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Field abundance of *Serangium parcesetosum*; a predator of *Bemisia tabaci* in two distinct cassava growing agro-ecological zones of Uganda

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Abstract
Serangium parcesetosum is a predator of the whitefly (*Bemisia tabaci*), a major pest of cassava in Africa which causes crop yield reduction of up to 50% in susceptible cassava varieties as well as vectoring cassava mosaic disease (CMD) and cassava brown streak disease (CBSD). In order to explore the use of this predator in the sustainable management of this pest, a study was conducted to evaluate the population of *Serangium parcesetosum* in two agro-ecological zones of Uganda, namely; North Western Savannah Grassland (Lira) and the Kyoga Plains (Kamuli) in the first rains of 2017. Results revealed that both mean adult and larvae *Serangium parcesetosum* per plant were more abundant in Kamuli (4.92 and 11.75) as compared to Lira (0.39 and 0.51) respectively. Location and cassava age emerged as the main drivers of whitefly population which directly influenced the *Serangium parcesesotum* population.

Keywords: pest, sustainable management, pesticides, environment

1. Introduction
Cassava whitefly (*Bemisia tabaci*) is the most important cassava pest in Uganda that is increasing rapidly in terms of numbers and spread [11]. High populations of the whitefly cause both direct and indirect damage to cassava. Direct damage is expressed as leaf chlorosis, mottled appearance, reduction in plant vigor, general plant stunting and induction of phytotoxic disorders. Indirect damage is however expressed through production of honeydew that results into growth of sooty mould on leaves, petioles and stems [3]. Both of these damages may result in crop yield reduction of up to 50% in susceptible cassava varieties [9]. The whitefly is also a known vector of *Gemini* and *Ipomo* viruses that cause cassava mosaic disease (CMD) and cassava brown streak disease (CBSD) respectively. These two diseases combined are regarded as the most important constraint to cassava production in Uganda causing losses of up to 24 million dollars annually [15]. Much as efforts have been made to control these diseases in Uganda, little attention has been given to controlling the vector directly. In addition, the improved varieties are increasingly harboring high whitefly numbers yet the use of chemical pesticides to control this devastating pest has proven uneconomical and may cause adverse effects to the environment [5].
Serangium parcesetosum is a known predator of whitefly (*Bemisia tabaci*). In Turkey, *Serangium parcesetosum* was evaluated as a possible biological control agent of *Bemisia tabaci* on eggplants and found that the predator reduced the pest population by over 90% [8]. In addition, studies revealed that *Serangium parcesetosum* was distributed and naturally occurring among some cassava fields in central Uganda [12]. Therefore, there is need to explore the use of *S. parcesetosum* as an integrated approach in the management of cassava whitefly. Hence, the objective of this study was to evaluate the natural population of this predator in cassava fields in order to provide baseline information that can guide future biological control programs involving *Serangium parcesetosum* in Uganda.

2. Materials and methods
2.1 Experimental sites
Two field trials were established in the first rains of 2017; one on-farm trial in Mbulamuti Sub County, Kamuli district and the other at Ngetta Zonal Agricultural Research and Development Institute in Lira district. These sites (Lira and Kamuli) represent two important cassava growing agro-ecological zones of Uganda, namely Kyoga Plains and North Western

Savannah Grassland respectively. These two agro-ecological zones were selected for the study based on their distinct ecological features or conditions and their known history of cassava production in Uganda.

Kyoga Plains agro-ecological zone is characterized by sandy clay alluvial soils with moist semi-deciduous forest, savannas and swamps. The area has a bimodal rainfall ranging from 1215mm to 1328mm (first rains are from March to May while the second begins from October to December). Temperatures ranges from 15 ^{0}C to 32.5 ^{0}C. Climate is warm and wet with relatively high humidity and average altitude of 1134m above sea level.

Northwestern Savannah Grassland is comprised of ferruginous sandy loam soils with intermediate savanna grassland and scattered trees. The average annual rainfall ranges between 1340 mm and 1371mm with bimodal rains followed by a dry spell for about 5 months. Temperature and altitude range from 15-25 ºC and 951-1341m above sea level respectively [14].

