# A CLOSER LOOK INTO THE IMPACT OF AVOCADO SUNBLOTCH VIROID ON AVOCADO PRODUCTION

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## INTRODUCTION

Avocado sunblotch viroid (ASBVd) is found in many avocado-growing regions of the world, where it affects fruit yield and quality. Symptomless carrier trees play an essential role in the epidemiology of ASBVd, as they have been described as the primary sources of infection for spreading the disease through budding and grafting practices. Studies have shown that ASBVd can significantly reduce the yield and quality of avocado fruit (Da Graça, 1985; Saucedo-Carabez *et al.*, 2014). Avocado sunblotch viroid-infected symptomless carrier trees could lead to between 50% to 80% yield reductions compared with symptomatic trees, which cause a yield reduction between 15% and 30% (Saucedo-Carabez *et al.*, 2014).

We hypothesised that ASBVd-affected asymptomatic trees will have an impact on fruit quality and yield. The purpose of the study, therefore, was to assess the impact of ASBVd on tree morphology, fruit maturity, yield and quality of 'Hass' avocado trees in South Africa.

## MATERIALS AND METHODS

### Field selection of symptomless carrier trees and seasonal monitoring of trees

An experimental 'Hass' orchard, located at a commercial farm in Mbombela, province of Mpumalanga, South Africa, was selected for the study. Thirty trees were utilised for all the investigations of the study including 15 ASBVd infected symptomless carrier trees (selected by molecular screening) and 15 ASBVd negative trees (confirmed negative with molecular screening and hereafter referred to as 'healthy' trees). Trees with different ASBVd infection levels were selected for the study. Since ASBVd infected symptomless carrier trees are difficult to identify in the field, infected trees showing fruit symptoms were first identified. In their immediate vicinity, trees were screened using molecular testing. Screening was also conducted in the immediate areas where confirmed positive trees had been removed.

Infected and healthy trees were monitored for three consecutive seasons from 2019 until 2021, from the flowering stage until harvest. These included observations of differences in tree morphology (branches, leaves, and reproductive structures), flowering patterns, and fruit sets that could be physical indicators of ASBVd symptomless carrier trees in avocado orchards.

### Determination of the dry matter content (% DM) of fruit, yield, fruit ripening and quality, fruit firmness, colour rating, fruit quality, and data analyses

The degree of ripeness of avocado fruit was determined by measuring the % DM content of fruit at four different intervals before harvest in the years 2019 and 2020. The yield per tree was determined by counting the number of fruit on each tree in the years 2020 and 2021. Thirty fruit were harvested from each of the 30 trees in this study (infected and healthy), except in the case of highly infected trees because they produced less than 30 fruit and all available fruit were harvested. Fruit firmness was measured using an automated Sinclaire IQ instrument (51DFTB, International Ltd, Jorrold, Bowthorpe

# SYNCROSPRAY GENERATION 2

80 - 115 | 94 - 140 | 94 - 180 | 94 - 265 | 112 - 265

The Rovic mistblower was previously available in three ranges with various models per range. This has now evolved into our new **SyncroSpray** range with nine models, split between 5 families, according to capability. There are various tank sizes from 1000ℓ all the way up to 3000ℓ. The families represent an assortment of pumps and fan groups - with pump sizes from a delicate 115ℓ/h paired with a ø80cm fan group, perfectly suited for berries and vineyards, all the way up to a piston pump and ø112cm fan group, capable of a staggering 265ℓ/h. Equipped with this new 112cm diameter fan, the 112-265 model can deliver a mind-blowing 75 700m³/h of airflow, seamlessly carrying liquid and powder mixes to over 15m high. Rovic's patented **EVENFLOW** turret have been expanded to a 3.3m **SUPERFLOW** – perfect for **avocados**, pecan, and macadamia nut trees.

