Du Roi

Du Roi Group of Companies

ROOTED

FOR THE CITRUS
AND SUBTROPICAL FRUIT GROWER

POST-HARVEST RIND DISORDERS IN CITRUS

GONE WITH THE WIND: THE SILENT THREAT TO AVOCADO YIELD

HOW BANANA PLANTS RESPOND TO THEIR ENVIRONMENT

GUAVA WILTING DISEASE: CURRENT STATUS IN SOUTH AFRICA

ISSUE 08
DECEMBER 2025

SCAN, GIVE FEEDBACK, AND **STAND A CHANCE TO WIN 1 OF 3** CLEMENGOLD GIN AND DU ROI HAMPERS!

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"Working with the earth is not a task — it is a gift."

Robin Wall Kimmerer

Du Roi Group of Companies

Du Roi Nursery

Letsitele, Limpopo Province, South Africa

With its 35 years of excellence, Du Roi Nursery specialises in the production of recommended citrus cultivars and rootstocks from certified material. It is the biggest establishment of its kind in Southern Africa. With over 9 hectares of grow-out structure (under shade and under cover), Du Roi Nursery can annually produce more than 1,5 million citrus trees.

Du Roi Nursery follows strict phytosanitary standards by being registered with the South African Department of Agriculture, Forestry and Fisheries in terms of the Plant Improvement Act, as well as being a member of the South African Citrus Nurserymen's Association. Du Roi Nursery is also fully accredited by the Citrus South African Improvement Scheme as a five-star nursery.

Du Roi's team of technical specialists strives to provide the best technical support to all its clients to ensure the success of their citrus development, locally or internationally.

The company does not only aim to get the benefits of selling good products, but also to enhance the communities in and around the vicinity of the facility.

Du Roi Laboratory

Letsitele, Limpopo Province, South Africa

Du Roi Laboratory, established in 1994, specialises in the production and distribution of disease-free, virus-indexed tissue culture plants, with a focus on the banana and sugarcane industries. The Laboratory annually produces over eight million plants for supply to local and international customers in more than 35 countries. Elite selections of banana plants are made available at three stages of development: rooted in-vitro, weaned in-vivo, and nursery-hardened field-ready plants. As an ISO 9001 accredited facility for banana tissue culture production, Du Roi Laboratory provides customers with quality plants with complete traceability from foundation block to the grower.

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Du Roi Multiplant

Letsitele, Limpopo Province, South Africa

Established in 1998, Du Roi Multiplant specialises in the production of subtropical crops, such as macadamia and mango, as well as the micro-propagation of guava, pomegranate, litchi and granadilla plants. The company also possess the technology and genetics to produce dragon fruit, kiwi and casuarinas. The company is equipped with specialised rooting facilities which allow for multiple types of plants to be cultivated simultaneously. The plants can be produced in different formats that are suitable for local and international growers.

Du Roi Multiplant is fully accredited by the Seedling Growers Association of South Africa (SGASA) as well as the Department of Agriculture, Land Reform and Rural Development (DALRRD), which guarantees that only high standard trees are distributed locally and internationally.

Furthermore, the nursery partners with the Agricultural Research Council (ARC) in plant breeding and cultivar selection programs and holds propagation licenses with Citrogold and Westfalia to guarantee the supply of elite cultivars.

Cederberg Tree Nursery

Citrusdal, Western Cape Province, South Africa

Established in 2014, Cederberg Tree Nursery (CTN) specialises in the propagation and distribution of field-ready commercial citrus trees. The facility is located in Citrusdal, which has been declared a greening-free and citrus black spot-free area. CTN is fully accredited by the South African Citrus Improvement (SACIP) Scheme, which means all trees are certified and disease-free. The CTN team delivers unparalleled plant quality and goes the extra mile for all their clients.

Du Roi Halls Nursery

Nelspruit, Mpumalanga Province, South Africa

We believe in enabling excellence for all farmers by giving access to top-quality clonal avocado trees that are produced within an environment of developing our people and supported by our collective passion, experience, and pioneering, innovative approach.

In 2017 Halls (a sub-tropical fresh produce business with global footprint) and Du Roi Nursery (SA's largest and most progressive citrus nursery) combined their expertise to address the shortfall of quality avocado trees resulting from the current and projected growth trajectory of the industry.

Du Roi Halls Nursery is registered with the Department of Agriculture, Forestry and Fisheries (DAFF), Avocado Nurserymen's Association (ANA) with a current 5-star accreditation, and a member of the South African Avocado Growers' Association (SAAGA).

From the Director

Zylon McGaffin

As we reach the end of another eventful year in South African agriculture, I find myself reflecting on both the challenges we have navigated and the opportunities that lie ahead. This year has tested our agricultural sector in many ways — from uncertainty around global trade tariffs, to a particularly tough avocado season, very favourable lemon prices and a sudden decline in Valencia prices from week 32-34.

Yet, despite these headwinds, the resilience of our farmers and industry partners continues to stand out. Much like our unbelievable national sporting teams — who time and again demonstrate grit, adaptability, and the ability to rise under pressure — our agricultural community has shown the same determination.

In the face of setbacks, both farmers and athletes adjust, strategise, and push forward with unwavering commitment. It is this shared spirit as South Africans that defines us and keeps our industries moving.

Importantly, in response to the challenges created by US trade tariffs, our Agricultural Ministry has taken proactive steps to open new international markets. These efforts are beginning to create really exciting fresh opportunities for growers and exporters, helping to diversify our market access and strengthen long-term sustainability in key industries.

The cooler spring has supported favourable fruit set conditions across most crops, and early indications of a developing La Niña brings promise of improved rainfall and a more stable production environment. These signs give us reason to be optimistic, with the coming year holding potential for recovery, renewed momentum, and meaningful growth.

To our clients, suppliers, partners and teams — thank you. Your commitment, collaboration, and trust have carried us through a demanding but rewarding year. It is your support that allows our industry to keep advancing, adapting, and delivering excellence even in uncertain times.

As we enter the festive season, we wish you and your families safety, rest, and time well spent. Let us look to the new year with hope, excitement, and a shared belief in the opportunities that 2026 will bring.

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What's News?

