Stink bugs on avocado

Progress report

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ABSTRACT

Three bug species were able to breed successfully in avocados, namely *Pseudotheraptus wayi*, *Anolcus campestris* and *Coenomorpha nervosa*. Successful breeding of an insect species on a specific plant is normally a good indicator of the ability of such a plant to act as an effective host. The three species appear to succeed each other in time with *A. campestris* being dominant during December; *P. wayi* occurred from September – January and *C. nervosa* occurred in small numbers from November onwards. Host plants grown in close proximity to the orchards will influence the severity of attack. Additionally well-defined infestation gradients were present early in the season when bugs first migrated into avocado orchards. Recommendations were also made regarding the optimal timing of insecticide sprays on a commercial estate in the Nelspruit region. Orchards on the commercial estate where some of the trials were done are bordered by dense subtropical vegetation and has a history of considerable stink bug damage. Apart from the standard *Taylorilygus* sp. spray early in the season, a registered synthetic pyrethroid was applied during mid-November and was subsequently followed up with pymetrozine WP 250 g/kg and acephate SP 750 g/kg applications during January and February 2015.

INTRODUCTION

Stink bugs are true generalists. According to Panizzi & Slansky (1985) this group of insects normally have a wide host range, are very mobile and normally inflict more serious damage than their relative low population densities would suggest.

Prinsloo & Uys (2015) lists 13 major pentatomid pests in South Africa. Only four of the insects have not yet been recorded in the subtropical sector. To exacerbate the situation even further, only relatively small areas of South Africa are really suitable for the commercial production of subtropical fruit. This resulted in the establishment of large monocultures consisting of potential host plants in relative close proximity to each other. Joubert (1997) warned that when these trees reached maturity, a proliferation of hemipterous pests and subsequent damage is to be expected.

The diverse number of damage symptoms as well as the presence of a range of pentatomid and coreid bugs occurring on avocado, prompted a more in depth investigation into the orchard ecology. The urgency of this investigation was further intensified by previous reports indicating that the coconut bug only comprise a relative modest percentage of all bugs that were recovered from this crop (Schoeman, 2014).

MATERIALS AND METHODS

Population survey

Population levels of stink bugs occurring in avocados (cv. Pinkerton) were monitored with a thermal fogging machine (model Superhawk, Dyna Fog Africa). The trial was initiated on the 7th of February 2013 and lasted until the 23rd of July 2014. Six randomly selected trees at the Nelspruit research farm of the Agricultural Research Council's Institute for Tropical and Subtropical Crops (ARC-ITSC) (25° 27′ 23.14S; 30°58′ 09.91E) were monitored every fortnight by placing plastic sheeting (± 5 m^2) underneath each tree. Trees were fogged between 07:00 – 08:00 to ensure limited disruption of the smoke cloud due to air movement. Dead insects were collected ± 1 hour after treatment.

During 2014/15 the survey was continued in nearby commercial 'Hass' orchards (25° 25′ 46.02S; 30°55′ 51.63E) because of concerns regarding over monitoring in the small orchard at the ARC-ITSC. Mango, macadamia and litchi orchards were also monitored with the thermal fogging machine, because Schoeman (2014) indicated that these crops are important hosts for a complex of indigenous stink bugs as well.

Stink bug management

The study was conducted at the ARC-ITSC as well as a nearby commercial avocado estate. The small 'Pinkerton' orchard at the ARC was bordered by a mango orchard (cv. Sensation) that was severely infested by the coconut bug *Pseudotheraptus wayi*. The avocado orchard was divided into four equal portions (Table 1) relative to its proximity to the infested mango orchard. The incidence of fruit damage was recorded every week from the 6th of November 2014 to the 20th of January 2015 in each of these blocks by visually examining 50 fruit for stink bug damage. All damaged fruit were subsequently removed during these weekly inspections. Fruit damage represented in Table 1 will therefore reflect insect activity during the preceding monitoring interval.

At the commercial estate, 250 fruit (50 fruit/location x 5 locations) were also examined every week in a mature 'Hass' orchard. This orchard was surrounded by natural bush which presumably acted as a source for stink bugs. As a result this orchard has a history of severe stink bug damage (±12%). This orchard was then compared to unsprayed avocado trees along the perimeter of an adjoining orchard. All damaged fruit were removed from both orchards during the weekly inspections.

