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OILSEEDS focus

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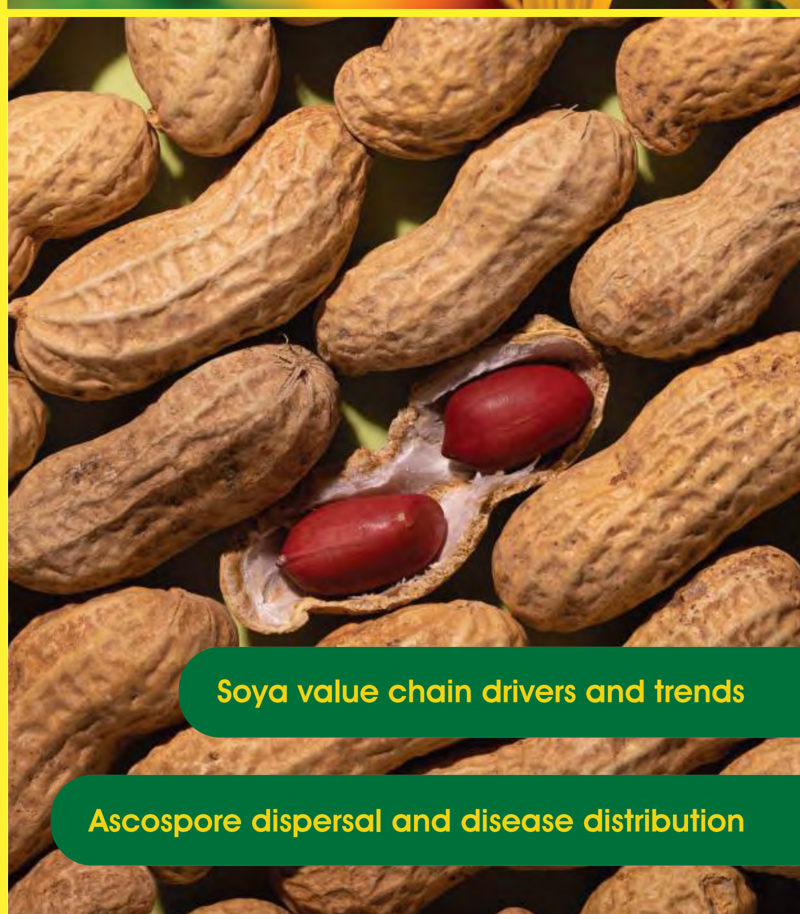

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Oilseed production in South Africa: Consistently trending upwards

By Dr Tobias Doyer, CEO, Grain SA

South Africa's oilseed industry plays a crucial role in the agricultural sector, with a consistent upward trend in production. The combined output of canola, soya beans, and sunflower seeds has grown significantly, from 924 500 tonnes in the 2004/5 season to 2 665 500 tonnes in the 2023/24 season. This growth has been fuelled by the increasing demand for vegetable oils and protein for human consumption, and feed for the livestock industry.

While the sector has demonstrated resilience and notable growth, particularly in soya bean and canola production, it continues to face substantial challenges. Addressing these issues is crucial for ensuring the industry's sustainable development and maintaining its competitiveness on a global scale.

Production challenges

A pressing challenge for oilseed producers is the growing unpredictability of climate-change driven weather patterns. Soya beans, canola, and sunflower crops are particularly sensitive to temperature fluctuations, rainfall patterns, and extreme weather events such as droughts and floods.

In recent years, prolonged drought in regions including the Western Cape, Free State, and North West have significantly impacted South Africa's crop yields. The average soya bean yield for the past season is estimated at 1,55t/ha, approximately 26% below the five-year average. Sunflower yields are also down, with an expected 1,23t/ha this past season – this is a 12% decrease from the five-year average of 1,4t/ha.

The unusually high winter rainfall in the current production season in the Western Cape is also challenging for canola producers, as waterlogged soils hinder root growth and nutrient uptake. Prolonged wet conditions also heighten the risk of fungal diseases, which can damage oilseed crops. These issues reduce yields and can lower seed quality, leading to decreased market prices and financial losses for producers.