2.2 Source and description of cassava varieties

Three varieties namely; Njule Red, Narocass1, and Nase 14, were used for the study. These varieties were selected based on their distinct leaf morphological characteristics.

Njule Red is a landrace, sweet in taste and predominantly grown in the central and western areas of Uganda. It has got long slender smooth leaves.

Narocass1 is a recently released improved variety that is being promoted for its high yields and disease tolerance. It possesses broad smooth leaves.

Nase 14 is an improved variety previously promoted for its high yield, drought and disease tolerance. It has broad hairy leaves.

The planting materials for the respective varieties were sourced from low cassava mosaic and cassava brown streak disease pressure areas (Nwoya and Kabarole districts) and were then visually assessed for the absence or presence of the two diseases. Only clean disease-free fields were used as source of materials.

2.3 Experimental design and management

The field experiments were laid out in a Randomized Complete Block Design (RCBD) with three replications and each plot measured 9m x 4m. The plots were separated by 2m from each other while the replicates were separated by 3m. Each stake of 25cm length with 3-5 nodes was planted at a spacing of 1m x 1m between plants and rows. Weeding was done using a hand hoe so as to avoid competition for resources.

2.4 Field data collection

Monthly data collection commenced from 3 to 8 (MAP) months after planting. Data was collected on *Serangium parcesetosum abundance* and *Whitefly Nymph population*.

2.4.1 Data collection procedure

2.4.1.1 *Serangium parcesetosum* abundance

10 plants were randomly selected from each of the trial plots. Each plant was then observed from top to bottom (including both the top and underside of all leaves), petioles and the stem. A count of all *Serangium parcesetosum* larvae and adults per plant were recorded [2].

2.4.1.2 *Whitefly Nymph* population

From the 10 plants previously assessed for *Serangium parcesetosum* abundance, 5 plants were selected randomly and the 14th leaf (counting from top to bottom) was later harvested and placed in Ziploc bags. The nymphs were then counted in the laboratory using a 10X magnifying hand lens [6].

2.5 Data analysis

The data sets were summarized per plant and mean values were obtained. Mean *Serangium parcesetosum* populations were subjected to ANOVA followed by mean separations with least significance difference (LSD) at ($p \leq 0.05$) using XLSTAT 2016 statistical package.

3. Results and discussions

3.1 Effect of the environment on *Serangium parcesetosum* abundance

Kamuli registered a higher mean population of *Serangium parcesetosum* adults per plant (4.92) than Lira (0.39) (Figure 1). A similar trend was observed among the *Serangium parcesetosum* larvae where Lira recorded a lower population (0.51) compared to Kamuli (11.75) (Figure 1). Both *Serangium parcesetosum* adults ($p<0.0001$) and larvae ($p<0.0001$) varied significantly with the location. This is being related to a much higher population of the whitefly nymphs in Kamuli compared to Lira (Figure 2). This therefore means that the predator, *Serangium parcesetosum* preferred the location with more abundant prey. This variation in the abundance of the whitefly nymph population between the two locations could be associated to the varying temperature and relative humidity experienced. The trial site in Kamuli was located near the banks of River Nile and this provides high temperature and relative humidity that favors high whitefly reproduction rate. Lira on the other hand experiences high temperature but low relative humidity. The variation in whitefly nymph population can also be linked to the nature of the landscape of the two locations. The Kamuli landscape has been greatly disturbed by human settlement and agriculture compared to that of Lira which is moderately disturbed. This therefore leads to the migration of the whiteflies onto the cultivated cassava crop since its natural habitat has been destroyed. The reverse is true for Lira where the pest could still be confined to the natural habitat and thus less likely to colonize cassava crop. The observed results are in confirmation with research carried out by [1] which revealed that prey abundance, temperature, relative humidity and rainfall were the observed factors influencing the survival of *Serangium parcesetosum* on cotton. [10]. Also found that climatic factors like high temperature, relative humidity had a direct bearing on the population of whiteflies. He explained that the two factors resulted into faster development of the pest since the life cycle period had been greatly reduced.

