

■ Challenges of growing avocado's in subtropical South Africa

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ABSTRACT

In South Africa, avocados comprise a large portion of the subtropical fruit industry. Because the South African avocado industry is export-orientated, emphasis is placed on ensuring high fruit quality standards. One of the most serious threats to the maintenance of these standards are pre- and post-harvest diseases such as *Pseudocercospora purpurea* (Cercospora spot), *Colletotrichum gloeosporioides* (anthracnose) and various species in the Botryosphaeriaceae group (stem-end rot).

For more than 20 years research has been conducted at Westfalia Fruit Estate to develop effective control measures for these avocado diseases. Westfalia is situated in the hilly subtropical area of the Limpopo province, where most of the country's avocados are grown. The average rainfall is between 800mm and 1300 mm, but in some years, it exceeds 1800 mm during the warm summer months. These warm, wet conditions contribute to a very favourable environment for avocado fruit diseases to develop. It is therefore crucial to have an adequate pre-harvest spray programme in place for this purpose. Control of these pathogens focuses mainly on inoculum reduction and prevention of latent infections.

Currently diseases are controlled by high volume pre-harvest fungicide applications. Recent research has focused on reducing the volumes of fungicides applied to orchards by exploring new formulations and new application methods. It is thought that ultra-low volume application technologies, such as TracFog and/or Electrostatic spray systems could reduce spray volumes, run-off and the amount of fungicide applied per hectare compared to traditional commercial practices using hand guns or mist blowers.

El aguacate supone una parte importante de la producción de frutas subtropicales en Sudáfrica. Debido a que la producción de aguacate en Sudáfrica está orientada hacia la exportación, un aspecto clave es asegurar estándares para una alta calidad de la fruta. Una de las amenazas más importantes para mantener dichos estándares son las enfermedades pre- y poscosecha como las causadas por *Pseudocercospora purpurea* (mancha de Cercospora), *Colletotrichum gloeosporioides* (antracnosis) y distintas especies en la familia Botryosphaeriaceae (podredumbre del pedúnculo).

Durante más de 20 años se ha estado investigando en Westfalia Fruit Estate para desarrollar medidas efectivas de control para estas enfermedades. Westfalia se encuentra situada en el área montañosa subtropical de la provincia de Limpopo, donde se cultiva la mayor parte de los aguacates del país. La precipitación media anual oscila entre 800mm y 1300 mm, pero, en algunos años, puede ser superior a 1800 mm durante los meses cálidos del verano. Estas condiciones cálidas y húmedas suponen un ambiente muy propicio para el desarrollo de enfermedades en los frutos de aguacate. Es, por tanto, indispensable el disponer de métodos apropiados de tratamiento precosecha. El control de estos patógenos se centra principalmente en la reducción del inóculo y en la prevención de infecciones latentes.

Actualmente el control de estas enfermedades se realiza mediante altos volúmenes de aplicaciones de fungicidas en precosecha. Se han llevado a cabo investigaciones recientes para reducir los volúmenes de las aplicaciones en las parcelas de cultivo mediante el estudio de nuevas formulaciones y nuevos métodos de aplicación. Los resultados obtenidos indican que las tecnologías que permiten aplicaciones con volúmenes muy bajos, como TracFog y/o sistemas de aplicación electrostáticos, pueden reducir los volúmenes de aplicación, escorrentías y la cantidad de fungicida aplicada por hectárea comparado con las prácticas comerciales tradicionales que utilizan pistolas o nebulizadores.

INTRODUCTION

Climate play an important role in avocado production. Extreme climatic conditions and high annual or seasonal variability of climatic parameters worldwide adversely affects productivity (Li *et al.*, 2006). The pattern and amount of rainfall are among the most important factors that affect agricultural systems. Long term rainfall records provide the grower with information about rainfall patterns and variability which aid his/her planning and management of orchards (Lazaro *et al.*, 2001).

Avocado production in South Africa is concentrated mainly in the subtropical areas of Limpopo, Mpumalanga and parts of KwaZulu-Natal. Several diseases affect South African avocado fruit such as Cercospora spot, anthracnose and stem-end rot (Darvas & Kotzé, 1981; Lonsdale & Kotzé, 1989). In South Africa these diseases are controlled by pre-harvest application of high volumes of copper oxychloride fungicides (Labuschagne & Rowell, 1983). Previously these applications were done using hand gun sprayers, with two to three ultra-high volume copper sprays of up to 10 000L spray mix/ha per application. However, there were many negatives associated with this kind of application, such as: 1) the amount of copper that ended up on the ground (affecting the soil microorganisms); 2) the high volume sprays were expensive in terms of labour and chemical costs, and 3) these application caused high levels of chemical wastage. Hand gun sprayers have thus increasingly been replaced by mist blowers over time (Boshoff *et al.*, 1996).