Oilseed production requires nutrient-rich soils for optimal yields, and producers must adopt sustainable practices such as crop rotation, cover cropping, reduced tillage and fertiliser use, which can require costly investments.

Another major threat to oilseed crops is pests and diseases. The fall armyworm is a significant issue for soya bean producers, while *Sclerotinia* and rust affect canola, soya bean, and sunflower yields. The heavy use of chemical pesticides is costly and poses environmental and health risks, highlighting the need for sustainable, integrated pest management strategies.

Economic and market volatility

Oilseed producers in South Africa also face numerous economic challenges, including fluctuating market prices, rising input costs, and competition from imported products. Global market trends often dictate the prices for soya, canola, and sunflower seeds, and local producers are sometimes unable to compete with cheaper imports from countries such as Brazil and Argentina. The weak rand further exacerbates this issue by increasing the cost of imported inputs such as fertilisers, seeds and machinery, squeezing already thin profit margins.

Moreover, challenges due to the lack of infrastructure in certain rural areas increase transportation costs and limit market access, making it difficult for commercial and small-scale producers to compete in both domestic and international markets. Small-scale oilseed producers in South Africa also face limited access to finance and modern technology.

Dr Tobias Doyer, CEO of Grain SA.

The road ahead

However, there are definite opportunities for continuous growth in the oil industry in South Africa despite the numerous challenges. The resilience of the country's producers, combined with strategic support and investment, will pave the way for an even more sustainable and profitable future for soya, canola, and sunflower production. Grain SA is actively involved in promoting the interest of oilseed producers in this regard.

A golden opportunity to encourage oilseed production in South Africa lies in the successful implementation of the Agriculture and Agro-processing Master Plan (AAMP). Increasing domestic production through the AAMP can reduce dependence on imports, stabilise the supply chain, and stimulate the local economy. Furthermore, the AAMP's emphasis on improving infrastructure and market access is set to enhance the industry's competitiveness and expand export opportunities.

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Navigating oilseed production

South Africa is expected to produce a soya bean crop nearing three million tonnes in a typical rainfall season. The introduction of improved seed technology and germplasm should assist in achieving higher yields. South Africa boasts the highest rate of yield improvement in soya bean production in the world. In addition, the gap between commercial yields and those from national cultivar trials is closing, indicating that improved farming practices and agronomy are also making a meaningful contribution to improved yields.

The number of first-time producers planting soya beans in recent years, who will gain experience over time, should assist in improving average yields in the country. Crop rotation between maize and soya beans will continue and possibly expand in the west, as soya beans are more profitable than maize in most regions.

Profitability presents challenges

The profitability of soya bean and grain production has become more challenging given the low commodity price cycle we are in. To remain economically viable, the focus must be on improving productivity. Currently, soya beans are trading closer to import parity than export parity. However, this will change once crop conditions normalise, possibly with a crop exceeding 2,7 million tonnes, which will result in lower producer prices.

The export markets that have been opened for soya beans in Malaysia, China, Vietnam, Bangladesh, and Thailand are extremely important to South Africa, as production is likely to increase faster than the sluggish demand.

Optimising logistics

Logistics remain one of the keys to unlocking our supply chain productivity. Improving the transport of soya bean meal to the Western and Eastern Cape, with a focus on using more rail and less road, can help to reduce costs. Overcoming harbour challenges, especially at the Port of Durban where we compete for space with many other grains, is essential.

Positive canola prospects

All indications are that despite late rainfall in many regions of the Western Cape, the number of canola hectares planted remains positive. Excessive rainfall is unfortunately likely to have a negative effect on the anticipated record canola crop. European canola prices are looking favourable compared to other oilseeds.

Enjoy this issue of *Oilseeds Focus*.

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NEWS

Canada invests in Atlantic region

The Canadian government will invest up to CA$3,04 million (R40,36 million) over five years to support research for grain and oilseeds producers in the Atlantic region, according to *World Grain*. Expected to focus on regional issues such as growing conditions, production challenges and agronomy, the funds would be given to the Atlantic Grains Council via the AgriScience Programme – Projects Component, an initiative under the Sustainable Canadian Agricultural Partnership.