Innovation in the field

TORPEDO BANANA PLANTS GIVE GROWERS A HEAD START

In a sector where timing, efficiency, and quality are everything, *Du Roi Laboratory's* torpedo banana plants are redefining how growers approach crop establishment. These innovative plants are engineered for speed, simplicity, and scalability – offering a smarter alternative to traditional nursery-dependent methods.

NO NURSERY? NO PROBLEM.

Torpedo banana plants arrive field-ready, grown in compact 250 ml containers instead of the conventional 1.5 L bags. At 20 cm tall, they're robust enough to go straight into the ground, eliminating the need for on-farm nursery infrastructure. This means growers can skip the delicate early-stage grow-out phase and move directly into production.

WHY IT MATTERS

Accelerated timelines: Du Roi handles the nursery phase, allowing growers to focus on planting and harvesting sooner.

Export-friendly packaging: With 250 plants per carton, torpedoes offer a practical solution for international growers who need larger plants but lack nursery space.

Cost-effective logistics: Locally, torpedo plants reduce transport costs compared to standard 20 cm plants, offering savings without compromising quality.

Smart investment: While international freight costs per plant are higher than Du Roi's smallest (5 cm) option, the infrastructure and time savings make torpedoes a compelling choice for growers aiming to scale efficiently.

THE RESULT?

Faster establishment, reduced risk, and more time to focus on what matters most – growing bananas. Torpedo banana plants are more than just a product; they're a strategic innovation designed to meet the evolving needs of modern agriculture.

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Let the children play!

The village of Nkambako near Letsitele recently came alive with excitement as over 400 children experienced their very first Play Day, a vibrant celebration of fun and learning. Organised by the ClemenGold Foundation and warmly supported by volunteers from Du Roi, the day offered a memorable blend of playful discovery and community connection.

The event is an extension of the Foundation's Teacher Toolbox Programme, which supports rural Early Childhood Development centres with practical resources and hands-on training.

Celebrating our roots, together

Du Roi's annual Culture Wellness Day honours the cultural diversity of our teams. The outcome: unity, an increased sense of belonging and a feeling of being valued.

Weeks of planning and practice resulted in stirring choir performances, poetry, drama pieces, as well as Shangaan and Sepedi traditional dances.

Colourful and energetic to say the least!

Your opinion matters!

We'd appreciate your feedback on whether this e-publication hits the spot in terms of the contribution it makes to your business. Answer 6 quick questions by scanning the QR code on the cover page or click on this link:

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STAND A CHANCE TO WIN!

WIN 1 of 3 ClemenGold Gin and Du Roi hampers.

Win!

Gone with the wind...

WIND DAMAGE AS A LOSS FACTOR IN AVOCADO PRODUCTION: CAUSES, COSTS, AND PRACTICAL SOLUTIONS

INTRODUCTION

Wind is one of the most underestimated environmental challenges in South African avocado production.

Although growers often focus on pests, disease, nutrient and irrigation management, wind can silently reduce orchard performance, causing direct physical damage, increasing fruit losses, and negatively affecting overall pack-out percentages. Across key avocado-growing regions such as Limpopo, Mpumalanga, KwaZulu-Natal, and parts of the Eastern and Western Cape, seasonal winds (particularly during flowering, fruit set, and young fruit stages) pose a threat to orchard productivity.

Strong gusts can cause limb breakage, defoliation, fruit abrasion, and fruit drop. Persistent dry winds increase evapotranspiration, causing stomatal closure and stress related to the loss of turgor pressure which leads to uneven fruit development. The economic impact to the farmer is significant: fruit bruising and scarring reduce the percentage of export-grade fruit.
As the industry continues to expand into new production areas, of which some are wind prone, understanding and mitigating wind-related losses has become increasingly important.

This article explores the nature of wind damage in South African avocado orchards, examines its physiological and economic effects, and highlights practical solutions and innovations. Ranging from orchard layout and windbreak management to technological tools, we aim to assist growers in reducing loss factors to improve pack-out percentages.

HOW WIND DAMAGES AVOCADOES – MECHANISMS AND VULNERABILITY WINDOWS

Abrasion and scarring (fruit to fruit and limb to fruit) take place when windblown branches, leaves, and fruit rub against neighbouring fruit. Scars can be longitudinal or patchy and can reduce the cosmetic grade of the fruit.

Schutte, G.C., et al. reports in the 2011 SAAGA Yearbook, that immature fruit – within ±12 weeks after fruit set – are often the most vulnerable to wind scarring.

Figure 1: *Vigorous movement during strong winds causes bumps, carapace spots, and cracking on avocadoes.*

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Increased fruit drop and stem or leaf damage occur when strong winds promote abscission. This, in turn, reduces yield, number of flowers, and fruit set potential for the following seasons. The indirect effects of wind-damaged fruit include increased susceptibility to pathogens and post-harvest disorders, decreasing the pack-out and shelf life.

OVERLAP BETWEEN SOUTH AFRICA'S WINDY ZONES AND AVOCADO PRODUCTION AREAS

Many of South Africa's top avocado-growing regions lie within or adjacent to wind-exposed zones ***(Figure 2),*** making wind management an integral part of orchard planning and farming practices.

