ARC • LNR
Excellence in Research and Development

No. 11

Published:
14 October 2021

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ARC-Vegetable, Industrial and Medicinal Plants Newsletter

Newsletter of the Vegetable, Industrial and Medicinal Plants, campus in the Crop Sciences Programme of the Agricultural Research Council (ARC)

The whitefly pest in greenhouses

Compile by Dr Diedrich Visser, Crop Protection Division

Approximately 300 pests are known to attack vegetables in South Africa. Most of these pests may damage crops wherever they are grown, but a few are especially damaging under protected environments. A few common greenhouse pests include aphids, thrips, leafminers, whiteflies and red spider mites. Of these, whiteflies, when the adults are present, are the most easily recognizable because of their habit to fly up in strikingly white swarms when disturbed.

Figure 1. Whitefly adults on the underside of a potato leaf.

Whiteflies are not flies, but tiny white insects belonging to the same insect order as aphids, i.e. Hemiptera. They occur worldwide, and are common pests of crops that are planted in protected environments. They have piercing-sucking mouthparts and, like aphids, suck the sap from plants. Whiteflies attack a variety of agricultural crops, including potato, tomato, sweet potato, legumes, cucurbits, crucifers, lettuce, tobacco, cotton, cassava and various other crops and weeds. Approximately 16 whitefly species occur in South Africa, of which two, the tobacco whitefly, *Bemisia tabaci*, and the greenhouse whitefly, *Trialeurodes vaporariorum,* are commonly found on vegetables in greenhouses.

Figure 2. Whitefly adults with sedentary nymphs (white arrow).

Whiteflies hide on the underside of leaves, and are usually only noticed when leaves are turned upside down. They have a milky-white appearance, and are approximately 1 –2 mm in length (Fig. 1). Whitefly nymphs (larvae) are very different in appearance from the adults. They are wingless and translucent (Fig. 2 arrow) and become immobile after the first moult. Only the first instars (also called crawlers) are capable of moving around while searching for a feeding site on the undersides of leaves. Because of their translucency, they take on the colour of the leaf and are not often noticed. The nymphs resemble flat scale insects, and on some crops, e.g. cucurbit leaves, they are nearly invisible to the naked eye.

Whiteflies may damage crops in three different ways. Firstly, by direct feeding (sucking plant sap), secondly, by acting as vectors of virus diseases, and thirdly, by producing copious amounts of honeydew. The sucking action of whiteflies does not always damage plants. However, when plants are very small or when plants are under stress, direct feeding may cause wilting and eventually yellowing of leaves and die-off. Up to 50% yield losses have been reported on some crops, directly linked to whitefly feeding. However, serious yield losses may occur when certain viruses, e.g. the tomato curly stunt virus (ToCSV) or geminiviruses, are present in the ecosystem. Whiteflies may transmit these viruses when moving between healthy and infected plants. Viruses cause malformed and chlorotic leaves, stunted growth and poor yield. Heavy yield losses are usually encountered when young plants are

infected.

Similarly to a few other sucking pests, e.g. aphids and mealybugs, whiteflies are notorious for their honeydew secretions. Honeydew is the sweet, sticky, excretions of plant-feeding hemipterans, usually secreted in such a way that it always lands on the upper leaf surfaces lower down from their feeding sites. Sooty mould (Fig. 3) may grow on the honeydew on the leaves, eventually killing individual leaves. Sometimes entire plants may be killed, e.g. the potato plant in Fig. 3. Sooty moulds are saprophytic black or brown fungi that grows superficially on leaf and fruit surfaces (Fig. 4), on which honeydew has accumulated. Sooty mould colonies may consist of mixed populations of eight or more different fungal species belonging to different families of the order Dothideales. It does not cause disease, but may downgrade the value of produce because the sticky brown/ black powdery growth does not easily rub off. The black layer of fungal growth also prevents photosynthesis and therefore interfere with physiological processes of the affected plant.