As part of the initiative, researchers will be exploring ways to adapt to a changing climate and enhance soil health, while improving the production and quality of grains and oilseeds to remain sustainable and competitive into the future. One of the key project activities would be the yield enhancement network (YEN), to help local producers better understand their yield potential.

The YEN will also provide a real-time snapshot of trends affecting the production, yield, quality, and environmental impacts of grains and oilseeds, the report said. – *Oil & Fats International*

Soya bean surge boosts Sacta's levy income

A rapid rise in South Africa's soya bean harvest has significantly boosted the South African Cultivar and Technology Agency's (Sacta) statutory levy income for the financial year ending 29 February 2024. During Sacta's annual general meeting, CEO Andrew Bennett announced that as levy administrator, the agency has collected gross levies amounting to R245,92 million for the year (R159,92 million for 2023).

The 2024 statutory levy income was divided as follows: soya beans (R169,25 million), wheat (R63,64 million), barley (R12,18 million), and oats (R680 000). Most of this income (75%) is distributed among seed companies for the technological advancement of various crops. The amount allocated depends on the specific company's market share. In addition, 20% is allocated to support transformation and socio-economic projects, while the remaining 5% covers administrative costs and commissions. – *Susan Marais, Plaas Media*

New managing director for InteliGro

InteliGro recently announced the appointment of its new managing director, AJ Griesel, with effect from 1 June 2024. Griesel took over the position after Gideon Hefer stepped into a new role in the WinField United South Africa Group.

Griesel most recently led the South African Table Grape Industry as its chief executive officer and with over 20 years' experience in the agricultural industry, brings a wealth of knowledge and experience to the team. He places emphasis on leading people so that business performance, operational excellence, and profitable growth are achieved and accelerated. – *Inteligro*

AJ Griesel.

Boost to Australian soya bean production

The Grains Research and Development Corporation (GRDC) will invest AU$3 million (approximately R36 million) in a new five-year soya bean breeding programme that will be led by the University of Adelaide and aims to deliver new elite soya bean varieties to Australian growers.

Since 2012, GRDC has invested over AU$5 million (more than R60 million) in soya bean breeding that has developed new varieties and advanced breeding material. Worth AU$6 million (over R72 million) in total, the new breeding programme will accelerate the delivery of new varieties to growers by 'speed breeding' using new technology to improve germplasm evaluation and other key breeding processes.

GRDC genetic technologies, biosecurity, and regulation general manager Juan Juttner said GRDC and the University of Adelaide have joined forces in a quest to deliver higher yielding soya bean varieties suitable for a broader range of growing environments.

"The important new, national soya bean breeding programme will build on previous investments GRDC has made in this area that have delivered significant gains for Australia's soya bean growers," Dr Juttner said. "This programme will focus on delivering improved varieties for the existing soya bean growing regions in Queensland and New South Wales, and work towards expansion for new regions such as Central Queensland and Southern Australia." – *Grain Central*

Argentina oilseed workers strike

An oilseed workers' strike since the beginning of August in Argentina was set to carry on during the second week of the month as wage negotiations with firms remained stalled, affecting shipments from one of the world's major grain exporters.

Two industrial unions kicked off the strike as workers demanded that salaries stay ahead of high inflation. The strike has mainly affected terminals located north of Rosario along the Parana River, where more than 80% of Argentina's agricultural and agro-industrial exports are shipped. At least three dozen ships were still delayed on 11 August near Rosario, one of the most important agro-export hubs in the world.

