

ASIAN CITRUS PSYLLID

Investigating its spread

A. MANRAKHAN¹, C. LOVE^{1,2}, P. LYIMO³, R. CLASE¹, G. COOK¹,



The distribution of Asian Citrus Psyllid (ACP) south-west of Morogoro, Tanzania, was determined in November 2018.

The presence of the Asian Citrus Psyllid (ACP), *Diaphorina citri* Kuwayama (Hemiptera: Liviidae), in parts of East Africa (Rwomushana et al., 2017; Shimwela et al., 2016) is currently placing citriculture in southern Africa at risk. ACP is a threat to the southern African citrus industry, mainly because of its effective ability to vector Huanglongbing (HLB), a destructive citrus greening disease associated with the gram negative α -Proteobacteria *Candidatus Liberibacter asiaticus* (Las) (Inoue et al., 2009). Las is present on the African continent, more specifically in Ethiopia (Saponari et al., 2010), and it is a question of time as to when the vector and the pathogen will meet. Las can also be transmitted to citrus by the indigenous pest present in SA, the African citrus triozid (ACT), *Trioza erytreae* (Del Guercio) (Hemiptera: Triozidae), (Massonie et al., 1976).

ACP was first detected in East Africa in Morogoro, Tanzania, in January 2015 (Shimwela et al., 2016). Regional surveys in East Africa conducted between September 2015 and August 2016 covering parts of Tanzania and Kenya, revealed that ACP is present in the east and north-east of Tanzania, on the eastern coast of Kenya, in Nairobi and even in western Kenya up to Kisumu bordering Lake Victoria (Rwomushana et al., 2017). After the East African surveys on ACP referred to above, no further information has emerged on the distribution of the pest further south of Morogoro.

A survey was carried out between 17 and 23 November 2018, along a transect from Morogoro to Songea, Tanzania, following the main road network, in order to determine the spread of ACP south-west of Morogoro towards the Malawian and Mozambique borders. This transect was selected as parts of it are characterised by a warm, temperate climate with a unimodal rainfall pattern. These conditions are similar to those in the northern citrus production areas of SA.

MATERIALS AND METHODS

Field sampling

There were ten sampling locations (Fig. 1 and Table 1) along the Morogoro-Songea transect. Sampling locations were selected on the basis of the presence of ACP host trees, of which *Citrus* spp (Fig. 2 A) were mostly targeted. There were three sampling sites at each sampling location.

At a sampling site, the tree was visually inspected by three observers for the presence of ACP and ACT adults and nymphs. Each observer inspected the entire tree for 2.5 minutes. When adults of ACP (Fig. 2b) or ACT were detected during visual inspection, the specimens were collected using a hand-held aspirator. Specimens collected during visual inspection were placed in vials containing 90% ethanol.



Figure 1. Map of Tanzania showing the positive ACP finds (red circles) at the sampling locations (black squares) along the Morogoro-Songea transect, Tanzania, surveyed between 17 and 23 November 2018.

¹ Citrus Research International, P.O. Box 28, Nelspruit 1200, South Africa

² Department of Conservation Ecology and Entomology, Stellenbosch University, Stellenbosch, South Africa

³ Department of Ecosystems and Conservation, Sokoine University of Agriculture, P.O. Box 3010, Chuo Kikuu, Morogoro, Tanzania

⁴ Department of Crop Science and Horticulture, Sokoine University of Agriculture, P.O. Box 3005, Chuo Kikuu, Morogoro, Tanzania

⁵ Hoppie Nel Fruit Consulting, P.O. Box 149, Onrusivier, 7201, South Africa

Table 1. Trap catches and collections (during visual sampling) of ACP and ACT adults along the Morogoro-Songea transect, Tanzania, between 17 and 23 November 2018. There were three ACP lime green traps in each location, which were serviced over one to six days depending on location. In each location, three observers checked the leaves of three trees for the presence of ACP/ACT, for 7.5 minutes per tree.

Location	GPS co-ordinates	Elevation (m)	Host environment	Trap Catches		Adults collected during visual sampling		Presence of nymphs during visual sampling	
				Mean (± SE) ACP adults per trap per day (total numbers)	Mean (± SE) ACT adults per trap per day (total numbers)	Total number of ACP	Total number of ACT	ACP	ACT
Morogoro	S 06°50'52.3" E037°39'37.4"	528.61	Citrus orchard and orange jasmine	1.06 ± 1.06 (19)	0.06 ± 0.06 (1)	17	2	-	-
Mikumi	S 07°24'07.7" E036°59'26.0"	528.37	Backyard trees	0.08 ± 0.08 (1)	0.00 ± 0.00 (0)	0	0	-	-
Mtandika	S 07°32'49.9" E036°25'18.7"	569.22	Citrus orchard	0.16 ± 0.08 (2)	0.00 ± 0.00 (0)	0	0	-	-
Iringa	S 07°47'32.6" E035°41'54.6"	1537.98	Backyard trees	0.11 ± 0.11 (1)	0.33 ± 0.33 (3)	0	0	-	+
Mafinga	S 08°17'45.1" E035°16'53.7"	1865	Backyard trees	0.00 ± 0.00 (0)	0.50 ± 0.29 (3)	0	1	-	+
Makambako	S 08°54'25.8" E034°50'52.4"	1695.16	Backyard trees	0.00 ± 0.00 (0)	0.67 ± 0.44 (3)	0	0	-	+
Njombe	S 09°21'16.2" E034°46'22.9"	1978.5	Backyard trees	0.00 ± 0.00 (0)	0.00 ± 0.00 (0)	0	0	-	-
Mahanje	S 09°53'11.6" E035°20'14.3"	1051.56	Citrus orchard	0.00 ± 0.00 (0)	0.00 ± 0.00 (0)	0	0	-	-
Luhimba	S 10°25'53.0" E035°40'27.0"	1029.45	Backyard trees	0.00 ± 0.00 (0)	0.00 ± 0.00 (0)	0	0	-	+
Songea	S 10°40'19.8" E035°39'11.5"	1097.46	Citrus nursery	0.00 ± 0.00 (0)	0.33 ± 0.33 (1)	0	16	-	+