Whiteflies can be controlled with various insecticides. However, certain strains (or biotypes) of the tobacco whitefly exist that are more harmful and difficult to control. It is important to be aware of the nymph stage of this pest. Control measures should be implemented before the nymphs change into adult flies which move between plants and transmit viruses. Good insecticide coverage, especially on the undersides of leaves, is therefore necessary. Always read the insecticide label and use strictly according to label instructions.

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Figure 3. Sooty mould growing on potato leaves.

Figure 4. Sooty mould growing on tomato fruit.

Planting water-wise: just a trend or a necessity?

Compiled by Dr Mariette Truter, Crop Protection Division

South Africa is a water scare country prone to droughts and unstable water supply in some regions. Currently, as from 26 August 2021, stage 3 water restrictions are implemented in regions 1, 3 and 4 of the City of Tshwane (https://www.tshwane.gov.za/pages/media-releases.aspx). Residents are reminded not to water or irrigate gardens with a hosepipe or sprinkler system between 06:00 and 18:00; not to wash vehicles with hosepipes or high-pressure systems; and not to fill swimming pools. Saving water should be a key consideration for every garden lover, however, this shouldn't mean doing without a garden or that your garden needs to be drab. There is a large variety of water-wise plants available at various nurseries to choose from and spring is an excellent time to visit your local nursery for suitable water-wise plants. Planting water-wise plants is not just a trend, but a necessity to make your garden less dependent on supplemental water.

Choosing the right water-wise plants can make all the difference. Garden lovers have moved away from selecting plants just based on aesthetic appeal, but to rather consider whether these plants are adapted to their specific climate conditions and rainfall patterns. Not all indigenous plants are water-wise and planting water-wise plants does not only mean using succulents or aloes. There are many species that may not be considered as 'succulent', but are nonetheless beneficial in their own way to help you conserve water in your garden. Consult your local nursery for advice on suitable water-wise plants for your garden.

The ARC-VIMP, Roodeplaat campus has also applied climate-smart agriculture technologies for their ornamental gardens. These include roof-top and in-field rain-water harvesting, using mulches where practical, and replacing water thirsty plants with groundcover plants, and planting a variety of water-wise plants (Fig. 1). Some of the water-wise plants utilised at Roodeplaat includes the baby sun rose, campfire crassula, wild garlic, corpse flower, spekboom, tongue-leaf plant and stalked bulbine.

Figure 1. A variety of mostly succulent water-wise plants at one of the gardens at Roodeplaat, ARC-VIMP.

The baby sun rose or red aptenia (*Aptenia cordifolia*) (Fig. 2), is a succulent groundcover plant that can help to conserve water by reducing evaporation of water from the soil. It requires full sun or semi-shade, is drought-resistant, and tolerates high rainfall and irregular watering regimes. The shiny, bright pink-purple to red flowers attract butterflies, bees and other insects. It can spread rapidly, helping to cover an area in a short space of time. Trim or prune the plant to maintain its shape. It can be used to stabilise soil in areas which may be susceptible to run-off or erosion.

Figure 2. Baby sun rose planted in a semi-shade area.

The campfire crassula (*Crassula capitella*) (Fig. 3) is a branching succulent with fleshy propeller-like leaves that mature from bright lime green to bright red. The leaves turn bright red if not over-watered and the plant receives direct sun for most of the day, during drought or during periods of cold temperatures. It does best in partial sunlight and when grown in shade, the leaves are bright apple green for most of the year. Although fairly drought tolerant, it requires occasional watering. Spikes of insignificant white, star-shaped flowers are borne in summer and attract bees, butterflies and other tiny insects. It requires well-drained soil and pruning after flowering.

Figure 3. Campfire crassula with bright light green to red leaves.

Wild garlic (*Tulbaghia violacea*) (Fig. 4) is a very hardy species and is very popular with gardeners and landscape architects around the country. It has a long-flowering period, and when mass planted, creates a stunning display with its pinkish-mauve flowers. It can survive extended dry spells, as well as heavy rain, and is generally a fuss-free plant provided it is planted in a sunny to semi-shade area. Clumps can be split after a few years and used elsewhere in the garden.