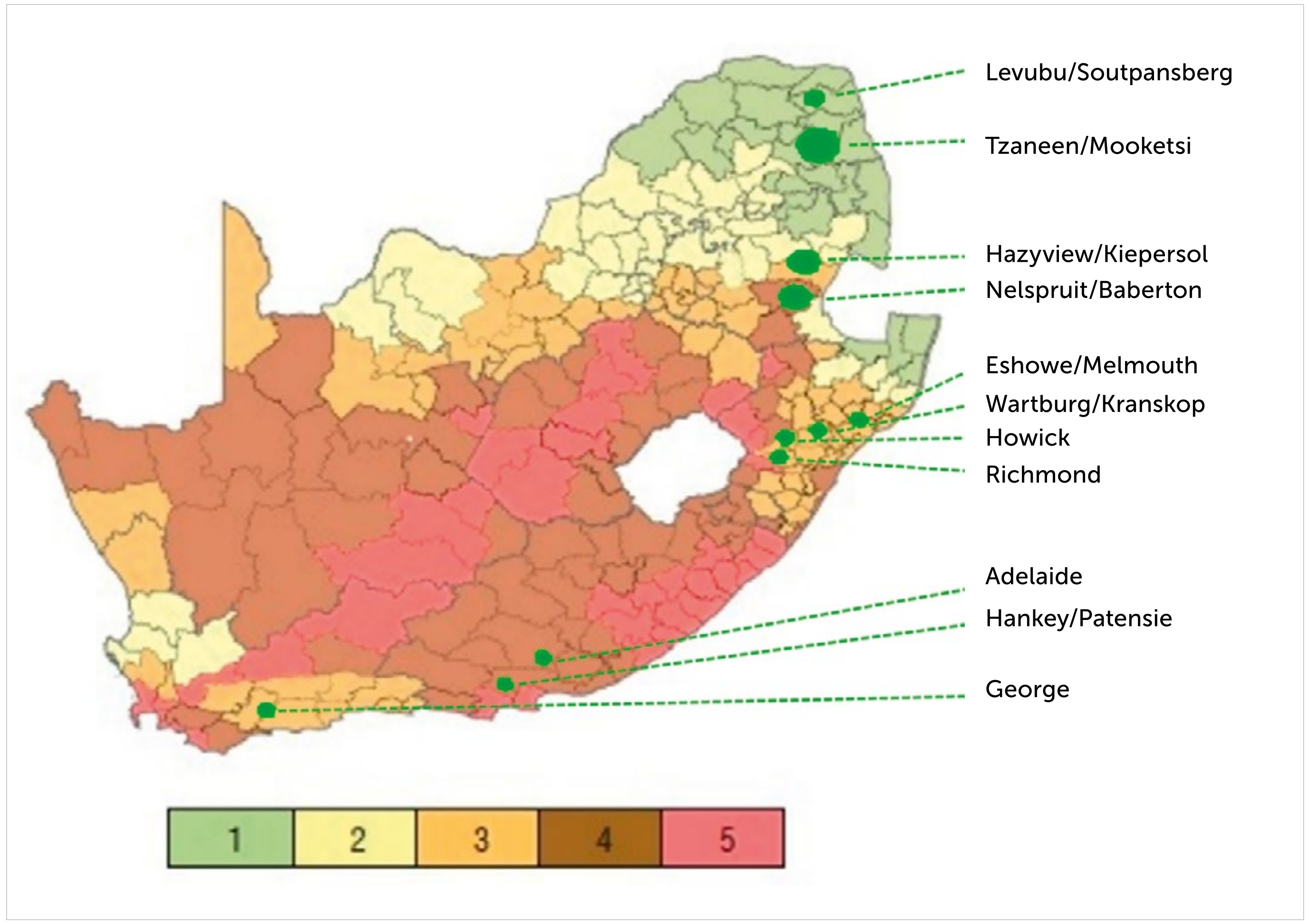


Figure 2: *The main avocado-producing areas indicated on a relative wind hazard map of South Africa for all seasons combined. Wind hazard is measured on a scale of 1 (low wind hazard risk) to 5 (high risk).*
Source: SciELO & SAAGA

LIMPOPO

(Tzaneen, Levubu, Mooketsi)

These regions, while generally subtropical, experience **seasonal hot, dry winds,** especially the Berg winds that blow from the interior during late winter and early spring. These winds can coincide with flowering and early fruit set, increasing fruit drop and dehydration stress.

LOWVELD OF MPUMALANGA

(Kiepersol, Nelspruit, Barberton)

The topography here funnels **strong valley and escarpment winds,** particularly during storm fronts and the changing of seasons.

KWAZULU-NATAL MIDLANDS AND NORTH COAST

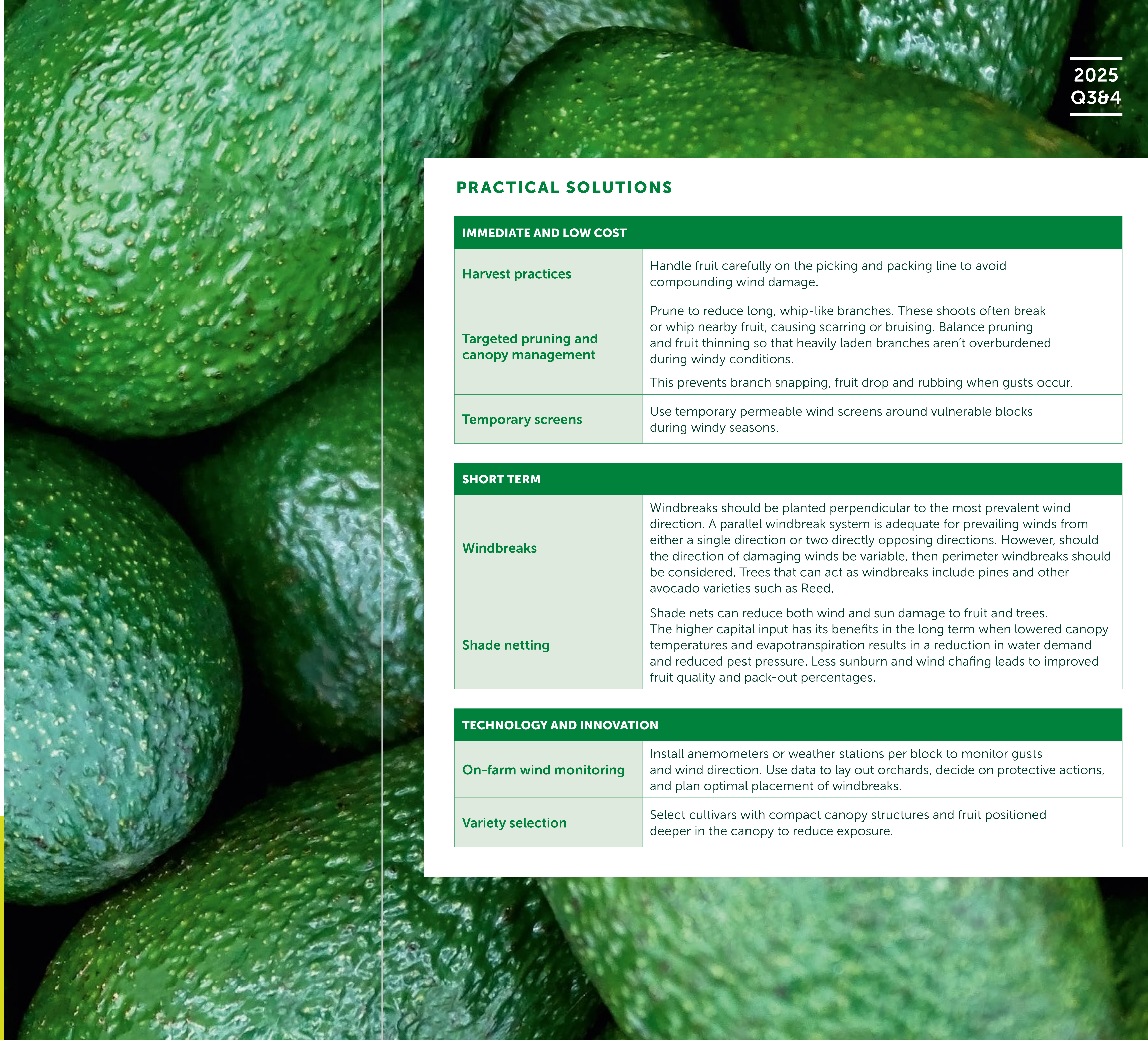
(Howick to KZN North Coast)