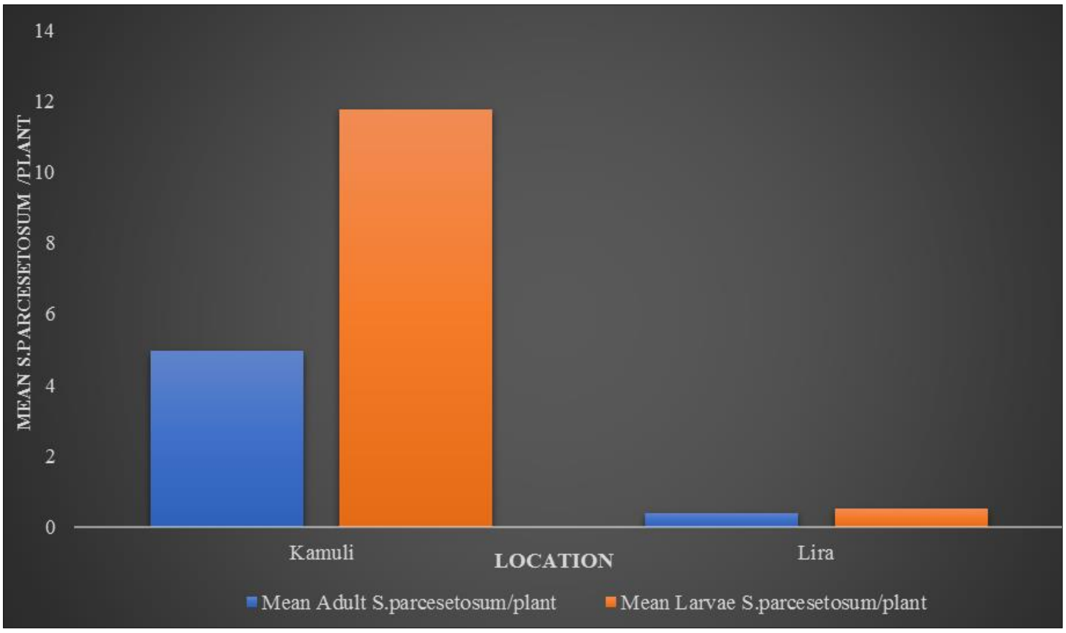

Fig 1: Mean *S. parcesetosum*/plant across the two locations

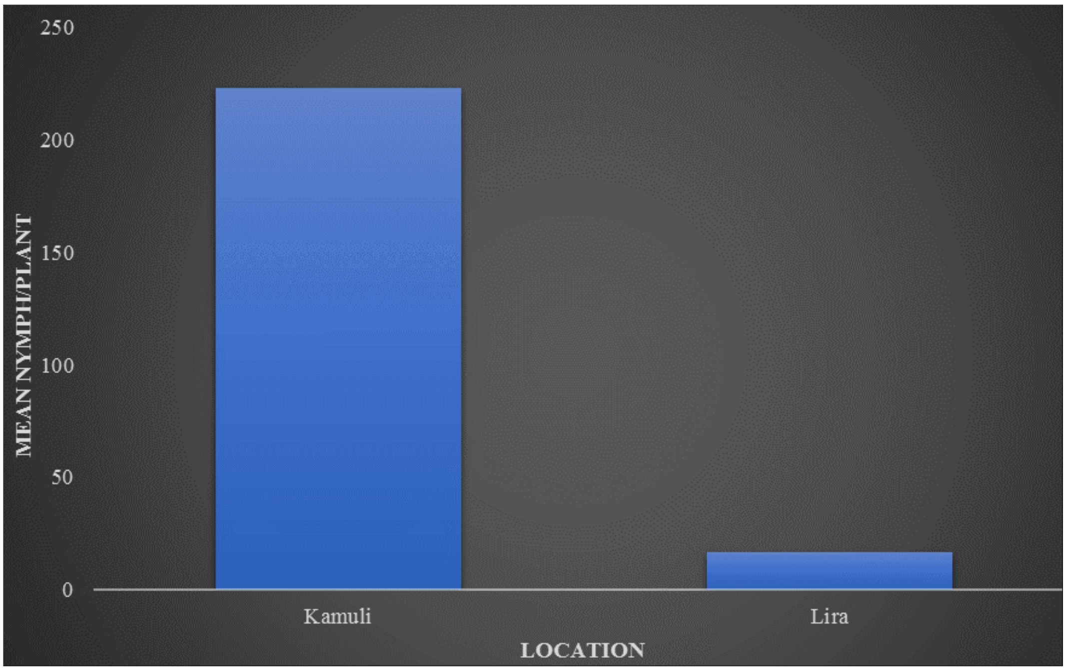

Fig 2: Mean whitefly nymph /plant across the two locations

3.2 Effect of cassava variety on *Serangium parcesetosum* abundance

3.2.1 Adult *Serangium parcesetosum* population

In Kamuli, improved broad-leafed cassava varieties; Narocass1 (4.88) and Nase 14 (5.74) had more adult *Serangium parcesetosum* than Njule red (4.13), a slender long leafed landrace. The same trend was observed in Lira where Njule red registered 0.23 adults per plant compared to Nase 14 (0.41) and Narocass1 (0.47) (Table 1). There was no significant difference ($P < 0.489$) in the adult *Serangium parcesetosum* population across the three varieties.

3.2.2 *Serangium parcesetosum* Larvae population

In Kamuli, Njule red (9.59) had the least *Serangium parcesetosum* larvae compared to Narocass1 (12.71) and Nase 14 (12.97). The same trend was observed in Lira where Nase 14 (0.62) and Narocass1 (0.63) registered higher *Serangium parcesetosum* larvae per plant than Njule red (0.26) (Table 1). The *Serangium parcesetosum* larvae per plant did not differ significantly ($P < 0.598$) among the cassava varieties.