Figure 4. Wild garlic plants with pinkish-mauve tubular flowers.

The corpse flower or carrion flower (*Stapelia* spp.) (Fig. 5) is a low-growing, spineless, stem succulent plant. Most *Stapelia* flowers are visibly hairy and generate the odour of rotten flesh when they bloom. Such odours serve to attract various specialist pollinators, including blow flies. The hairy, oddly textured and coloured appearance of many *Stapelia* flowers has been claimed to resemble that of rotting meat, and this, coupled with their odour, has earned the most commonly grown members of the genus *Stapelia*, the common name of the corpse flower. They grow well under full sunlight and with light to moderate watering. They should be planted in well-drained soil as the stems are prone to rotting if kept moist for too long.

Figure 5. The corpse flower is named after the odour of rotten flesh produced when they bloom.

The spekboom or elephant bush (*Portulacaria afra*) (Fig. 6A) is a soft-wooded, succulent shrub or small tree, usually up to 4.5 m tall, with horizontally spreading growth. Similar in appearance to the jade plant or money plant (*Crassula ovata*) (Fig 6B), it has red stems and small, round, succulent leaves up to 1.2 cm long and up to 1 cm wide. The flowers are pink, star-shaped and appear in small clusters. The spekboom is more sensitive to frost than the jade plant, although regrowth of the spekboom is faster after die-back or pruning.

The tongue-leaf plant or Gumby plant (*Glottiphyllum longum*) (Fig. 7) is a succulent with long, distinctively strap-shaped leaves with rounded margins and bright yellow flowers. The basics of care are very simple, with free-draining soil, plenty of sun and ventilation, and regular light watering during the

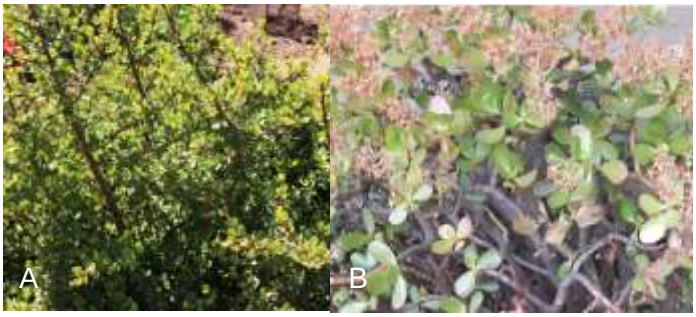

Figure 6. The spekboom (A) and jade plant (B) are often confused with each other.

summer. They are a favourite with some birds, e.g. the grey go -away-bird, which eat the fleshy leaves in times when other food sources are scarce.

The stalked bulbine or burn jelly plant (*Bulbine frutescens*) (Fig. 8) is a popular water-wise plant, especially when planted *en masse* as a ground cover. These clump-forming groundcovers have tubular succulent green leaves, giving them a grass-like appearance. The fresh leaves produces a jelly-like juice that is wonderful for burns, rashes, blisters, insect bites, cracked lips, acne, cold sores, mouth ulcers and areas of cracked skin. They spread quickly, producing star-shaped yellow or orange flowers borne on tall spikes. The dead flower heads should be removed to encourage further flowering. These plants prefer full sun, but they will also grow in semi-shade for part of the day.

Figure 7. The tongue-leaf plant with bright yellow flowers.

Figure 8. Stalked bulbine plants with yellow and orange flowers.

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Beetroot production in the Vhembe District through climate-smart adoption technologies

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Beetroot (*Beta vulgaris* subsp. *vulgaris* Conditiva group), also called garden beet or table beet, is one of the major root vegetables belonging to the family Amaranthaceae. It produces edible green leaves and a swollen root, which are used as vegetables and in salads. It is rich in protein, carbohydrates, calcium, phosphorous, and vitamin C, hence, it is an ideal vegetable in a healthy diet [1]. The red root colour is due to the presence of the betanin pigment [2]. Smallholder farmers in the Vhembe District, Limpopo Province, adopted climate-smart irrigation technologies to reduce vulnerability to extreme weather conditions and to contribute to sustainable production and income generation.