| | SYNCROSPRAY FAMILY | 80 - 115 | | 94 - 140 | | 94 - 180 | | 94 - 265 | | 112 - 265 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Model SKU | RM21080-115 | RM21580-115 | RM21594-140 | RM22094-140 | RM22094-180 | RM23094-180 | RM22094-265 | RM23094-265 | RM23011-265 |
| GENERAL | Chemical Tank (ℓ) | 1 000 | 1 500 | 1 500 | 2 000 | 2 000 | 3 000 | 2 000 | 3 000 | 3 000 |
| | Water Tank (ℓ) | 90 | 120 | 120 | 120 | 120 | 234 | 120 | 234 | 234 |
| | Fan Group (~cm) & Gearbox | ø80 w/ D-27J | | ø94 w/ D-21B | | ø94 w/ D-21B | | ø94 w/ D-21B | | ø112 w/ D-21B |
| | Flow@540RPM \| 40BAR (ℓ/min) – Contact | 115 - Diaphragm | | 140 - Diaphragm | | 180 - Diaphragm | | 265 - Piston | | 265 - Piston |
| | Standard Blade Count & Pitch | 6B @ 28.5° | | 6B @ 38.5° | | 9B @ 38.5° | | 9B @ 38.5° | | 8B @ 33.5° |
| | Airflow @ 1:3 Speed (m³/h) Std. Pitch | 21 000 | | 36 000 | | 44 000 | | 44 000 | | 58 700 |
| | Airflow @ 1:4 Speed (m³/h) Std. Pitch | 26 000 | | 49 000 | | 60 000 | | 60 000 | | 75 700 |
| | Turret (Fitted as Std.) | N/A | | EVENFLOW | | EVENFLOW | | EVENFLOW | | SUPERFLOW |
| | Peak PTO Power Draw (kW) [PS] | ~ 21 [29] | | ~ 37 [50] | | ~ 45 [61] | | ~ 52 [71] | | ~ 70 [95] |
| | Tyre & Rim | 225/70 R15 | 10/75 R15.3 | 10/75 R15.3 | | 12.5/80 R18 | 400/60 R15.5 | 12.5/80 R18 | 400/60 R15.5 | 400/60 R15.5 |

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Norwich, NR5, 9.D, England). The colour change was monitored visually using a six-point rating where: 1 - emerald; 2 - forest green; 3 - approximately 25% coloured; 4 - approximately 75% coloured; 5 - purple; 6 - black (White *et al.*, 2009). Statistical analyses of variance were obtained using STATISTICA 8 and the means were separated using the Post-hoc Tukey HSD test at a significance level of $p \leq 0.05$.

## RESULTS AND DISCUSSION

The ASBVd infection had a dramatic effect on the phenology of the trees, and quantity and quality of fruit. Results clearly showed that trees with high and medium ASBVd infection levels had a lower yield than healthy trees (Fig. 3). A few signs of infected trees that can enable their identification were observed. Firstly, ASBVd-infected symptomless carrier 'Hass' trees produced excessive flowers and shed leaves in the process (Fig. 1). Therefore, the flowering stage of 'Hass' can be useful in identifying the symptomless carrier trees in the field, before trees recover their canopy.

Secondly, infected 'Hass' trees also tend to remain in the flowering stage longer than healthy trees that are already at the fruiting stage at the same time interval (Fig. 2).

Lastly, infected 'Hass' trees produce very little to no fruit at all and by the end of the season, the trees will have recovered from the loss of canopy appearing greener and healthier just like healthy trees