Table 1: Mean adult and larvae *S. parcesetosum* /plant and mean whitefly nymph/leaf among the three varieties across the two locations of Lira and Kamuli

Variety	Mean Adult *S. parcesetosum*/plant	Mean Larvae *S. parcesetosum* / plant	Mean Whitefly Nymph/Leaf
		Kamuli	
Nase 14	0.62 ± 2.33	12.97 ± 1.23	273.4 ± 12.42
Narocass 1	0.63 ± 1.21	12.71 ± 0.14	237.3 ± 17.53
Njule Red	0.26 ± 1.16	9.59 ± 2.32	159.6 ± 8.34

	Lira		
Nase 14	0.41 ± 0.21	5.74 ± 2.61	18.83 ± 2.77
Narocass 1	0.47 ± 1.18	4.88 ± 1.74	15.08 ± 2.85
Njule Red	0.23 ± 0.45	4.13 ± 1.99	14.13 ± 2.85

3.3 Effect of cassava age on *Serangium parcesetosum* abundance
3.3.1 Adult *Serangium parcesetosum* population
In Lira, the adult *Serangium parcesetosum* population was first observed at 3 MAP registering 0.19 individuals per plant and steadily increased at 4 MAP (0.22) and 5 MAP (0.25). It then rose steeply reaching the peak at 6 MAP (0.90) before declining at 7 MAP (0.32) and 8 MAP (0.35) (Figure 3). In Kamuli, the adult *Serangium parcesetosum* population followed a slightly different trend. At 3 MAP, the population started very low (0.84) and then gradually increased at 4 MAP (1.84) before drastically increasing at 5 MAP (6.47) and peaking at 6 MAP (8.72). It then dropped at 7 MAP (4.05) followed by a sudden rise again at 8 MAP (7.58) (Figure 4).

