



CITRUS BLACK SPOT

Apply your fungicides correctly for control of CBS

Citrus black spot (CBS) is a disease that bears economic significance in SA's citrus landscape. This is due to the phytosanitary regulations imposed by the European Union (EU).

The control of the disease, which is caused by the fungus *Phyllosticta citricarpa*, is largely dependent on the use of fungicides. Several contact and systemic fungicides are registered for the control of CBS in SA and are applied during the fruit susceptibility period from October to March.

Contact fungicides are generally regarded as preventative, as they cannot penetrate plant tissue and therefore, need to be applied to plant surfaces before pathogen infection. It is important that contact fungicides are applied uniformly on plant surfaces, to ensure effective protection against pathogen infection and establishment. Examples of contact fungicides used in the control of CBS include dithiocarbamates like mancozeb (25-day protection if applied on its own, or 21-24 days if applied in tank mixtures with strobilurins); dipotassium phosphate (28-day protection) and copper based products (35-day protection). Systemic fungicides are selective in their mode of action and have the ability to penetrate and move within plant tissues. Strobilurins (azoxystrobin, trifloxystrobin and pyraclostrobin) and benzimidazoles (benomyl and carbendazim) are examples of systemic fungicides used in the control of CBS and both fungicide groups provide six weeks of protection. Certain systemic fungicides are registered to have curative action, viz. benomyl or carbendazim [curative ability (time) is not specified on the label, but research indicates four weeks' curative action at the higher registered rates when applied with oil] and pyraclostrobin (three days' curative action when applied with oil). They are able to cure pathogen infections that occurred a few days or weeks before the sprays were applied.

Both strobilurins and benzimidazoles are recommended for use with horticultural mineral oil in tank mixtures and should, therefore, be used as such. Oils enhance the penetration of fungicides into the plant tissues, ultimately increasing the efficacy of the fungicides (Kellerman and Kotzé 1977). For further information regarding the use of different fungicide products for CBS control, refer to CRI Cutting Edge No. 254 (October 2018).

Getting it right

The correct use of fungicides is of utmost importance in the effective control of CBS. Because contact fungicides have broad-spectrum activity with multiple modes of action, the risk of pathogens developing resistance to these fungicides is minimal. The risk is, however, high in systemic fungicides with single modes of action. Therefore, care must be taken when using systemic fungicides. The first case of benomyl resistance was reported in 1982 in Mpumalanga (Herbert and Grech 1985), and resistance to this fungicide occurs at varying frequencies in the other citrus growing areas where these fungicides are used to control CBS. The use of benomyl should, therefore, be limited to one spray per season and used in a mixture with chemically unrelated fungicides as per registration.

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Fungicide resistance

Resistance development to benzimidazoles should be monitored regularly, and can be done through the Diagnostic Centre at the CRI Citrus Research Centre in Nelspruit.

At present, no resistance in *P. citricarpa* to strobilurins (also referred to as quinone outside inhibitor fungicides - QoIs) has been detected. Research showed that the chance of resistance development is low due to the presence of a certain intron in *P. citricarpa*'s cytochrome b gene; this intron reduces the risk of the G143A mutation, which causes QoI resistance (Stammler et al. 2013). Nonetheless, to avoid the development of strobilurin resistance in other fungal pathogens in citrus orchards (such as *Alternaria alternata* that causes Alternaria brown spot of mandarins, or *Penicillium digitatum* that causes green mould), exposure to these fungicides must not exceed two applications per season. Strobilurins should also be applied in mixtures with chemically unrelated fungicides as per registration to limit fungicide resistance development.

The ineffectiveness of fungicides to control CBS can be attributed to various reasons besides fungicide resistance. Other reasons include poor fungicide coverage of target plant tissues, wrong timing of spray application and wrong dosage rates. It is crucial that fungicide labels are read and adhered to, if CBS is to be controlled effectively. This is also a legal requirement according to Regulation 1716 of Act 36/1947.

Timing is everything

Control of CBS relies mostly on well-timed fungicide applications. To prevent infection of fruit, protection is recommended from fruit set until the end of the fruit susceptibility period, specifically during conditions suitable for infection, i.e. long periods of fruit wetness at mild to warm temperatures (>12 h at the optimal 27°C); longer wetness periods are required at sub- or super-optimal temperatures. The use of CRI-Phytrisk (www.cri-phytrisk.co.za), a free online warning system that provides information about CBS infection risks, weather forecasts and suitability of conditions for spraying fungicides, is recommended to assist growers in ensuring that fruit is protected during periods when conditions are suitable for infection. CRI-Phytrisk can be used to indicate the risk of infection during the six-day forecast period, as well as the historical risk of infection. Based on the latter, CRI-Phytrisk is a useful decision support tool

References

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when considering the use of a fungicide with curative action. Growers can also export the historical weather data with the daily CBS infection risk predictions (indicated either as red, yellow or green) from CRI-Phytrisk, to compare with their fungicide spray records. This enables assessment of whether orchards were protected during all predicted infection periods (indicated as red or yellow), or not.

The correct equipment and technique

Despite adhering to spray application times and label recommendations, growers can fail to control CBS due to improper spray techniques and the resultant poor spray coverage of susceptible plant parts.

Correctly calibrated, well-maintained spray machines must be used in the correct manner to ensure adequate fungicide deposition. Research has shown that tower sprayers are better suited for large citrus trees than low-profile machines, and higher spray volumes (± 8000 L/ha) and slow tractor speeds (<3 km/h) resulted in better canopy penetration and uniformity of spray deposition. Lower spray volumes showed potential in various research projects and were significantly more efficient in terms of water use and work rates. However, canopy penetration and deposition uniformity were compromised in dense canopies, and lower spray volumes should not be considered in high disease pressure situations.

Inoculum management

Inoculum management is often neglected among the recommended CBS control measures. Research has shown that removal of leaf litter or mulching with wheat straw, in spring prior to fruit set, resulted in a significant reduction of CBS symptoms on fruit (Truter 2010). Ascospores are only produced on leaf litter and by removing leaves, the primary inoculum source of CBS is essentially eliminated. By reducing the CBS inoculum and therewith the disease pressure, CBS can more effectively be controlled and the intensity of the CBS chemical control programmes can be reduced.