Quantifying and controlling thrips and scales in avocado

PS Schoeman and L Linda

Agricultural Research Council – Tropical and Subtropical Crops,
Private Bag X11208, Mbombela (Nelspruit) 1200, SOUTH AFRICA

E-mail: Schalk@arc.agric.za

ABSTRACT

Surveys were conducted in the Hazyview and Nelspruit regions to quantify scale infections. Scales were predominantly found in overgrown orchards as well as in orchards bordering dirt roads. Various scale management practices such as ant and dust control linked with IPM friendly agrochemicals are briefly discussed. Thrips were surveyed on a commercial orchard in Nelspruit as well as in a mixed cultivar orchard at the Agricultural Research Council (ARC). To quantify thrip damage, macadamia flower racemes containing mostly citrus thrips were placed in organza bags which were subsequently tied around young avocado fruit. Thrip damage was also simulated by scarifying young fruit with a scalpel blade. Photographs of this damage were taken and were compared to damage in the orchard. In order to quantify the economic impact of thrips and other insects, fruit from commercial 'Edranol', 'Pinkerton' and 'Hass' orchards were surveyed for damage symptoms. Although general damage symptoms varied to some extend between the orchards, thrip damage was nearly constant at approximately 11.5% which makes this a pest of considerable economic consequence. Results of a spray trial are presented as well as methods for improving control without forfeiting environmental sustainability. Current trends regarding pesticide usage on products imported into the EU are briefly discussed as well as new agrochemicals that should be considered mainly for the sucking bug and thrip pest complexes. When all the above is considered, it is important to realise that although the avocado industry in South Africa faces some challenges regarding pesticide usage, there are already a considerable amount of appropriate green technologies available.

INTRODUCTION

Milne (1973) listed four pests on avocado in South Africa but mention that more than 300 pests are known to occur on this crop outside South Africa. Approximately 76 of these pests were known to occur in South Africa, indicating that a considerable number of potential pests may attack this crop in future. Fortunately this did not really happen as approximately 10 years later, Annecke & Moran (1982) only increased the tally with one new pest. Interestingly, the majority of attention in this publication was devoted to thrips, which are only recently being recognised as important economic pests.

This trend of an increasing number of pests over time continued and Van den Berg *et al.* (2001) compiled a very comprehensive list of approximately 73 pests. Fortunately not all of these are serious economic pests. Prinsloo and Uys (2015) listed 17 common species that can roughly be divided into the following categories: Hemipterans (avocado bug, stink bugs, mealy bugs & scales), thrips (Order: Thysanoptera), beetles (Order: Coleoptera), fruit flies (Order: Diptera) and moths (Order: Lepidoptera).

Since 2015, the citrus thrip as well as a complex of bark beetles have been added to the growing list of avocado pests. It is, however, very important to be aware of the economic significance of each pest or pest complex. Thrips, fruit flies and the avocado bug can be regarded as ubiquitous and some form of control is probably necessary in most commercial orchards.

Earliest records of the false codling moth on avocado date back to Milne (1973) and despite the ability of this pest to adapt to new food sources, it is generally not regarded as a main avocado pest in most production regions. In certain localised areas, damage ranging up to 10% has been reported but this is very rare.

The coconut bug can cause significant crop reductions in certain localised areas and damage percentages of as high as 60% has been observed. Avocados grown near lowland riverine bush appears to be specifically at risk and the cultivars Pinkerton and Hass appear to be favoured.

Bark borers have a specific fondness for trees subjected to some kind of stress factor. Drones equipped with infrared cameras can therefore be a very handy tool to pro-actively identify individual trees or areas on a farm that are at risk. The bark borer guild is generally poorly studied in South Africa, but it consists of a large group of indigenous species. Apart from the polyphagous shot hole borer two other cosmopolitical beetle pests have also been recorded in South Africa, namely *Xyleborus crassiusculus* and *Xyleborus affinis*. It is not clear when these insects were introduced to South Africa for the first time, but first records at the ARC-TSC of *Xyleborus affinis* on citrus date back to March 1980.