In June, the federal government had forced the San Lorenzo Department Oilseed Workers and Employees Union (SOEA) to suspend a strike by calling it to mandatory reconciliation talks, forcing the union and firms back to the negotiating table. Argentina is a major grains producer and is a top exporter of soya bean oil and meal. The country's economy heavily relies on the foreign-exchange funds brought in by grains exports, as the government works to shore up scarce central bank reserves. – *Reuters*

EU sunflower seed production faces challenges

In a recent announcement that has sent ripples through the agricultural sector, the European Commission has substantially revised its forecasts for European Union (EU) sunflower seed production in 2024. The updated projections paint a concerning picture for producers and industry stakeholders alike, as drought and extreme heat continue to pose significant challenges across many of Europe's key growing regions.

The commission's latest assessment highlights the severe impact of prolonged dry spells and above-average temperatures on crop development. These adverse weather conditions have forced experts to reassess their initial production estimates, with the new figures indicating a notable downturn in expected yields. The sunflower seed sector, known for its resilience, is now facing one of its most challenging seasons in recent memory.

The repercussions of this forecast revision extend far beyond the fields. Sunflower seeds are a crucial commodity in the European agricultural landscape, serving as a vital source of vegetable oil and an important component in various food products and animal feeds. A significant drop in production could potentially lead to supply chain disruptions and price volatility in related markets concerning both sunflower and its downstream sunflower oil.

The potential shortfall in EU sunflower seed production could have far-reaching consequences for global markets. Producers in the sunflower regions of the centre and north of the agricultural area have faced climate challenges in recent years that affected both the surface area and sunflower production. Entering this year's growing season, the soil moisture reserves are noticeably depleted in comparison to the preceding agricultural cycle. Concurrently, meteorological forecasts indicate a strong likelihood of experiencing a productive period characterised by climate conditions ranging from 'neutral' to La Niña patterns. – *Chemanalyst.news*

FAO reports stable food prices in July

The Food and Agriculture Organization of the United Nations (FAO) has reported that in July, the benchmark for global food commodity prices remained largely stable for the second consecutive month. Increases in international prices for vegetable oils, meat products, and sugar offset the ongoing decline in cereal prices.

The FAO Food Price Index, which tracks monthly changes in the international prices of a set of globally traded food commodities, averaged 120,8 points in July, marginally below its revised 121 figure for June. The index is now 3,1% lower than its corresponding value one year earlier.

The cereal price index declined by 3,8% from June as the global export prices of all major cereals decreased for the second consecutive month. Wheat quotations dipped on increasing seasonal availability from ongoing winter harvests in the northern hemisphere and generally favourable conditions in Canada and the United States, supporting expectations for large spring wheat harvests later in the year.

The vegetable oil price index, by contrast, rose 2,4% from June to reach a one-and-a-half-year high. Global quotations for palm, soya, sunflower, and rapeseed oils all rose, lifted by robust demand for soya oil from the biofuels sector and deteriorating crop prospects for sunflower and rapeseed oils in several major producing countries. – *FAO*

Ukraine grain and oilseed harvest update

As of 2 August this year, more than 28,5 million tonnes of new-harvest crops were gathered across Ukraine. According to a statement by the Ukrainian Agrarian Policy and Food Ministry, a total of 25 291,8 million tonnes of grain crops and more than 3 236,3 million tonnes of oilseeds had already been gathered at the time. Overall, a total of 28 528,1 million tonnes of the new-harvest crops were threshed.

In particular, Ukrainian producers harvested 19,4 million tonnes of wheat, 4,8 million tonnes of barley, and 451,6 thousand tonnes of peas. In addition, a total of 3,2 million tonnes of rapeseed was gathered. In terms of harvested areas, producers from the Odesa region took the lead while in terms of the yielding capacity, the Khmelnytskyi region topped the ranking with 65 quintals (6 500kg) per hectare. – *Ukrinform*

Current research on canola diseases:
Impact of retained seed and fungicide deposition

By Dr Gert van Coller, Lizette Nowers, Piet Lombard, Huibrecht Schreuder, Mariana van Deventer, Zander Fölscher and Dr Diane Mostert

The June issue of *Oilseeds Focus* featured our first article on canola diseases, emphasising the fact that steady growth in canola production has brought with it the need to address some of the challenges producers face. Among these, the most economically damaging are diseases such as blackleg and *Sclerotinia* stem rot, the impact of which local producers are increasingly aware of.