Westfalia Technological Services is the research division of Westfalia Fruit (Pty) Ltd and over the past 30 years has conducted many trials to aid the South African avocado grower with improving both tree and fruit health. Specific research into the reduction of copper-based fungicides for the control of fruit diseases has been on-going at Westfalia Fruit Estate, with good progress being made in a) developing a predictive spray model,

b) testing various spray formulations (i.e. Ortiva™ and cuprous oxide) and c) testing new spray technology (i.e. mist-blowers and more recently the TracFog ultra-low volume applicator).

The aim of this paper is to highlight the challenges of growing avocados in subtropical South Africa in terms of disease control and the precautionary measures that have been taken to limit the loss often incurred by these diseases.

Review of pathology challenges in South Africa

South Africa's mean annual rainfall is highly variable from year to year therefore farmers need to look a rainfall and temperature data for the management of diseases on avocado.

a) Determining the timing of the first spray

Westfalia Fruit Estate (Pty) Ltd is one of the biggest avocado producers in South Africa. The farms are situated in the hilly subtropical area of the Limpopo Province where the average (summer) rainfall is between 800mm and 1300 mm. The warm and humid climate of the area creates conditions conducive to a wide variety of disease problems on avocados, including fungal fruit pathogens.

The data that will be discussed was collected for trials which were conducted at Westfalia Fruit Estate, Tzaneen. A model was used to determine critical infection periods, thus facilitating accurate timing of fungicidal sprays. The timing of the first fungicide application is based on the model developed by Darvas and Kotze (1987) and an update released in 2007 by the South African Avocado Growers' Association (Blakey, 2014).

The model is basically used to predict the number of *Pseudocercospora purpurea* conidia. It uses an arbitrary Z value which tells the grower when to apply his/her first spray.

$$Z = -58.99 - 3.22X + 0.18Y:$$

Where: Z = conidia number, X = mean weekly air temperature using daily (min+max)/2,

Y = total weekly rainfall (mm).

According to this formula, spore release occurs when $Z > 0$. Cercospora infection takes place when Z value is ≥ 15 and fruit are larger than pigeon egg size. The first copper spray should be applied when fruit are bigger than pigeon egg size and the Z value > 5 . The potential for Cercospora spot infection is high when $Z > 20$.

In the various trials the Z value was used in conjunction with localised weather data. The weather data was collected from a weather station which is located at Westfalia Fruit Estate, Tzaneen, Limpopo province (Blakey, 2014). The importance of real time data is shown by the variation in rainfall between seasons on the same farm (Figure 1).

Generally in South Africa the fruit mature earlier in the northern parts of the country and later as one travels south. It is thus not surprising that the timing of the first spray is different between the provinces. For example, the best timing for the first pre-harvest spray for Cercospora spot control in Burgershall (Mpumalanga) was determined to be between the third week of October and the second week of November (Lonsdale & Scott, 1991). The first critical infection period was identified as the third week of November at Westfalia Fruit Estate (Limpopo), so the first round of fungicide sprays must be before then to protect against early infection (Blakey, 2014). In the KwaZulu –Natal Province the critical infection period for Cercospora spot appears to be February to March, which is later than elsewhere in the country because of the lower temperatures. It was however recommended that copper sprays start in November when the temperatures and humidity/rainfall increases (Boshoff *et al.*, 1996).

b) Spray formulations

Alternative products to copper oxychloride such as Bion (salicylic acid compound) and Avogreen® (*Bacillus subtilis*) were evaluated at Westfalia Estate from 1999 to 2002 (Willis & Duvenhage, 2003). Bion® was considered expensive and while it controlled Cercospora spot it did not offer any protection for post harvest diseases such as anthracnose or stem-end rot, testing was therefore discontinued. Avogreen® was found to provide some control of Cercospora spot (Willis & Duvenhage, 2003). When Ortiva® (azoxystrobin) and Bravo® (chlorothalonil) were tested against copper oxychloride, Ortiva® reduced postharvest anthracnose more than the other treatments, but not significantly (Willis & Duvenhage, 2003). A second season of good results from Ortiva® with Demildex® (copper oxychloride) meant Syngenta registered the product for use on avocados. Strobilurin fungicides have to be managed to reduce disease resistance development (Willis, 2007). Manicom & Schoeman (2009) reviewed the control of Cercospora spot in South Africa and concluded that copper oxychloride is still the best available fungicide for Cercospora spot control. Westfalia Fruit Estate is presently also evaluating liquid copper formulations (unpublished data) which have the potential to reduce the amount of copper applied per hectare per year. They are also easily soluble in water and leave less visible spray residues on fruit.

c) Spray technology

Willis & Mabunda, (2004) found that mistblower applications (5 000L/ha four times per season) rather than hand gun applications (14 000L/ha 3 times per season) of copper oxychloride (Demildex®, 3g/L) were effective in controlling Cercospora spot on 'Fuerte' at Westfalia Estate. Mistblower application was also four times cheaper than hand gun applications.