These areas are subject to **gusty coastal and summer storm winds,** which can damage young trees and bruise fruit if not properly sheltered.

WESTERN AND EASTERN CAPE

(Newer production regions like Riversdale and Kirkwood)

Although cooler and drier, these regions often face **persistent coastal winds,** especially south-easterlies, which can cause mechanical damage to trees and increase evapotranspiration.



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PRACTICAL SOLUTIONS

IMMEDIATE AND LOW COST	
Harvest practices	Handle fruit carefully on the picking and packing line to avoid compounding wind damage.
Targeted pruning and canopy management	Prune to reduce long, whip-like branches. These shoots often break or whip nearby fruit, causing scarring or bruising. Balance pruning and fruit thinning so that heavily laden branches aren't overburdened during windy conditions. This prevents branch snapping, fruit drop and rubbing when gusts occur.
Temporary screens	Use temporary permeable wind screens around vulnerable blocks during windy seasons.

SHORT TERM	
Windbreaks	Windbreaks should be planted perpendicular to the most prevalent wind direction. A parallel windbreak system is adequate for prevailing winds from either a single direction or two directly opposing directions. However, should the direction of damaging winds be variable, then perimeter windbreaks should be considered. Trees that can act as windbreaks include pines and other avocado varieties such as Reed.
Shade netting	Shade nets can reduce both wind and sun damage to fruit and trees. The higher capital input has its benefits in the long term when lowered canopy temperatures and evapotranspiration results in a reduction in water demand and reduced pest pressure. Less sunburn and wind chafing leads to improved fruit quality and pack-out percentages.

TECHNOLOGY AND INNOVATION	
On-farm wind monitoring	Install anemometers or weather stations per block to monitor gusts and wind direction. Use data to lay out orchards, decide on protective actions, and plan optimal placement of windbreaks.
Variety selection	Select cultivars with compact canopy structures and fruit positioned deeper in the canopy to reduce exposure.

MEASURED IMPACT OF SOLUTIONS

WINDBREAKS/SHELTERBELTS:

In a study funded by SAAGA at Everdon Estate (KwaZulu-Natal), a 4-year-old Hass orchard was perimeter protected by a *Casuarina cunninghamiana* (Beefwood) windbreak. This reduced the wind cull in the orchard by 26%.

SHADE NETTING:

In a 3-year study conducted by Westfalia Technological Services in multiple locations, shade netting increased the production of Class 1 fruit by more than 10%. The outcomes of the above-mentioned study confirm what *Whiley, et. al.* writes in *The Avocado: Botany, Production and Uses:* shade netting in avocado orchards reported improved pack-outs with reduced wind and sun damage. A lower canopy temperature under nets coupled with decreased wind speed led to a reduction in evapotranspiration during key phenological stages. These studies provide consistent evidence that shade netting can strongly reduce wind-related external defects, at the same time addressing sunburn and hail damage.

RISKS AND SOLUTION TRADE-OFFS

Although the above-mentioned mitigation strategies have proven to significantly reduce wind damage, there are a few points to take into consideration when implementing them. Windbreaks can compete for water and nutrients, especially when planted too close to young avocado trees. Tree species used as windbreaks need careful selection and spacing consideration to avoid competition with avocadoes. Windbreak layout mistakes could create turbulence and increase turbulent gusts through solid barriers. Porous designs and correct spacing to maximise the sheltered area without producing harmful gusts are preferred. Shade netting could change the microclimate and influence pollination (bee activity), pest dynamics, and canopy temperature and humidity.

"'N BOER MAAK 'N PLAN"/ ASK A FARMER

KARKLOOF, KWAZULU-NATAL

When dairy farmers in the Karkloof area decided to diversify their portfolio and plant avocado trees in old pastures, they had to come up with a solution to protect their young trees against the Berg winds and high nitrogen levels in the soil. Planting Napier fodder *(Pennisetum purpureum)* right next to their avocado ridges remedied both these problems and even had some additional benefits. This fast-growing grass quickly provided a windshield to the newly planted avocado trees and absorbed some nitrogen from the soil, keeping nitrogen toxicity at bay. In addition, the grass could also be trimmed and fed to livestock or used as mulch on ridges.

DALTON, KWAZULU-NATAL

Nestled in the Valley of a Thousand Hills, farmers needed to get creative with solutions to minimise wind damage on the ridges of hills. Avocado tree varieties that have a compact shape and tend to carry fruit on the inside, such as 'Lamb Hass', are proving to do better on the windswept mountain ridges. This has expanded their production area and variety portfolio.

RUITERBOSCH, WESTERN CAPE

The South African avocado production area is increasing rapidly, and certain challenges only become evident after orchard establishment. Innovative farmers in the Western Cape found that cross nets, running through the orchard at a certain angle, prove to be effective at slowing the wind speed between the trees. Although it could hamper production slightly by blocking rows, an easy fix was to roll up the nets to allow tractors and pickers to pass through.