Blackleg is caused by two closely related fungal species, *Leptosphaeria maculans* and *Leptosphaeria biglobosa*, which affect *Brassica* species. Managing blackleg involves integrating host resistance with chemical control. Agronomical practices such as ploughing or burning of stubble, which reduce the inoculum load, are effective in lowering disease levels but cannot be integrated with conservation agriculture. Planting canola at least 500m away from the previous year's stubble, which enables the crop to evade the disease, is also effective but is often impractical to implement.

Using host resistance is the most durable, cost-effective and environmentally friendly approach to managing blackleg, but it should be carefully managed due to the potential of the fungus to overcome this resistance through sexual reproduction. Similarly, chemical control should be carefully managed to avoid the build-up of resistance to fungicides.

Sclerotinia sclerotiorum, the causal agent of *Sclerotinia* stem-end rot (SSR) in canola, can affect more than 400 host plants. Specific environmental conditions and senescent tissue are required for disease development, but once successful infection occurs, the disease can be extremely devastating. The sporadic nature of the causal pathogen and its tough survival structures that remain in soil and plant debris for years, challenge the management of the disease. Chemical control remains the most effective disease management strategy; however, producers often over- or under-apply fungicides, which has cost implications and detrimental effects to the environment.

To manage these diseases, the Western Cape Department of Agriculture (WCDA) and the Department of Plant Pathology at Stellenbosch University are conducting numerous research projects aimed at mitigating the detrimental effects of blackleg and *Sclerotinia* stem rot. This article discusses the effects of planting

The canola retained seed trial at Langgewens research farm during 2023, showing the difference between treatments. (Photograph: Gert van Coller) retained seed on disease development, and the quality and quantity of fungicide deposition on canola canopies.

Planting retained canola seed

Australian canola cultivars are primarily planted in South Africa. This seed is propagated and imported from Australia, South America, and Canada as no local propagation occurs. Canola, a self-pollinating crop, produces commercial seed through careful cross-pollination between two parent plants. This seed is known as F1 seed (first generation). The producer is thus guaranteed that the new seed purchased commercially is genetically pure and uniform.

When F1 seed is planted, the crops will develop and pods containing seeds will eventually develop, following self-pollination. After ripening the crop is harvested. This harvested seed is called F2 seed (second generation). Due to recent seed availability challenges and other factors, producers are more frequently planting F2 seed in subsequent seasons, a practice known as planting retained seed.

However, significant differences occur between F1 and F2 seed of the same cultivar. While F1 seed is genetically pure and uniform, the same cannot be said of F2 seed. Since F1 seed is a hybrid seed (derived from cross-pollination between two parent lines), F2 seed, which developed following self-pollination, can revert to the genetic background of either of its original parental lines used in cross-pollination. This has important implications, not only for agronomical characteristics such as a reduction in vigour, yields and oil content, among others, but also for resistance against blackleg disease.

Resistant genes in F2 seed

Genetic resistance to blackleg is governed by major genes conferring well-understood qualitative resistance (Van de Wouw and Howlett, 2020), and by quantitative resistance, which is poorly understood but involves numerous minor genes, contributing to overall resistance (Delourme *et al*. 2006; Stuthmann *et al.* 2007). The major genes present in canola cultivars against blackleg are indicated by the letters A, B, C, D, F and H, different cultivars containing various combinations of one to four of these genes (*Table 1*). In harvested F2 seed, the combination of major genes is no longer uniform, unlike F1 seed.