Ultra-volume thermal fogging of agrochemicals has been used successfully in tropical crops such as cocoa, rubber and bananas for disease control (Mabbett, 2007). This application requires that the agrochemical is in a liquid formulation which is then subjected to very high temperatures in the fogging machine. This turns the concentrated mixture into a vapour, which is released into the atmosphere. On interaction with the cold air, the vapour condenses to form clouds of tiny droplets that collectively form a fog that settles on the target plant surface (Mabbett, 2007).

The pulsFOG filial in Brazil developed the TracFog 100, an agricultural cold fogger with a PTO (power take off) drive. This is a non-thermal,

compressed air aided ultra-low volume (ULV) fogging machine used with great effect in poplar and Eucalyptus plantations for the control of insects and fungal diseases. This new technology was tested at Westfalia Fruit Estate on a small scale between 2008 and 2011 with varying degrees of success (Van Niekerk & Mavuso, 2011). It was used in trials to apply copper oxychloride to 'Fuerte' and 'Hass' trees. The machine was compared to commercial mist blowers with regards to copper residues deposited on the leaves and the level of disease control achieved.

Currently Westfalia Technological Services is evaluating the efficacy of three different application technologies including the TracFog 400/6, a tractor-mounted ultralow volume cold fogging machine, a Pneumatic-Electrostatic Mist-blower, and a commercial mistblower. Different copper formulations are being compared, as well as other products for the control of pre-and post-harvest diseases on avocado. Ultra-low volume application technology has the potential to reduce the amount of fungicide applied per hectare for disease control, while still giving good disease control. Additionally due to the very low volume applied per hectare (75L/ha), a greater area can be sprayed per tank than when using the conventional mistblowers which apply much higher volumes (1800L/ha).

SUMMARY

South African researchers continue to add value to the avocado industry as they are always searching for smarter spray technology and better copper formulations or alternative fungicides. It is now well understood that climatic conditions play a role in potential disease incidence and disease management is a dynamic process requiring active management. Timeous applications of fungicides are crucial for producing fruit of good quality in South Africa. Growers are also encouraged to ensure that orchard practices are tailored to ensure that their trees undergo as little stress as possible and thus that fertilizers, irrigation and pruning are done timeously. Canopy density affects spray penetration and coverage, and not all spray rigs can effectively reach the inside area nor the tops of tall trees. With a holistic approach to disease management it is hoped that the South African grower can overcome the challenges posed by growing avocados in the lovely warm sub-tropics.

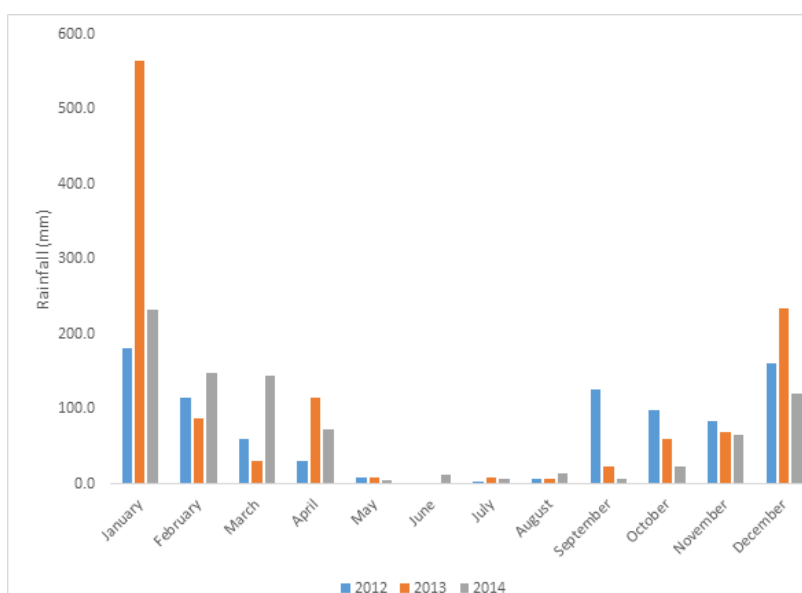


Figure 1. Monthly rainfall at Westfalia Fruit Estate between year 2012 and 2014

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