Given that a large percentage of the country's croplands are located in areas that do not receive rainfall during the winter season, winter crops such as beetroot are affected by intermittent or insufficient water supply. Therefore, approaches that conserve soil moisture, improve soil structure and temperature, improve soil micro-organisms, and thus increase plant growth and yield are crucial [4, 5]. Organic mulch material, including grass, straw, dry litter, bark, sawdust and compost, are biodegradable and contributes organic matter and nutrients to soils [4].

A recent survey indicated that grass seedless mulch application in beetroot production resulted in differences in growth, shape and colour of the roots compared to the non-mulch application (Fig. 1). The application of seedless grass mulch resulted in a more intense red colour and smooth texture of the roots (Fig. 2B), compared to roots harvested from the no-mulch treatment (Fig. 2A). As with the roots, the beetroot leaves showed greater biomass for the treatment subjected to the no-mulch application (Fig. 1A). This is understandable considering that the effects of mulching include an increase in the uptake of soil mineral elements, microbial richness, and an alteration in soil pH [5]. Although the growth of beetroots that did not receive the mulch treatment showed higher harvestable yield for the roots and the leaves, the roots from the plants grown with mulching were tastier and more succulent, according to a smallholder farmer and the researchers from the ARC-VIMP, Roodeplaat in Gauteng. The ARC-VIMP collaborated with the Water Research Commission (WRC) to fill the production gaps, such as integrated management for water to ensure profitable farming systems that have been identified regarding the low adoption of climate-smart irrigation technologies in the Vhembe District. The enormous potential of the vegetable root crops and the role of organic mulches in sustaining or improving yield is essential, and further investigations are underway on the morphological, yield-related characters and consumer perceptions for beetroot.

Figure 1. The leaves (A) and roots (B) of beetroot in response to mulch (left) and no-mulch (right) application.

Acknowledgements:
The Water Research Commission (Project no: C2021/2022-00247) and the Agricultural Research Council are gratefully acknowledged for funding and institutional support.

Figure 2. Beetroot without mulch (A), with mulch application (B) and comparison of the two roots (C) cultivated in farmers' fields in the Vhembe District.

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Cut-back response of Moringa at three agro-ecological zones

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Moringa (*Moringa oleifera)* has been described as fast-growing and can reach a height of 3 m when left to grow naturally [1]. The tree re-sprouts vigorously, particularly after a cut-back, thus exacerbating a dense shape, shaded canopies and excessive tree size, particularly in hot climates. Cut-back is often recommended to enhance lateral branching and give the tree a bush shape to facilitate the harvest [2, 3]. Other advantages of cutting back have been associated with increased water use efficiency, improved quality, increased growth, and increased leaf nutrients [4]. Although Moringa can thrive in diverse ecological regions, including in areas with high temperatures and in areas experiencing drought where most crops cannot survive, the prevailing agro-ecological conditions can influence the tree's response to cut-back [5, 3]. Thus, resulting in a variation in environmental conditions between sites, seasons and years [6]. On-farm trials and training of smallholder farmers on climate-smart agriculture technologies were conducted in Limpopo's Vhembe and Capricorn Districts. An observation trial on re-sprouting of Moringa after cut-back was conducted in three agro-ecological zones, including arid (Vhembe District, Limpopo Province), semi-arid (Capricorn, Limpopo Province)

and sub-humid semi-arid (ARC-VIMP, Roodeplaat, Gauteng Province) regions.