All the facts supplied above may sound bewildering to the novice grower, but all these pests hardly ever occur simultaneous. The first question often asked is what product can be sprayed against a particular pest. This is usually the wrong question, as most avocado orchards in South Africa are under relative good biological control. In order to maintain the balance in the orchards, it is important to quantify the economic significance of each individual pest and to manage them in a holistic way. This report should therefore be regarded as an attempt to quantify thrip damage as well as define the economic impact of this poorly studied pests in avocados.

MATERIALS AND METHODS

Quantifying thrip damage symptoms

A measure of uncertainty and controversy currently exist regarding typical thrip symptoms. Accurate symptom description is regarded as an important first part of the study, as it will determine economic damage and consequently the amount of effort needed to manage the pest. Two methods were used to quantify thrip damage, namely:

- Simulating damage to the epidermis of the fruit.
  This was done by lightly scraping the skin of a number of 'Pinkerton' fruit during November with a scalpel blade. Three treatments of increased severity were applied.
- Inducing thrips to feed on the fruit and monitoring the resulting symptoms.
  Racemes containing open flowers from a nearby macadamia orchard (cv. Nelmak 2) were picked and placed into organza bags. The organza bags were then tied around young avocado fruit (cv. Pinkerton) and left *in situ* for ± a month. Fruit were randomly selected and approximately 40 fruit were therefore exposed to citrus thrips (*Scirtothrips aurantii*) which occurred on the macadamia flowers.

Quantifying thrip damage in a commercial avocado orchard

Twenty randomly selected fruit from 25 randomly selected locations were evaluated in commercial 'Pinkerton', 'Hass' and 'Edranol' orchards (20 fruit x 25 locations x 3 cultivars = 1 500 fruit). All external symptoms on the skin of the fruit were recorded.

This trial was also expanded in an 'Edranol' orchard to determine if thrips have an affinity for fruit occurring in either apical or basal tree portions. Damage on fruit in darker inner parts of the trees were also monitored and compared to fruit in the more exposed outer areas of the trees. In both these trials, 20 randomly selected fruit were selected from 25 randomly selected locations inside the orchard.

Chemical management of thrips

To determine the efficacy of a number of environmentally friendly products, the following trial was conducted at a commercial orchard in the Nelspruit region:

Treatments
Pymetrozine WP 500 g/kg (Chess) @ 40 g/100 L
Neem oil (Azadirachtin) @ 300 ml/100 L
Beauveria bassiana @ 45 g/100 L
Untreated control.

The trial was conducted during 7 September 2019 in a commercial 'Edranol' orchard and all treatments were applied with a commercial air blast sprayer calibrated to deliver 1 500 L/ha. Due to the nature of the sprayer, large blocks were sprayed and although data was taken at five different locations in each block, statistically these should be regarded as pseudoreplicates. The trial layout was selected because a pre-count of damage during the previous season indicated a relative homogenous distribution of thrip damage in the orchard.

Quantifying scale insect problems

A number of orchards in the Nelspruit/Hazyview area were scrutinized for scale insects as well as possible factors involved in outbreak situations.

Statistical analysis

Means were compared with an analysis of variance as well as a students t test. Data was analysed with the statistical program Genstat 64-bit Release 15.1 (PC/Windows 7) Copyright 2012, VSN Int. Ltd.

RESULTS

Quantifying thrip damage symptoms

According to Figure 1A even superficial scarring relatively late in the season led to damage similar to what is generally believed to be thrip damage. Deeper damage induced premature abortion and the resultant scarring (Fig. 1B) did not resemble thrip damage.

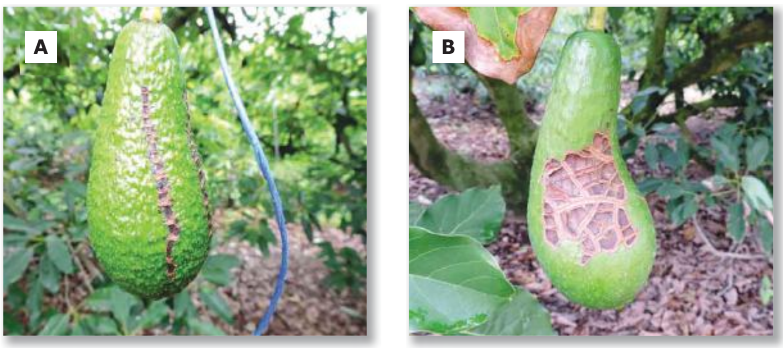

Figure 1. Mechanical damage induced to immature 'Pinkerton' fruit during November 2018. A: Light scarification with a scalpel blade; B: Deeper scarification where parts of the skin were removed.