Figure 3: *Nets spanned diagonally in avocado orchards in the Western Cape proved to slow down wind.*

WHAT'S NEXT?

A sunny December holiday at the beach could be the perfect way to end the year, but what effect does high UV have on your avocado trees?

Find out in the next edition of Rooted.

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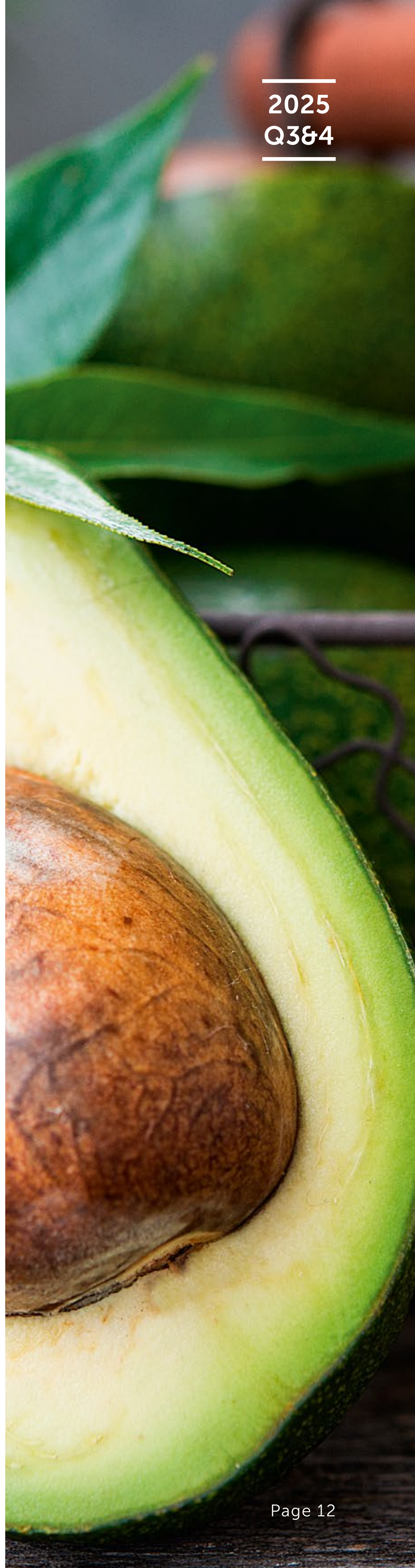

Understanding and preventing post-harvest rind disorders in citrus

THE ROLE OF PHYSIOLOGY, NUTRITION, AND IRRIGATION

Post-harvest rind disorders such as pitting, rind breakdown, chilling injury, anthracnose, oleocellosis, and creasing cause major quality and financial losses in citrus worldwide *(Strano, et al., 2022; Sala, et al., 2005)*. Although most symptoms appear after harvest, the underlying causes are largely physiological and develop in the orchard *(Lafuente & Sala, 2002; Porat, et al., 2004)*. This article outlines the cellular and environmental physiology of these disorders and highlights how nutrient balance and irrigation scheduling influence rind integrity and post-harvest performance.

Citrus pack-outs are often limited not by internal fruit quality but by rind appearance; even mild surface blemishes significantly reduce marketability, especially for export fruit *(Strano, et al., 2022)*. Rind disorders are complex, involving interactions between fruit physiology, orchard management, and post-harvest handling *(Sala, et al., 2005)*.

Although packhouse hygiene and temperature management remain essential, many issues originate from pre-harvest factors such as nutritional imbalance, irregular irrigation, harvest timing, and climate during fruit growth *(Porat, et al., 2004; Joubert, 2016; Khurshid, et al., 2022)*. Understanding these linkages is critical for designing effective prevention programmes.

PHYSIOLOGICAL BASIS OF RIND DISORDERS

Pitting

Pitting appears as small sunken areas on the fruit surface, typically after packing and/or cold storage. It results from membrane disintegration and oxidative stress in flavedo cells triggered by water loss or temperature/relative humidity fluctuations. Dehydration and mechanical stress destabilise membrane lipids and oil glands, causing localised collapse *(Alférez & Burns, 2004; Cronjé, et al, 2017; Strano, et al., 2022)*.

Management tip:
Avoid rapid cooling or storing below the recommended temperature immediately after harvest.

Rind breakdown

Rind breakdown involves general softening and brown collapse of the albedo and is non-pathogenic; this is associated with senescence-related cell wall enzyme activity and the loss of integrity. Fruit with low Ca and B, or with excessive N, are more susceptible, and delayed harvesting may exacerbate the disorder *(Storey & Treeby, 1994; Marschner, 2012; Golding, 2022)*.

Management tip:
Maintain adequate Ca and B levels; avoid excessive N before harvest.

Chilling injury

Chilling injury occurs when storage temperatures drop below cultivar-specific thresholds. Low temperatures alter the composition of membrane lipids, leading to electrolyte leakage and cell death. Symptoms include brown staining, surface pitting, and peel collapse *(Lafuente & Sala, 2002; Valenzuela, et al., 2017)*.

Management tip:
Store fruit above cultivar-specific minimum temperatures (usually 5–8 °C).

Anthracnose

Anthracnose, caused mainly by *Colletotrichum gloeosporioides*, is often observed post-harvest from latent field infections and is favoured by senescent or nutritionally stressed tissues *(Peralta-Ruiz, et al., 2023; Zhang, et al., 2024; Law, et al., 2025)*.

Management tip:
Apply pre-harvest fungicide sprays where field infections are known to occur, and avoid late N applications.

Oleocellosis

Oleocellosis is a physiological oil-spotting disorder caused by the rupture of oil glands in the flavedo; phytotoxic essential oils burn the surrounding tissues. The risk increases when fruit are harvested when turgid and wet or handled roughly *(Knight, et al., 2002; Melgar, et al., 2011; UF/IFAS, 2012; Smith, et al., 2018)*.

Management tip:
Delay harvesting for 24–48 hours after heavy rain or irrigation to reduce turgor pressure; avoid rough handling.