The following treatments were applied during 2014/15:

- Bullock EC 50 g/L week 39 (sucking bug complex – avocado bug);
- Acephate SP 750 g/kg week 47 (immigrating coconut bugs);
- Acephate SP 750 g/kg week 2 (immigrating bugs & nymphs – various species);
- Pymetrozine WP 250 g/kg week 11 (resident stink bugs).

All applications were strictly guided by monitoring results and must therefore not be considered as a standard spraying programme applicable to all farms.

RESULTS

Population study: General observations

Approximately 19 different heteropteran species (stink bugs) were recorded on avocado trees at the ARC-ITSC trial site thus far. Although the trial orchard is normally severely affected by stink bugs, surprisingly few insects were recorded (321 insects during 31 monitoring sessions = 10.35 bugs/monitoring session or ±1.73 bugs/tree/week). The situation in the commercially managed orchard was similar, as even less insects were recorded (71 insects during 18 monitoring sessions = 3.94 bugs/monitoring session or ±0.66 bugs/tree/week).

At the ARC trial site, *P. wayi* comprised only 7.17% of the total number of stink bugs and ± 8.19% of the five most numerous Hemiptera species recovered during this study (Fig.1). At the commercial site, *P. wayi* comprised ±7.15% of all insects that were recovered. This compared favourably with the study of Van den Berg *et al*. (2000) where *P. wayi* contributed only 6.1% of all stink bugs that were recovered in the Nelspruit area. Interestingly only two pentatomid species were recovered from this site, but a number of unidentified coreid species comprising ±15.71% of the total number of heteropterous insects were recovered from this site (Fig. 2).

During the study of Van den Berg *et al.* (2000) the powdery bug *Pseudatelus raptoria* (formerly known as *Atelocera raptoria*) made up 30.5% of the individuals that were recovered. Although a small number of these stink bugs were recovered from avocados, relative large numbers of a hitherto unknown bug *Anolcus campestris* were found in avocados. *A. campestris* made up nearly ±50% of all pentatomid and coreid bugs (excluding the avocado bug, *Taylorilygus* sp.). *A. campestris* and *P. raptoria* are morphologically very similar and according to Dawid Jacobs (personal communication), the taxonomy of this group of stink bugs are currently in a state of confusion, therefore *P. raptoria* may possibly have been misidentified in the past by various researchers. *A. campestris* was also considerably more prolific when fruit were available on the trees during summer, which indicates that it might be involved in fruit damage previously ascribed only to *P. wayi*.

C. nervosa made up less than 1% of the individuals recovered in the study of Van den Berg *et al.* (2000), but this insect was the second most abundant pentatomid bug recovered during the present study and contributed ±11.4% of the five most numerous hemipterans recorded on avocados at the ARC site (Fig. 1). Perplexingly at the commercial estate where the avocado orchards were surrounded

Table 1. Seasonal fluctuations regarding host preferences of the coconut bug *Pseudotheraptus wayi*.

Month	Crop			
	Macadamia	Avocado	Mango	Litchi
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