Figure 2 indicates the type of damage possibly inflicted by citrus thrips to developing 'Pinkerton' fruit while Figure 3A and B indicate the damage to fruit in an orchard that was bordered by a severely thrip infested macadamia orchard. Please note the webbing on the skins of the fruit as well as the longitudinal nature of damage symptoms.

Typical alligator skin type of damage was observed on a number of cases where fruit rubbed against each other and also against other parts of the tree. A number of free hanging fruit with severe alligator skin damage was also observed in the avocado orchard bordering the macadamia orchard, indicating that thrips may be the possible cause (Fig. 4A & B).

Other factors may also lead to blemishes on the skin of the fruit. Figure 5A depicts possible Lepidoptera damage while Figure 5B highlights late season mechanical damage.

Figure 2. Scarification to 'Pinkerton' fruit exposed to macadamia flowers containing citrus thrips.

Quantifying thrip damage in commercial avocado orchards

According to Figure 6, thrip damage was very constant in the three cultivars that were evaluated and at approximately 11.5%, damage was considerably higher than 5%, which is normally regarded as lowest damage threshold required for intervention. Interestingly, Figure 6 indicated that 'Pinkerton' fruit had significantly more coconut bug damage, but this was consistent with previous research findings.

According to Table 1, there were no statistically significant differences in damage between fruit originating from the inside of the canopy and fruit that occurred on the outside of the canopy. However, there were significantly more damage in the apical (upper) areas of the canopy when it was compared to fruit originating from basal (bottom) tree portions.

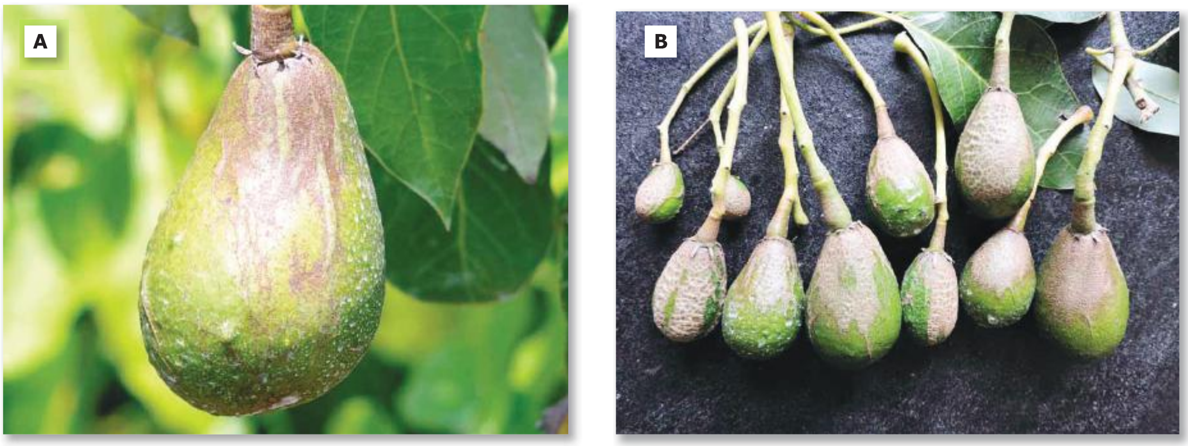

Figure 3A & B. Damage symptoms on young developing fruit in an avocado orchard bordered by a severely thrip infested macadamia orchard.

Figure 4A & B. Typical alligator skin type of damage on free hanging fruit in an avocado orchard adjoining a severely thrip affected macadamia orchard.

Efficient, functional paper packaging

Sappi provides a range of paper for packaging products, all manufactured to world class standards, for a variety of agricultural and industrial applications. Paper combinations of UltraFlute®, KraftPride® and FusionTopliner® offer strength and high humidity benefits, as well as yield and cost advantages to converters.