3.3.2 *Serangium parcesetosum* Larvae population
The mean *Serangium parcesetosum* larvae population in Lira followed a similar trend as that for the mean adult *Serangium parcesetosum* population (Figure 3). However, there was a slight difference in the abundance levels as the larvae registered high numbers compared to the adults. In Kamuli, the trend was slightly different compared to that of the mean adult *Serangium parcesetosum* population. The mean *Serangium parcesetosum* larvae population at 3 MAP was 2.39 individuals per plant before it declined at 4 MAP (0.41). This was followed by a very sharp increase to the peak at 5 MAP (22.48) and thereafter a deceleration at 6 MAP (19.71) and 7 MAP (11.08) before another increment at 8 MAP (14.46) (Figure 4).
The observed changes in the mean *S. parcesetosum* population per plant with the cassava age could be attributed to the mean whitely nymph population recorded. [4]. and [13]. all observed in their respective studies that whitefly population peaked between 3 and 6 MAP before declining more or less rapidly to a lower level for the remainder of the cassava crop life. They explained that in the early months, the pest was just beginning to colonize the crop but later builds up from 3 to 6 MAP. The decline thereafter was however attributed to crop maturity since the plant then diverts the photosynthetic to tuberization thus rendering the remaining aerial parts unpalatable for feeding by the whitefly [7].
From this current study, it was observed that the peaks of both mean adult and larvae *Serangium parcesetosum* at 6 MAP in Lira coincided with relatively high nymph population at the same MAP within the same locality (Figure 3 and 5). The predator population then reduced with the declining whitefly nymph population. The same trend was observed in Kamuli only that both mean adult and larvae *Serangium parcesetosum* peaked earlier before decelerating with the reduction in whitefly nymph population (Figure 4 and 5). These observations suggest that whitefly nymph population recorded as per respective ages of the cassava had an effect on the varying population of adult and larvae *Serangium parcesetosum*.

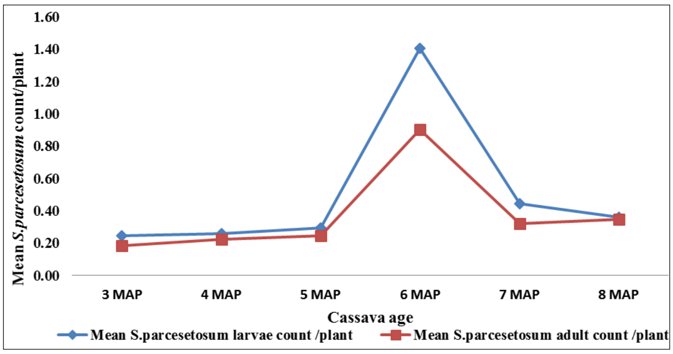

Fig 3: Changes in mean Serangium parcesetosum population per plant with cassava age in Lira

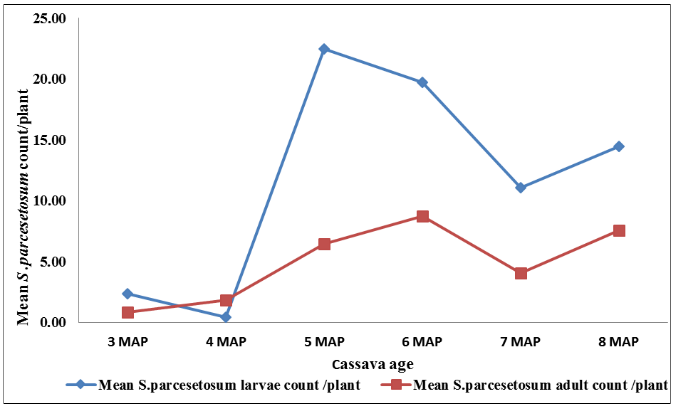

Fig 4: Changes in mean Serangium parcesetosum population per plant with cassava age in Kamuli

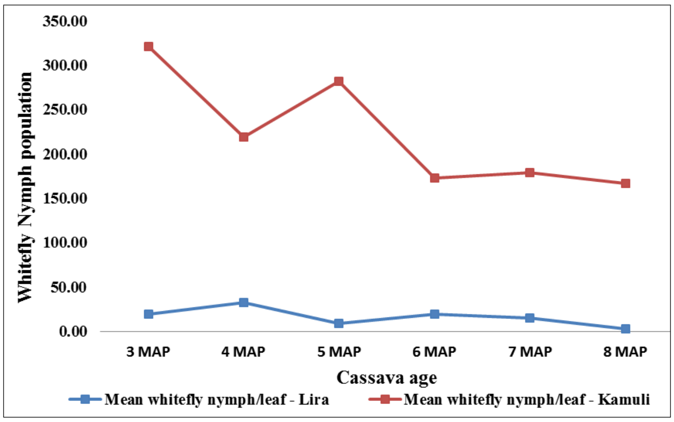

Fig 5: Changes in the whitefly nymph population with cassava age in the two different locations

4. Conclusion
This study established that location and cassava age were the main drivers of whitefly population which directly influenced the population of adult and larvae *Serangium parcesetosum*. This finding is important towards the development of biological control options for cassava whitefly. However,

There is need to validate this predator in other agro-ecological zones of Uganda before it can be recommended for nationwide application.