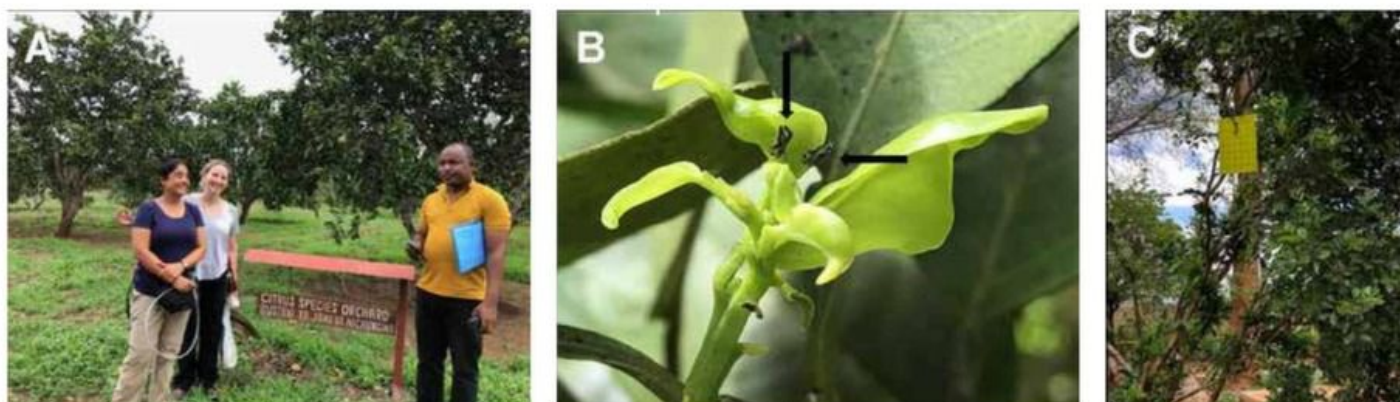


Figure 2. Sampling of ACP along the Morogoro-Songea transect, Tanzania. (A) Citrus orchard at Sokoine University of Agriculture, Morogoro, (B) ACP adults (pointed out with black arrows) found on young citrus leaves during visual sampling and (C) Placement of ACP trap on a citrus tree.

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Additionally on each tree, one double-sided sticky lime-green card (14.0 x 18.4 cm), ACP trap (Alpha-Scents, USA, supplied by Insect Science, South Africa) (Fig. 2c) was placed on the outside canopy at a height of between 1.5 and 3.0 m above the ground, depending on sites. Leaves around the trap were cleared away so that the sticky surfaces were not obstructed. Traps were removed after one to six days on the way back from Songea to Morogoro. At each sampling location, trees were checked for the presence of HLB symptoms (yellow leaf veins, yellow mottling on leaves and tree dieback).

Collected traps, insect specimens in ethanol and leaf samples were brought back to SA for analysis at the Citrus Research International (CRI) laboratories, Nelspruit, SA, under permits issued by the Directorate Plant Health, Department of Agriculture.

Laboratory analysis

Traps and specimens collected during visual inspection were checked under a stereomicroscope for ACP and ACT adults. The identity of ACP adults caught on traps outside of Morogoro was confirmed by molecular barcoding.

The presence of *Ca. L. africanus* (Laf) and Las in psyllid samples from all sites were determined using Real-time PCR.

RESULTS AND DISCUSSION

The most southern point of detection of ACP on the transect from Morogoro to Songea was in Iringa (Table 1 and Fig. 1), which is about 240 km south-west of Morogoro. Iringa is at a high altitude (1538 m above sea level). ACP was also detected in cooler and higher altitude locations in Kenya, up to 1666 m above sea level (Rwomushana et al., 2017). Although the optimal temperature range for population growth of ACP is between 25°C and 28°C, ACP was found to still be able to survive and lay eggs at lower temperatures (down to 15°C) (Liu and Tsai, 2000). ACP was not

found further south of Iringa on our transect. The absence of the pest further south of Iringa should, however, be confirmed by further surveys given that trap exposure was shorter for this region compared to the locations closer to Morogoro.

When comparing psyllid sampling methods used in this survey (trapping versus visual sampling), trapping was found to be more efficient in determining the presence of ACP than visual surveys. Whenever ACP adults were seen visually, they were also captured in traps (Table 1). And even when ACP adults were not seen during visual sampling, they were eventually captured in traps (Table 1).

Las or Laf were absent from all ACP and ACT specimens. No *Liberibacter* was detected from symptomatic leaf samples collected from Morogoro. Symptoms found could have been as a result of nutrient deficiency. Leaves showing HLB symptoms were not found in any other locations sampled outside of Morogoro.

CONCLUSION

The finds of ACP south-west of Morogoro are concerning. Given that ACP managed to spread to a certain extent towards the warm, temperate climate of Tanzania, an even wider spread of ACP can be expected along the coastal regions of Tanzania and Mozambique with a climate more favourable for ACP.

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