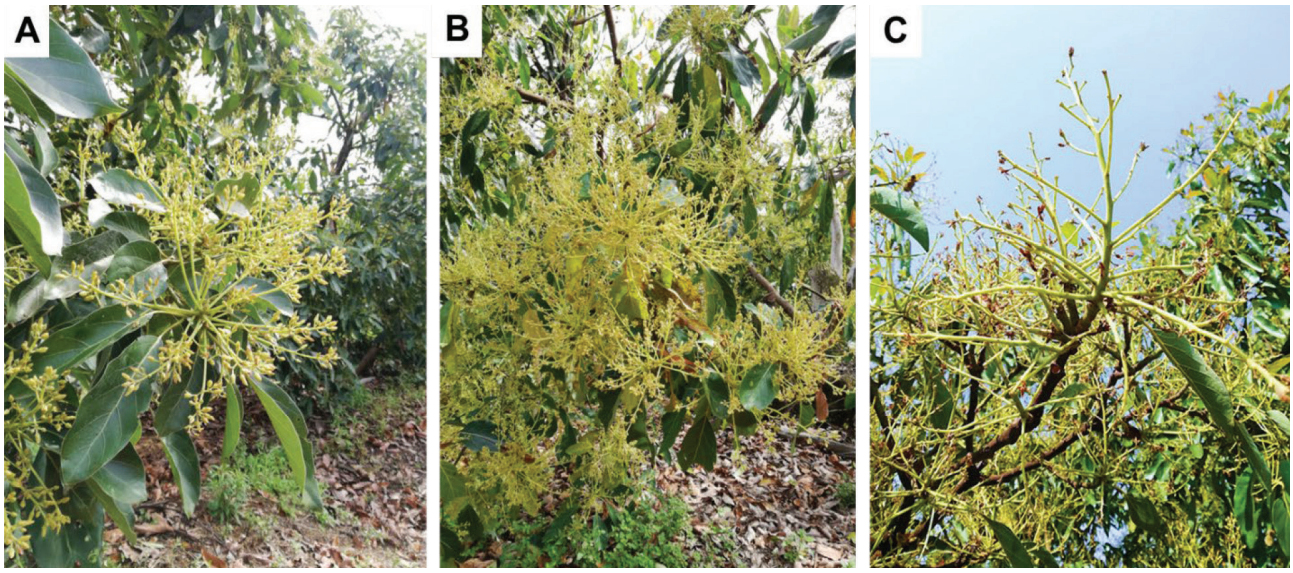


**Figure 1:** A comparison between flower development of a 'Hass' healthy tree (A) and ASBVd infected 'Hass' tree (B) towards the end of September 2020. ASBVd infected symptomless tree displaying a large amount of flower abscission at the end of the flowering stage (C).

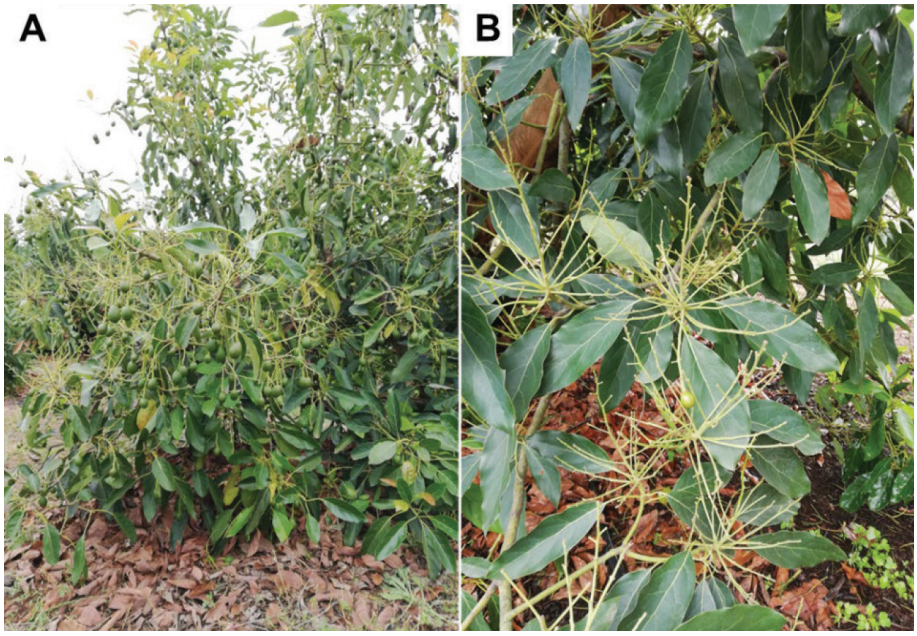


**Figure 2:** A comparison between the 'Hass' healthy tree (A) and the ASBVd infected tree (B) late October. The healthy tree had already reached full fruit set a few weeks before the ASBVd infected tree where a lack of fruit set is visible.

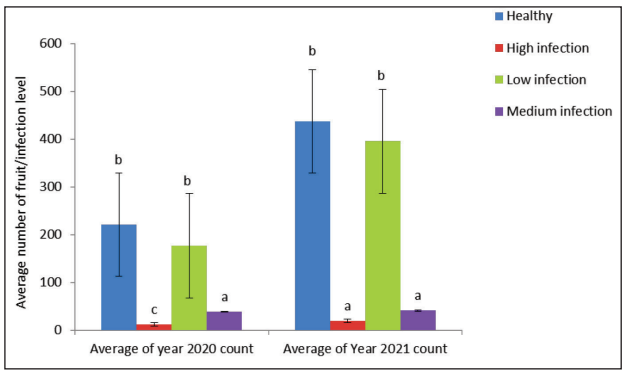


**Figure 3:** Average fruit yield counts of ASBVd infected symptomless 'Hass' carrier trees and healthy avocado trees for the 2020 and 2021 seasons. Values represent means ± standard errors (SE). Bars with the same letters did not differ significantly at P ≤ 0.05 (Tukey HSD).

(Fig. 3). These observations can be incorporated as part of ASBD management strategies in 'Hass' orchards and those of other cultivars. Postharvest fruit from infected trees ripened faster than normal fruit and were more prone to fungal infections during the ripening process. Because infected trees do not display symptoms, regular systematic indexing of orchards, especially trees for budwood and seed sources, is required.

## CONCLUSION

The study confirmed that the presence of ASBVd contributes to yield reduction in symptomless carrier trees regardless of whether trees alternate between off and on-crop years. All the field observations, yield and postharvest outcomes from this experiment are specific to the 'Hass' cultivar, and similar studies on other important cultivars will benefit the understanding of the relationship between ASBVd infection and yield losses.

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