Creasing

Creasing is a physiological disorder characterised by depressions or folds on the rind linked to excessive cell enlargement and the weakening of albedo/flavedo tissues. It develops pre-harvest and can intensify post-harvest with water loss. Creasing has been associated with fluctuations in fruit turgor, high N:Ca ratios, and imbalanced growth regulators such as gibberellins *(Li, et al., 2017; Huai, et al., 2022)*.

Management tip:
Maintain stable irrigation, avoid excessive N, and ensure adequate Ca throughout fruit development to strengthen rind cell walls.

NUTRITIONAL INFLUENCE ON RIND PHYSIOLOGY

Balanced mineral nutrition underpins rind resilience. Mechanical strength and membrane stability depend on adequate cell wall Ca, osmoregulation by K and Mg, and B-mediated pectin cross-linking *(Matoh, 2001; Marschner, 2012; Xie, et al., 2021; Begum, et al., 2023).* A practical grower target is to monitor Ca:K balance in leaves (to avoid excessive K relative to Ca, which suppresses Ca uptake) *(IFAS, 2020; Xie, et al., 2021).*

Calcium (Ca): Strengthens cell walls and stabilises membranes; efficiency increases rind breakdown and pitting *(Storey & Treeby, 1994; Marschner, 2012).*

Potassium (K): Regulates osmotic balance and sugar transport; excess K can suppress Ca uptake, promoting soft rinds *(IFAS, 2020; Xie, et al., 2021).*

Magnesium (Mg): Supports chlorophyll and lipid stability; a deficiency accelerates senescence *(Wang, et al., 2024).*

Nitrogen (N): Drives growth; over-application leads to softer, watery rind tissue and a higher susceptibility to physiological disorders *(IFAS, 2020).*

Boron (B): Essential for cell wall cross-linking via RG-II; a deficiency causes cracking and poor elasticity *(Matoh, 2001; Begum, et al., 2023).*

Silicon (Si): Can increase rind toughness and reduce mechanical injury in some fruits; evidence is emerging and cultivar specific.

IRRIGATION SCHEDULING AND RIND PHYSIOLOGY

Rind integrity depends on stable plant–water ratios. Fluctuating soil moisture alters fruit turgor, predisposing rind cells to mechanical stress and membrane leakage. Over-irrigation can maintain excessive turgor and reduce Ca uptake, whereas under-irrigation induces oxidative stress and rind collapse. Stable moisture with carefully timed regulated deficit irrigation can strengthen rind texture *(UC ANR, 2015; Khurshid, et al., 2022; Yang, et al., 2022).*

INTEGRATING ORCHARD MANAGEMENT AND POST-HARVEST HANDLING

Calcium programme: Apply soil Ca (e.g. gypsum, calcium nitrate) early and regularly; avoid large single applications *(Storey & Treeby, 1994; IFAS, 2020).*

Nitrogen management: Use moderate rates; select nitrate-based sources; avoid late or excessive dressings *(IFAS, 2020).*

Potassium: Maintain within target levels and monitor the Ca:K ratio; avoid overuse of KCl on sandy soils *(IFAS, 2020).*

Boron: Apply foliar B at petal fall and pre-colour break, especially on low-organic soils *(Matoh, 2001; IFAS, 2020).*

Irrigation: Maintain steady soil moisture using sensor feedback rather than a fixed schedule *(UC ANR, 2015; Khurshid, et al., 2022).*

Pre-harvest irrigation: Use a mild deficit before harvest to lower turgor where appropriate; avoid harvesting after heavy rain or irrigation *(UF/IFAS, 2012; UC ANR, 2015).*

CONCLUSION

Rind disorders, including creasing, are manifestations of pre-harvest physiological stress. The most effective prevention strategy integrates balanced mineral nutrition, precise irrigation management, and careful post-harvest handling. Fruit grown with adequate Ca, moderate N, and a consistent water supply develop rinds that are thicker, more elastic, and resistant to damage *(Storey & Treeby, 1994; Strano, et al., 2022).* In practice, the foundation of post-harvest quality is built in the orchard.

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The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings."

Masanobu Fukuoka

The response of banana plants to the environment

PART 1 OF A 3-PART SERIES: UNDERSTANDING HOW YOUR CROP INTERACTS WITH ITS SURROUNDINGS

Bananas are among the most environmentally responsive crops in commercial agriculture.

Every aspect of their growth, from leaf emergence to fruit filling, is finely tuned to the conditions around them. Changes in temperature, light, water, and soil can have immediate and measurable impacts on productivity. Understanding how banana plants respond to the environment is not just academic; it is the foundation of practical crop management, resilience, and profitability.

This first article offers a broad overview of how environmental factors influence banana growth, development, and yield. In later parts of this series, each factor will be explored in greater depth. Temperature, light, water, wind, humidity, and specific strategies to optimise performance in your production environment will be discussed.

Banana plants evolved in tropical humid regions where temperature and moisture levels remain fairly constant throughout the year. As a result, banana plants lack the ability to become dormant and do not have other protective mechanisms that temperate plants use to survive seasonal change. This makes bananas incredibly productive under favourable conditions but equally sensitive to environmental stress.

According to *Turner (1995),* the banana's entire physiology is shaped by environmental conditions. Photosynthesis, leaf emergence, root activity, and fruit filling are all controlled by temperature, water availability, and radiation. When any one of these factors shifts beyond the plant's comfort zone, physiological processes slow down or malfunction.

The effect is visible in the field as delayed flowering, smaller bunches, or poor fruit quality.

Figure 1: *Banana plants affected by frost.*

Temperature is the most critical environmental factor controlling banana growth and yield. Bananas are true tropical plants, performing best under warm stable conditions. Numerous studies, including Turner's work in Bananas and Plantains (1995), show that the optimum average temperature for growth is between 26 and 30 °C. Growth slows markedly below about 18 °C and essentially ceases near 14 °C *(Turner, 1995).* At the upper end of the scale, sustained temperatures above 35 °C reduce photosynthesis and can lead to physiological stress.

Higher temperatures initially accelerate water loss through transpiration. When high temperatures continue, the stomata close and plants lose the ability to cool themselves, which can cause leaf burn or sun-scorching, especially in young plants. The impact of temperature is best observed in the rate of leaf emergence. Under ideal conditions, a new leaf may emerge every six to eight days. When temperatures drop to around 20 °C, that rate may halve, meaning the plant takes much longer to reach the number of leaves needed to trigger flowering.

