13 regions of Tanzania surveyed with significant (F=74.87, df=12, P <.0001) variations in population density between regions. Iringa had the highest pest density with an average of 503.8 ±17.8 moths per trap while Mwanza with only 21.08 ± 2.41 moths per trap had the lowest density (Figure 1). Monitoring of T. absoluta populations with pheromone traps revealed a significant (F=42.42, df=23,p=<.0001) interaction effect of zone and month on its population. September had the highest pest count of 323.52 ± 26.69 adult T. absoluta/trap whereas the lowest count of up to 49.13 ± 4.18 adult *T. absoluta*/trap was recorded in April (Figure 2). The duration of the lure use also had a significant (F=36.08, df=15,p=<.0001) effect on trap captures. There was a significant interaction effect between lure age (in weeks) and zone in which higher counts were recorded in week 1, 2 and 3. (Figure 3).

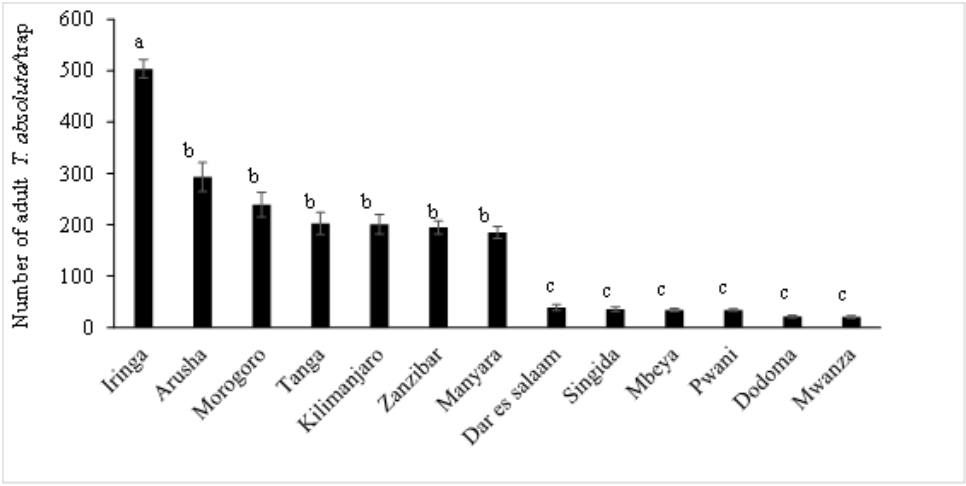

Figure 1. Population density o*f T. absoluta* in thirteen tomato growing regions in Tanzania from September-December 2015 as measured by pheromone traps in tomato fields. Different letters indicate significant differences between regions (ANOVA with Tukey's test at p<0.05), whereas error bars indicate standard errors

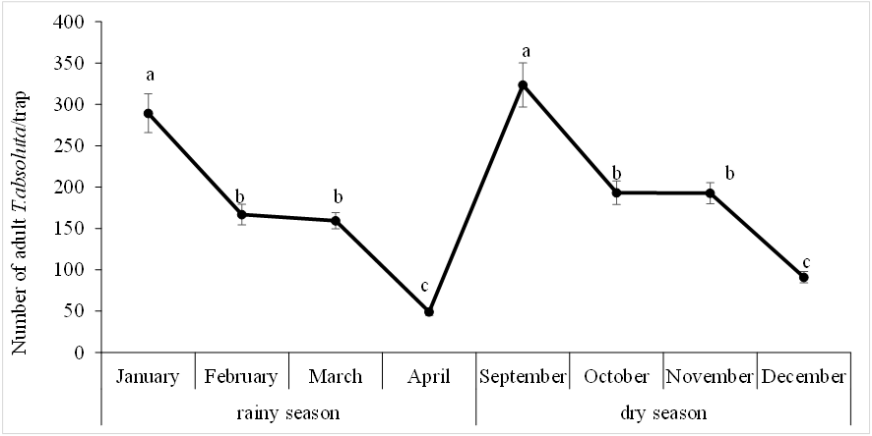

Figure 2. Average population of *T. absoluta* per month in rainy versus dry season in 2016 and 2017. Data are averaged from three growing zones (Arusha, Iringa and Morogoro) by ANOVA and Tukey's HSD was used to separate mean differences between months indicated by letters (p<0.05) whereas error bars indicate standard errors.