5. Acknowledgement
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6. References

1. Al-Zyoud F, Sengonca C. Prey consumption preferences of *Serangium parcesetosum* Sicard (Col., Coccinelidae) for different prey stages, species and parasitized prey. Journal of Pest Science. 2004; 77.4:197-204.
2. Asiimwe P, Ecaat JS, Guershon M, Kyamanywa S, Gerling D, Legg JP. Evaluation of Serangium n. sp. (Col., Coccinellidae), a predator of *Bemisia tabaci* (Hom. Aleyrodidae) on cassava. Journal of Applied Entomology. 2007; 131:76–80.
3. Bedford ID, Briddon RW, Brown JK, Rosell RC, Markham PG. Geminivirus transmission and biological characterisation of *Bemisia tabaci* (Gennadius) biotypes from different geographic regions. Annals of Applied Biology. 1994; 125.2:311-325.
4. Dengel HJ. Investigations on the incidence of *Bemisia tabaci* (Genn.) adults on different cassava varieties. Plant Research and Development. 1981; 1:37-49.
5. Faria M, Wraight SP. Biological control of *Bemisia tabaci* with fungi. Crop protection. 2001; 20(9):767-778.
6. Fishpool LDC, Abisgold JD. A method for estimating population sizes of whitefly nymphs (*Bemisia tabaci genn.*) on cassava. Tropical Pest Management. 1990; 36:3, 287-292.
7. Fishpool LDC, Fauquet C, Fargette D, Thouvenel JC, Burban C, Colvin J. The phenology of Bemisia tabaci populations (*Homoptera: Aleyrodidae*) on cassava in southern Ivory Coast. Bulletin of Entomological Research. 1995; 85:197-207.
8. Kutuk H, Yigit A. Ozdemir A. The effect of season on the levels of predation by the ladybird *Serangium parcesetosum* Sicard (Coleoptera: Coccinellidae) on the cotton whitefly *Bemisia tabaci* (Genn. (*Homoptera: Aleyrodidae*), a serious pest of eggplants. Journal of pest science. 2008; 81.4:207-212.
9. Legg JP, Mallowa S, Sseruwagi P. First report of physical damage to cassava caused by the whitefly *Bemisia tabaci* (Gennadius) (Hemiptera: Sternorrhyncha: Aleyrodidae). 3rd International *Bemisia* Workshop, 17-20 March, Barcelona, Spain, 2003. Abstract. 41.
10. Legg JP. *Bemisia tabaci*: The whitefly vector of cassava mosaic Gemini viruses in Africa: An ecological perspective. African Crop Science Journal. 1994; 2(4):437-448.
11. National Crops Resources Research Institute. Status report on cassava pests and diseases in Uganda. 2013. Unpublished report.
12. Otim MH. Distribution of natural enemies, biology and behaviour of the major parasitoids of *Bemisia tabaci* on cassava. 2006. Unpublished Ph.D. thesis, 80.
13. Ramzan C, Heather M. Effectiveness of parasitoids of *Bemisia tabaci* (Hemiptera: Aleyrodidae) on cotton cultivars differing in leaf morphology. Bio one / Florida entomological society. 2009; 92(4):538-547.
14. The agro ecological zones of Uganda. Food and Agriculture Organization (FAO) Statistics. Accessed on March 2017. http://www.fao.org/ag/agp/agpc/doc/counprof/uganda/uganda.htm
15. The New vision Newspaper publication 17th November 2015. 'NARO's new crop products offer hope against disease and drought'. www.newvision.co.ug.