Turner's data indicate that the time from planting to flowering can range from 200 days in hot lowland tropics to over 400 days in cooler subtropical areas, purely due to temperature differences.

Low temperatures not only slow growth but can also disrupt physiological processes. Cold conditions reduce the efficiency of photosynthesis and delay the transport of carbohydrates to developing fruits. This results in small lightweight bunches and poor finger filling. Conversely, high night temperatures causing increased plant respiration can shorten the fruit-filling period and lead to immature harvests. Where cold stress is unavoidable, mulching and maintaining optimal soil moisture levels can moderate root zone temperature fluctuationsand reduce damage *(Joshi, 2023).*

Light, or more precisely, photosynthetically active radiation, is the energy source that drives banana growth. When moisture and temperature are favourable, the rate of photosynthesis and therefore productivity is closely related to the intensity and duration of light exposure. *Turner (1995)* noted that banana leaves saturate photosynthetically at relatively high light levels, which means that full sunlight generally supports maximum carbohydrate production and vigorous growth. However, bananas are also sensitive to excessive radiation. Under extremely bright, hot, or dry conditions, particularly during the dry season when relative humidity is low, leaves may experience photoinhibition – a reduction in photosynthetic efficiency – caused by damage to the photosystem. In these conditions, stomata close to reduce water loss, which limits carbon dioxide uptake and slows photosynthesis *(Robinson & Galán Saúco, 2010).* Shading, meanwhile, reduces light interception and consequently photosynthetic capacity.

Studies have shown that heavy shading can significantly reduce yield. For example, *Israeli, Lahav, and Reuveni (1995)* reported that when light was reduced to 50% of full sunlight, the banana bunch weight decreased by about 8% and, when further reduced to 20% of full sunlight, yields dropped by more than 50%. This illustrates the fact that bananas are highly responsive to light availability because both deficient and excess light levels can reduce productivity. For farmers, this means that canopy management, plant spacing, and orientation play crucial roles in optimising light interception and air circulation.

Water availability is another powerful driver of banana performance. Because bananas have a large leaf area and a shallow root system, they lose water rapidly via transpiration. The crop's transpiration rate can reach 5–6 millimetres of water per day under hot, sunny conditions, equivalent to more than 150 litres per plant per week *(Turner, 1995).* Water stress, even over a few hours, causes immediate physiological changes. The stomata close to conserve moisture, reducing photosynthesis and slowing growth. Leaf rolling, marginal leaf necrosis, and premature leaf death follow if stress continues. Over time, this results in fewer functional leaves at flowering and smaller bunches.

At the other extreme, **waterlogging** is equally harmful. Oxygen deficiency in saturated soils inhibits root respiration and nutrient uptake, leading to yellow leaves and weak pseudostems. In poorly drained soils, even a few days of standing water can severely damage roots. Recent research confirms Turner's earlier findings that bananas perform best when soil moisture is maintained near field capacity with minimal fluctuation. Efficient irrigation scheduling, guided by physical soil observations (feel test) and supported by soil moisture sensors or tensiometers, can dramatically improve water use efficiency and reduce stress. Mulching with organic material helps to further conserve moisture, moderate soil temperature, and encourage root health.

Farmers should note that not all banana varieties respond to drought in the same way. Plantains are generally more drought tolerant than Cavendish cultivars (Ravi, et al., 2013). This genetic variation offers opportunities to match varieties to local conditions.

Figure 2: *Banana plants standing in water during a flood.*

Although temperature, light, and water are often discussed separately, their effects on bananas are closely interconnected. For instance, a temperature drop reduces leaf expansion and the photosynthetic rate, which in turn lowers the plant's ability to use available water and nutrients. Similarly, a water deficit with high radiation intensifies heat stress, whereas overcast conditions in cool weather can compound low temperature effects.

Turner (1995) emphasised that banana productivity depends not on a single factor but on the combined balance of environmental inputs. Even if temperature is optimal, yield will fall if water supply or light interception is inadequate. For this reason, field management must consider how multiple stressors interact rather than addressing them in isolation.

Recent studies highlight the fact that climate change is reshaping these environmental interactions. Global warming is altering temperature patterns and rainfall distribution across banana-growing regions. Research from *Varma & Bebber (2019)* indicates that extreme heat and droughts are already affecting productivity in parts of Africa, Asia, and Latin America, and new pest and disease pressures are emerging in previously cool highland zones. Adaptation measures such as improved drainage, irrigation infrastructure, organic mulching, and cultivar selection are becoming essential tools for maintaining yield stability.

Farms that track local weather data and monitor plant responses are best positioned to adjust management practices quickly when stress conditions arise. Varieties such as 'Williams' are replacing orchards of 'Grand Nain' in tropical areas as the former are more robust and are better able to withstand climatic pressures.

For farmers and managers, the key takeaway is that the banana's productivity reflects how well environmental conditions are managed and stabilised.

The plant's physiology gives clear signals: leaf production slows under cold conditions, leaves roll under drought, and fruit filling shortens with heat. Learning to read and respond to these signals allows for proactive management rather than reactive correction. Invest in basic measurements such as soil moisture monitoring and leaf temperature tracking, and keep field records of how different blocks respond to seasonal changes. These data, combined with local weather observations, can guide smarter irrigation and nutrition decisions.

As *Turner (1995)* concluded three decades ago,

"The environment does not simply support banana growth; it defines it."

That insight remains just as true today, but with modern tools and improved agronomy, farmers can increasingly shape the environment in the plant's favour.

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Guava wilting disease: Current status in South Africa

The guava *(Psidium guajava)* is a fruit that is native to tropical America. It has been widely cultivated throughout history for its nutritional and medicinal properties. Guavas are rich in antioxidants, potassium, and fibre and have been reported to contain more vitamin C than oranges *(Ordóñez-Santos, Luís E and Vázquez-Riascos, 2025).* Throughout history, their leaves and leaf extracts have been used to treat a variety of ailments, and there has been some research to suggest that taking guava leaf extract could reduce the intensity of menstrual pain.