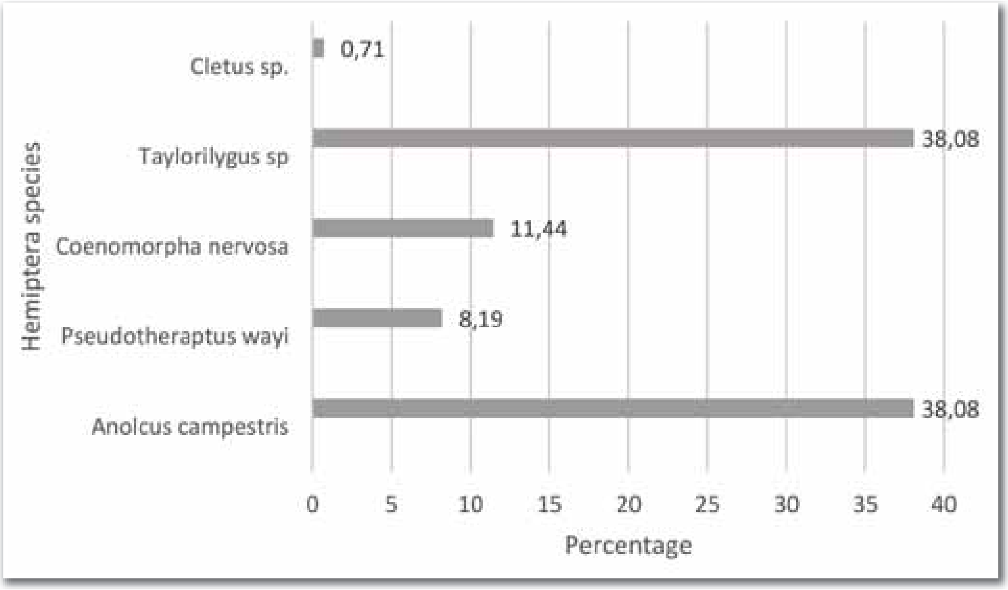

Figure 1. Abundance of five most numerous stink bugs (Coreidae & Pentatomidae) recovered from unsprayed avocado trees (cv. Pinkerton) at Nelspruit from the 7th of February 2013 to the 5th of March 2015.

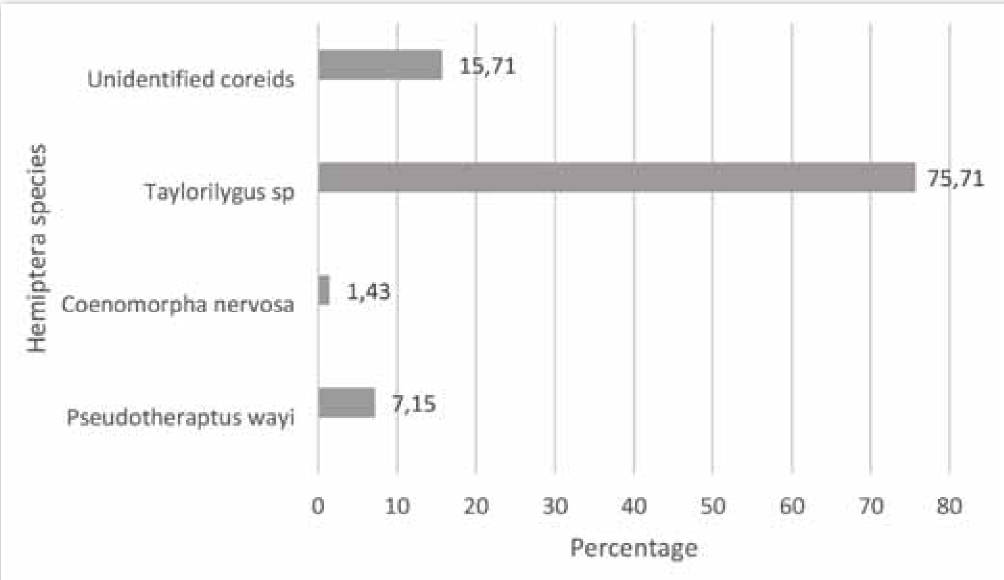

Figure 2. Abundance of four most numerous stink bugs (Coreidae & Pentatomidae) recovered from unsprayed avocado trees (cv. Hass) at a commercial farm outside Nelspruit from the 3rd of July 2014 to the 5th of March 2015.

Table 2. Seasonal immigration patterns of stink bugs (mostly *P. wayi*) from a spring host (mangoes) into avocados (cv. Pinkerton).

	Damage fruit (%) in relation to distance from severely infested mango orchard			
	Furthest away from alternative host (±100 m)	+ 60 m away from alternative host	± 40 m away from alternative host	Closest to alternative host (±10 m)
6 Nov	6	4	0	0
18 Nov	8	0	2	0
25 Nov	6	6	18	36
5 Dec	2	2	2	26
18 Dec	2	14	30	40
5 Jan	18	28	54	44
20 Jan	30	40	48	44

by well-known hosts of this bug (pecans and litchis), only one nymph was recovered during the entire monitoring period.