This ensures visually appealing, cost-effective end-use products that will retain their required performance in the supply chain. Paper is a versatile medium for packaging to protect products from farm to market, and is made from renewable resources.

www.sappi.com

sappi

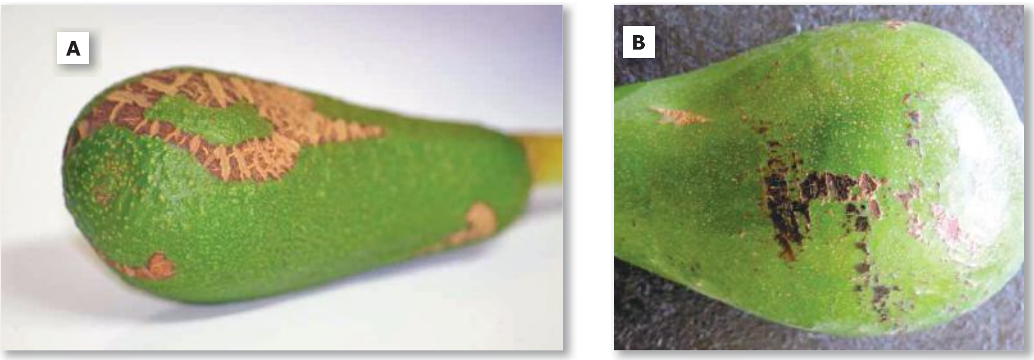

Figure 5. Damage not caused by thrips. A: Possible Lepidoptera damage; B: Late mechanical damage.

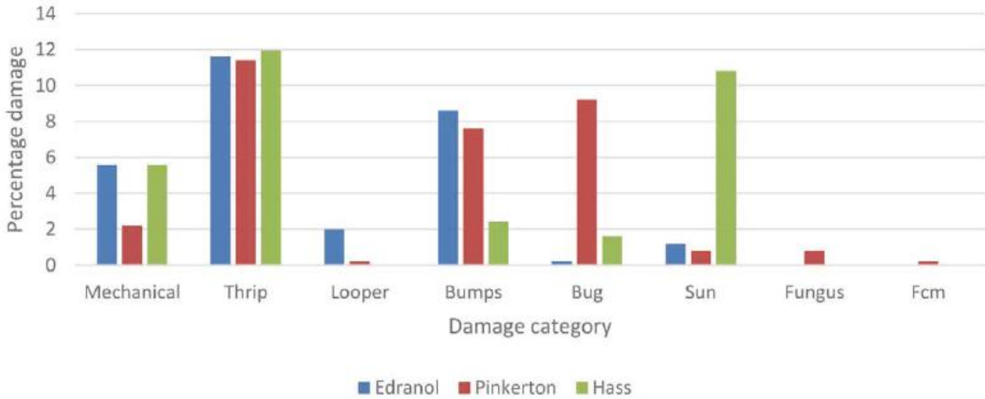

Figure 6. Relative damage caused by a number of biotic and abiotic factors in commercial avocado orchards in the Nelspruit region.

Table 1. The effect of the position of the fruit on the tree in terms of thrip damage.

Treatment	Parameter	Average percentage undamaged fruit ± SD	P	T -value	df
1	Inside canopy	89.6a ± 2.61	0.42	0.85	8
	Outside canopy	87.2a ± 5.76			
2	Apical fruit	93.2a ± 6.1	0.0045	3.9	8
	Basal fruit	79.2b ± 5.22			

Average percentages with the same letter do not differ statistically significantly at the specified P level. Treatments were calculated separately
df – degrees of freedom

Table 2. The effect of various environmentally friendly products on the incidence of thrips damage and bumps caused by *Taylorilygus* spp.

Treatment	Percentage clean fruit ± SD	
	Thrip damage	Avo bug damage
Pymetrozine	84.8a ± 11.682	79.6b ± 4.561
***Beauveria bassiana* (dry formulation)**	83.6a ± 4.775	78.0b ± 6.164
Neem oil	84.4a ± 4.561	73.6b ± 8.649
Control	78.8a ± 5.586	74.0b ± 3.162
P value	0.546	0.333
Cv%	8.7	7.9

Average percentages with the same letter do not differ statistically significantly at the specified P level. Columns were calculated separately

Chemical management of thrips

Although the control treatments for both the thrip and *Taylorilygus* sp. evaluations had consistently the lowest percentage clean fruit, damage between the treatments were not statistically significant.