In addition to these health-boosting properties, the guava is a tasty fruit that is popular fresh and is also very suitable for processing into juice, jams, dried strips, puree, and canned fruit. Indeed, in South Africa, around 70% of guavas produced are sent for juicing, with fresh, canned, and dried making up the difference *(Kriel, 2022).*

The first guavas introduced into South Africa in the late 1700s were from the Portuguese island of Madeira. The industry was only truly established from the early 1900s onwards when a wider range of cultivars were introduced into the Western Cape. Of these, the cultivar 'Fan Retief' stood out due to its vivid salmon-pink flesh, sweet taste, and high yield. In 1938, 'Fan Retief' was taken farther afield to the northern provinces of what are now Mpumalanga and Limpopo *(Schoeman, Botha, & Manicom, 2012).*

Until 1981, 'Fan Retief' was the dominant cultivar grown in South Africa when guava wilt disease (GWD) was first reported in the south-eastern Mpumalanga province. Within 10 years, it had spread throughout the growing regions of the Mpumalanga and Limpopo Lowveld, and drastically reduced the area planted to guavas in the northern provinces of South Africa. GWD continues to have an impact on the industry, and the 2024 guava yield was down 16% on the 2023 yield *(FreshPlaza.com, 2024).*

GWD is caused by the fungal pathogen *Nalanthamala psidii (N. syn. Fusarium psidii)* and is the causal agent found to be responsible for the large-scale destruction of orchards in the major guava-producing regions of the world.

Analyses of the secretion profile of this fungus revealed a range of carbohydrate-active enzymes, as well as protein and fat-digesting enzymes that are associated with breaking down plant cell walls, nutrient acquisition and disease development within the plant. Critically, through analysing the genome of this fungus and observing its interaction with its hosts, it has been revealed that the fungus has the ability to excrete absorbed fungicides *(Severn-Ellis, et al., 2022)* and that it is graft transmissible *(Kriel, 2017).*

This has two broad implications: the use of a resistant rootstock will be ineffective, and chemical control will be much more difficult than with other economically important fungal pathogens. Indeed, there is no chemical product registered for the control of GWD in South Africa at the time of publication.

Guava trees displaying symptoms of wilt are usually observed in a row or in groups near a wilted trunk *(Hong, et al., 2014)*. In South Africa, the rate of symptom development varies. When the disease pressure is high and the development rate is fast, the leaves at the tip of the branches in the upper part of the tree will show wilting symptoms first. From about 2–4 weeks, all leaves wilt and dry on the tree, which will then take on a scorched appearance. Fruit development will stop and the fruit already on the tree will mummify ***(Figure 1)***. Variable wilting can also occur, with fast wilting occurring in sectors, giving rise to trees with both dead and healthy branches. Eventually, however, the whole tree will die. Blisters that contain massed bunches of white to salmon-pink spores may also develop in the bark of dead wood. When the disease pressure is low and the rate of disease development occurs slowly, the leaves will first turn yellow and then red/brown and gradually drop *(Schoeman, Botha, & Manicom, 2012),* eventually resulting in the complete defoliation of the tree ***(Figure 2)***.

The guava wilt fungus is a wound pathogen. The fungus moves in the water-transporting vessels (xylem) of the trunk, infecting the most recently formed tissue and the cambium. When only certain branches are infected, the fungus can nevertheless be recovered from asymptomatic branches *(Schoeman, Benade, & Wingfield, 1997)*. In South Africa, roots and stems at ground level are regarded as the primary infection sites. Recent studies have shown that *N. psidii* can cause infections through wounds on both above- and belowground tissues, and it has also been confirmed that it can survive in the soil and remain pathogenic for an amount of time *(Hong, et al., 2014).*

Figure 1: *Mummified guava fruit on a tree.*

Figure 2: *A defoliated guava tree as a result of guava wilt disease (GWD) infection.*

The spread of GWD in a guava orchard needs to be monitored carefully, and steps can be taken to slow it down and mitigate its damaging effects:

- No fungicides are registered against it, but copper oxychloride can be used to dip and sterilise lug boxes during harvest to prevent its introduction and spread in an orchard.

- During pruning, shears need to be sanitised by dipping them into a 10% chlorine bleach (Jik) solution or by spraying the shears with ethanol when moving from one tree to the next.

- Good orchard sanitation practices must be implemented, such as removing diseased guava trunks and roots. The fungus survives in the roots, so this is especially important. Burning diseased plant parts may provide some measure of control.

- Protecting the wounds of pruned twigs and branches using sealing compounds or fungicide sprays should be considered.

- The lethal upper temperature range for *N. psidii* is 44–46 °C with an exposure period of around 2 hours. Soil solarisation can be considered during the summer months. There are no scientific studies to support this, but some farmers have reported replanting guava trees in previously infested fields after a veld fire has swept through to be successful.

- The planting of tolerant cultivars is a powerful tool in slowing down the effects of GWD in an orchard.

In 1994, the Agricultural Research Council (ARC)'s Institute for Tropical and Subtropical Crops (ITSC) released an improved cultivar, known as 'TSG2' which has shown tolerance to the Malelane strain of GWD, but is susceptible to the other two identified strains, namely Nelspruit and Levubu *(Kriel, 2017).* However, it is more tolerant than 'Fan Retief'. A white-fleshed guava cultivar, 'Lucknow', was imported into South Africa from India in 2014 and initially showed resistance to all strains of GWD *(Schoeman, et al., 2015).*

Figure 3: *Guava trees at Du Roi Multiplant nursery.*

Unfortunately, in recent times, reports of this cultivar becoming infected and showing signs of susceptibility to newer emerging strains of GWD have been observed.

Nevertheless, planting cultivars with some degree of tolerance, such as 'TSG2' and 'Lucknow', can prolong the productive lifespan of a guava orchard and allow for the cultivation of this nutrient-packed and tasty fruit.

Du Roi Multiplant has access to and can propagate the cultivars 'Lucknow', 'TSG2', and 'Fan Retief' to supply growers in all provinces except for the Western Cape (which is GWD free). Du Roi Multiplant works closely with ARC-ITSC, and the material at Du Roi Multiplant is inspected annually and certified disease free and true to type for added peace of mind when planning a new guava orchard ***(Figure 3)***.

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