Relative seasonal abundance

Gause's law of competitive displacement states: "different species having identical ecological niches (ecological homologues) cannot coexist for long in the same habitat" (DeBach, 1966). Yet *P. wayi*, *C. nervosa* and *A. campestris* appear to share the same habitat (fruit). All three species were able to breed successfully in avocados and all three species were present when developing fruits were present in the orchard, which seems to invalidate Gause's law. A corollary of the competitive displacement law further states that coexistence is only possible if both species have different ecological niches. This can clearly only be possible if they utilise different food sources or if they exploit the food source at different times. The latter case may be possible as Figure 3C indicates that *C. nervosa* was most numerous during November, *A. campestris* during December (Fig. 3A) and *P. wayi* during January (Fig. 3B).

Cletus sp. is probably a flower feeder as it occurred only from June to July and bugs were frequently observed on avocado flowers. However, these observations were based on a limited number of insects and follow up studies are needed to confirm these findings.

The relative seasonal abundance of *P. wayi* on a variety of host plants is summarised in Table 1. In most subtropical areas, many of the host plants listed in Table 1 are cultivated in close proximity to each other and will provide this notorious pest with a seemingly unending supply of food throughout the year. Although no *P. wayi* specimens were located during November and December 2013 (Fig. 3B) at the ARC-ITSC, a number of visual inspections during 2014 in the 'Pinkerton' orchard revealed numerous adults and nymphs during this time. This indicates that the interrelationships and subsequent ecological niche separations of the various bugs are probably more complex than anticipated.

Macadamias are generally exploited by *P. wayi* during the autumn when a concomitant decrease in *Bathycoelia distincta* activity is normally observed. This observation is also corroborated by Bruwer (1992). Macadamias is regarded as a true host plant as it harbours adults and nymphs, which indicates that this insect is able to breed successfully on this host.

In contrast *P. wayi* was not able to utilise litchis as a true host as no nymphal stages were ever collected. *P. wayi* nevertheless congregated on this host mainly during winter (June/July) and probably used litchis as a temporary winter refuge. Small numbers of *P. wayi* individuals were observed on this crop up to late spring (October).

No dominant pentatomid bug was recorded on mangoes, but adults and nymphs of *P. wayi* occurred in large numbers on this crop during spring when young developing fruit were present. According to