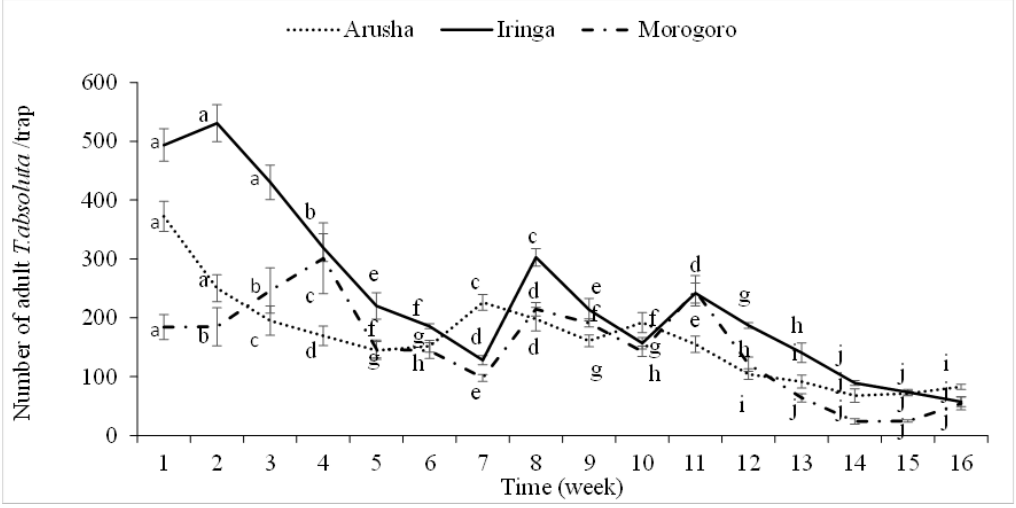

Figure 3. Variation of T. absoluta population within 16 weeks as average of four tomato growing seasons/traps with high count during first 3 weeks and low count in the last 3 weeks, new lure was deployed in week 1 and 8. Different letters indicate significant differences within weeks and between zones ($p<0.05$) whereas error bars indicate standard errors.

Discussion

The survey in 13 regions of Tanzania revealed that *T. absoluta* was present and established in all regions surveyed. Host plant availability enables *T. absoluta* to invade new areas and rapidly multiply (Desneux *et al*., 2011; Megido *et al*., 2013). The speed of dispersion and establishment of T. absoluta in invading areas was influenced by presence of tomato as the preferable host and other solanaceous crops (Megido *et al*., 2013; Urbaneja *et al*., 2013). In 2014, *T. absoluta* was only reported at Ngarenanyuki, northern of Tanzania (Chidege *et al*., 2016), however this study revealed that the pest had invaded and established in 13 regions covering all major agro-ecological zones of Tanzania. The pest may establish in the rest of the country other parts southern sub-Saharan Africa. This study also found that *T. absoluta* spread from Northern Tannzania (Arusha) Southwards towards Iringa. This also shows that the pest can adapt quickly to new environment (Guimapi *et al*., 2016). The high rate of spread is associated with availability of tomato host across seasons (Braham and Nefzaouil, 2016) and long distance transport of tomatoes to markets.

This study revealed that the dry season (from September to December) supported a higher density of T. absoluta compared to the rainy season (January to April), presumably due to favorable weather conditions as well as the abundance of tomato hosts. There are far fewer tomato plants during rainy season because farmers prefer to cultivate alternative crops such as maize when rain is abundant. Interestingly, the first month of each season exhibited higher trap catches than subsequent months, perhaps due reduced pesticide use in newly-planted crops and/or the heightened attractiveness of newly-deployed pheromone lures which may draw moths from great distances (Kılıç, 2010; Balzan and Moonen, 2012; Karadjova *et al*., 2013). We noted that during the first 3 weeks after lure deployment, higher numbers of moths were

trapped per week than in the next five weeks as the lure's pheromone emission rate slowly waned.

Conclusion

Understanding the occurrence and population dynamics of *T. absoluta* in different agro-ecological zones is of economic importance for tomato growers and policy makers to plan for better pest management. These findings inform farmers about the seasonal and spatial variation in populations of *T. absoluta* in Tanzania.

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