Quantifying scale insect problems

Incidence of scale insects was very low on the farms that were visited. Generally scales were found in older overgrown orchards as well as in orchards bordering dusty dirt roads.

CONCLUSIONS

The epidermis of young developing avocado fruit is very tender and any damage to recently formed fruit will potentially show up as alligator skin type damage. This will make it difficult to define typical thrip damage, as any early season mechanical damage will also closely resemble thrip damage to some degree. However, if results from the damage survey are considered, then clearly most of the alligator skin type of damage are caused by thrips. Mechanical damage is the only factor that can possibly be mistaken for thrips, but the experimental error made in assessing thrip damage at the end of the season should be regarded as very small when fruit that were injured by tractors and spraying machinery are excluded.

Spraying for thrips during flowering should be done with extreme circumspection and effort should be spent to protect pollinators as far as possible. The protracted and often successive flowering should be considered when spraying operations are planned. Due to the very short life cycles of thrips, suboptimal or repetitive insecticidal sprays often quickly give rise to the build-up of resistance. Softer chemicals as well as the use of biological products are therefore strongly encouraged. Registration of the following alternative active compounds should be considered: Abamectin, Spinetoram, Spirotetramat, Spinosad, Sabadilla and Neem oil.

Releases of natural enemies, such as *Amblyseius swirskii* – predatory mite, *Orius insidiosus* – predator (pirate bug) and *Neoseiulus cucumeris* – predatory mite, should also be considered. Thrips feed on the foliage, therefore manipulation of tender flush during flowering and early fruit development could be considered. Manipulation of the late summer flush could be considered to prevent an overwintering population. The application of an insecticidal spray during this time may be advantageous as it will limit damage to the pollinator complex during the subsequent season. This will obviously depend on pest load and should not be applied as a calendar spray. The effects of fungal as well as nematode based entomopathogens should be considered as a matter of priority. The effect of copper residue in the soil as well as the biological efficacy of nematodes in the dry leaf litter should be considered, as it may impact on the efficacy of these products.

Scales are normally under very good natural control. If outbreak situations of scales occur, it is therefore important to identify the factor(s) causing the imbalance. Spraying insecticides are often not necessary if the following measures are diligently practiced:

Ant control – Ants feed on honeydew secreted by these sessile insects. In doing so, they also protect these insects from natural control. Ant control (stem bands) as well as skirting and pruning trees to avoid contact with the ground and other trees is therefore a very effective departure point for effective scale control. If the problem persists, the application of a winter oil is then suggested. Overgrown orchards should be pruned to improve airflow, spray penetration and increase flowering. Dust control may also affect the efficacy of parasitoids and roads could be sprayed with water if deemed practical. The best method to encourage optimal levels of natural control is to adopt an integrated management plan for avocados and to spray only when it is really needed and to use the softest product available each time.

REFERENCES

ANNECKE, D.P. & MORAN, V.C. 1982. Insects and Mites of Cultivated Plants in South Africa. Butterworth & Co., Durban, South Africa. 383 pp.

GenStat 64-bit Release 15.1 (PC/Windows 7) 19 June 2014 10:01:33 Copyright 2012, VSN International Ltd. Registered to: ARC.

MILNE, D.L. 1973. Entomology memoir No. 33. Insect pests of subtropical fruit crops. Department of Agricultural Technical Services. Government Printer, 42 pp.

PRINSLOO, G.L. & UYS, V.M. 2015. Insects of Cultivated Plants and Natural Pastures in Southern Africa. Entomological Society of Southern Africa, Hatfield, South Africa. 785 pp. ISBN 978-0-620-60841-1.

VAN DEN BERG, M.A., DE VILLIERS, E.A. & JOUBERT, P.H. 2010. Pests and beneficial arthropods of tropical and non-citrus subtropical crops in South Africa. ARC-Institute for Tropical and Subtropical Crops, Nelspruit, 525 pp.