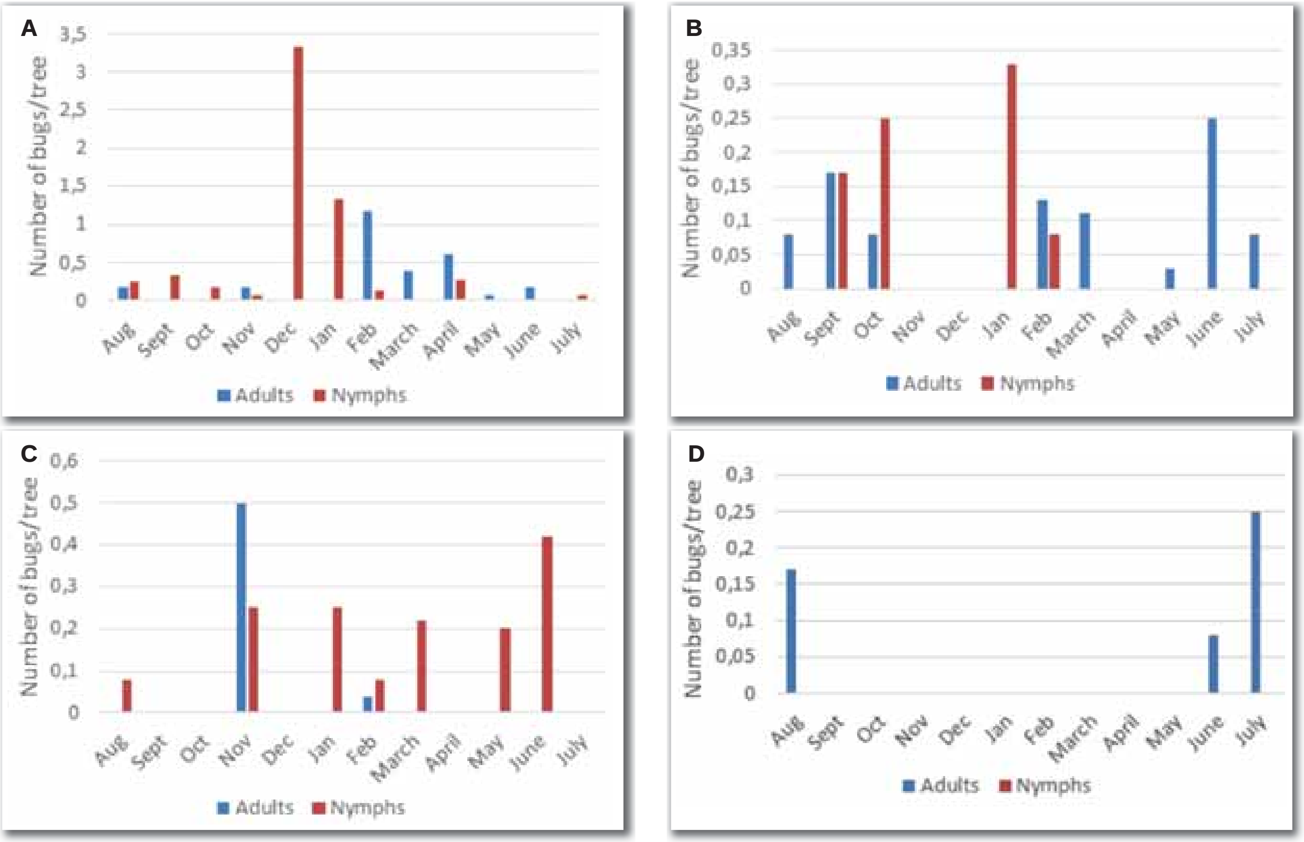

Figure 3. Seasonal abundance of adults and nymphs of the most common stink bugs found on avocado during a 17 month period in the Mpumalanga Province of South Africa. A: *Anolcus campestris*, B: *Pseudotheraptus wayi*, C: *Coenomorpha nervosa*, D: *Cletus* sp.

Table 1 the cultivation of these four crops in close proximity to each other will provide a season long availability of host plants for *P. wayi*. No knowledge regarding the relative seasonal abundance of this insect on pecans and guavas currently exist. While limited amounts of pecan orchards are present in traditional subtropical production regions, feral guavas are regarded as a weed and could be an important source of infestation.

Stink bug management

The chemical strategy employed by the commercial estate thus far was able to reduce damage to well below the 1% level in their high risk orchards. 'Hass' fruit matures relatively late in the season and will therefore only be harvested late in the production season. This will provide the bugs with ample opportunity to still inflict damage prior to harvest. The fruit as well as presence of important pests will therefore continue to be monitored until all the fruit are harvested. Feedback will be given before the start of the new production season regarding the results of this study.

In the unsprayed orchard at the ARC-ITSC, damage escalated significantly from 25 November (week 47) onwards, which indicates that the first stink bug spray at the commercial estate was probably applied at precisely the correct time.

Table 2 also indicates that infested alternative host plants in the immediate vicinity of an avocado orchard will have an important impact on the severity of infestation.

CONCLUSIONS

Results obtained thus far indicate that more than one species of stink bug is probably responsible for crop damage. In macadamias and litchis one stink bug normally becomes dominant when fruit is available on the trees, which reaffirms Gause's law of competitive displacement. In avocados three species of bugs were able to breed successfully in the crop and according to Figure 3A - C these species appear to succeed each other in time, which again would reaffirm Gause's law. Data for this assumption is not sufficient, therefore follow up work is currently in progress. However, evidence currently points towards a spray during late November (week 47) with follow up applications early in the New Year as possible means to control these intractable pests.

Alternative hosts grown in the immediate vicinity of avocado orchards are critical for the long term effective control of these insects. To prevent resistance and limit negative side effects of repetitive spraying, all control programmes should rely on sound scouting practices. These scouting practises should take cognisance of surrounding vegetation, because only when the farm is managed as an ecological unit will long term sustainable control be achieved.

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