The trees planted in the Vhembe District (Makonde) responded well to the cut-back by producing a considerable amount of new vegetative growth in the spring (Fig. 1A), compared to those in the Capricorn District (Tooseng) (Fig. 1B) and at Roodeplaat (Fig. 1C). The annual average temperature of the Capricorn site is 24.6°C, with the annual minimum average of 18.9°C and annual maximum average of 28.2°C. The wettest month is January, with 420 mm of rain, while the driest month is July, with 2 mm of rain [7]. The Vhembe District is located in a semi-arid region that frequently experiences dry spells in some areas, quickly turning into a severe drought. The district is classified by rainfall patterns that range from 246 mm to 681 mm per year [7]. The Capricorn District has a favourable climate, allowing for thriving agricultural crop production. Because it is located south of the tropic of Capricorn, the climate is predominantly subtropical. It has mild winters that are mostly frost-free and very hot, and often dry summers. The district receives an average annual rainfall of 455 mm, which falls between November and March. The regions' climatic conditions favoured Moringa re-sprouting, and the stems did not die back after the cut-back (Fig. 1A).

The average maximum and minimum temperature at the ARC-VIMP, Roodeplaat, is 34°C in summer (November-April) and 4°C in winter (May-August). The average annual rainfall is 560 mm. The site, in general, is characterised by high summer temperatures and frost in winter. The cold winter weather conditions are unfavourable for Moringa growth. During the winter season, the stems die back and sprout from the root collar area during more favourable weather conditions (Fig. 1C).

The cut-back of Moringa in varying agro-ecological zones needs to be understood to ensure that smallholder farmers in those regions can enter the market and ensure long-term viability. On-station research trials are currently being conducted at Roodeplaat to obtain more insight on the Moringa crop's responses to varying field management practices.

Acknowledgements: The Department of Science and Innovation (DSI), Water Research Commission (WRC - Project number C2020/2021-00484) and the Agricultural Research Council are gratefully acknowledged for funding and institutional support.

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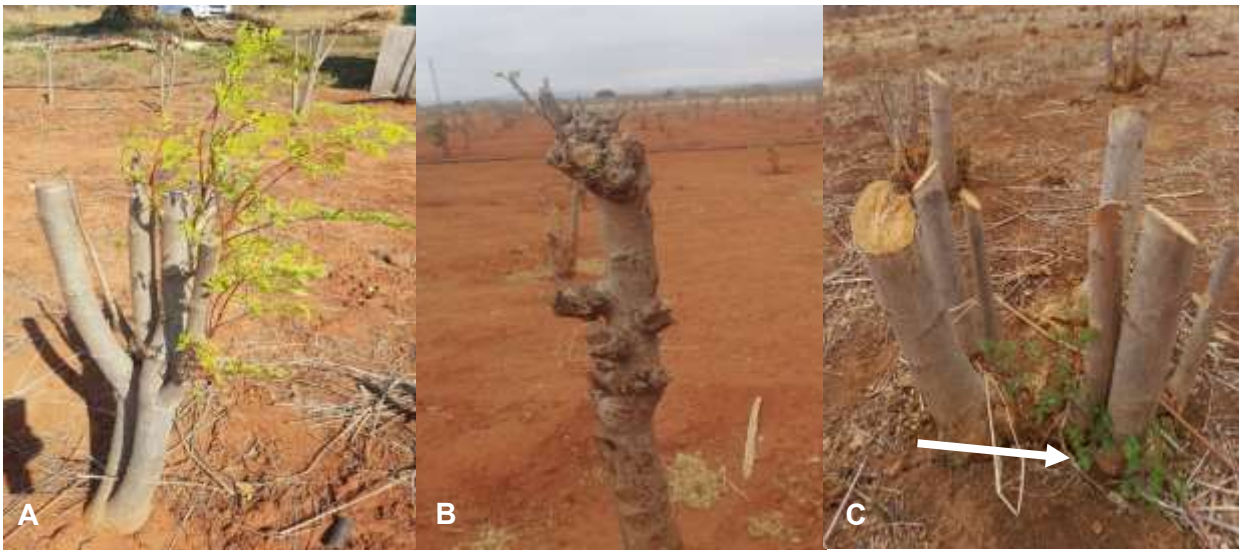

Figure 1. Cut-back of Moringa at Makonde (A), Tooseng (B) and Roodeplaat (C). Arrow indicate sprouts from the root collar area.

Technology Transfer - April to June 2021

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Technology Transfer - July to September 2021

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