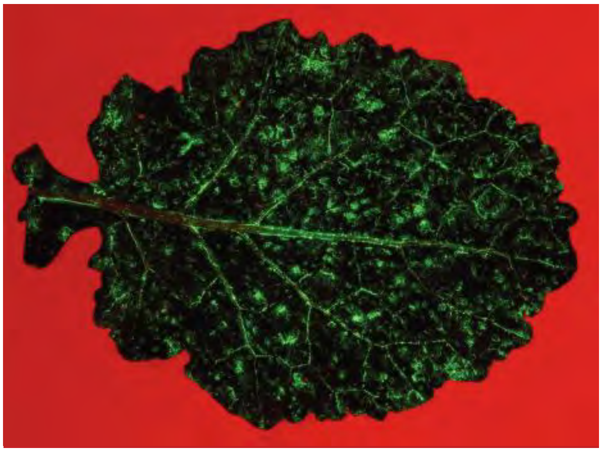
During seed production, gene segregation causes the major resistance genes to segregate into separate seeds, meaning F2 seed will not retain the original set of resistance genes. For example, each F1 seed of the cultivar 44Y94 contains both major genes B and C; in the F2 retained seed, 50% will have only the B gene, while the other 50% will only have the C gene. The occurrence of *R*-genes (resistance genes) in F2 seed of cultivars such as Hyola Solstice, which has four *R*-genes, is much more unpredictable. In this case, some seeds will contain only one *R*-gene, others will contain two or maybe three, but none will contain the full complement of resistance genes present in the F1 seed.

For a cultivar such as 45Y95, where only one *R*-gene occurs in the F1 generation,

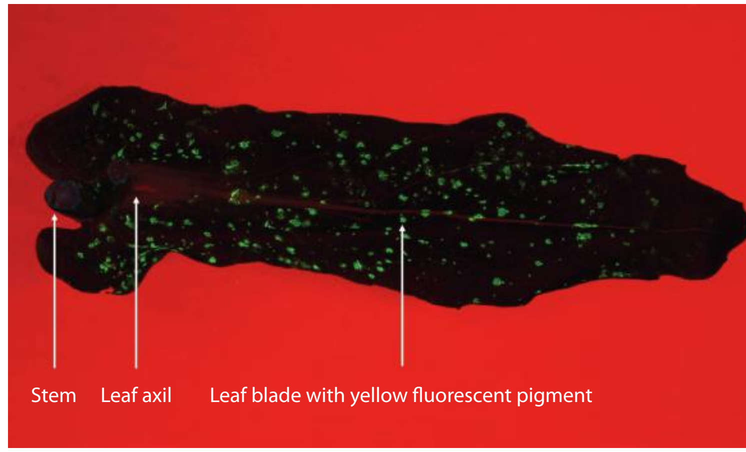
Table 1: Major genes (*R*-group) present in F1 (commercial) and F2 (retained) seed of different canola cultivars.

Name	Type of cultivar	*R*-genes present	
		F1 seed[a]	F2 seed[b]
Defender CT	Clearfield, Triazine tolerant	ADF	A / D / F / AD / AF / DF
PY327C CL	Clearfield	Unknown	
PY421C CL	Clearfield	A	A / nothing
PY520 TC	Clearfield, Triazine tolerant	BC	B / C
45Y95	Clearfield	C	C / nothing
Diamond	Conventional	ABF	A / B / F / AB / AF / BF
Alpha TT	Triazine tolerant	BF	B / F
Blazer TT	Triazine tolerant	ADF	A / D / F / AD / DF / AF
44Y94	Clearfield	BC	B / C
Quartz	Conventional	ABD	A / B / D / AB / AD / BD
Hyola Solstice CL	Clearfield	ADFH	A / D / F / H / AD / AF / AH / DF / DH / FH / ADH / DFH
Hyola Equinox CL	Clearfield	ADF	A / D / F / AD / DF / AF
CC90014	Conventional	ADFH	A / D / F / H / AD / AF / AH / DF / DH / FH / ADH / DFH
Hyola Continuum CL	Clearfield	ADF	A / D / F / AD / DF / AF
HyTTec Trophy	Conventional	ADF	A / D / F / AD / DF / AF
HyTTec Trifecta	Conventional	ABD	A / B / D / AB / AD / BD
PY429TT	Triazine tolerant	Unknown	
Ceres CL	Clearfield	AD	A / D

[a]F1 seed is genetically uniform, meaning each seed will contain all R-genes indicated. [b]F2 seed is no longer uniform, meaning individual seeds will contain the possible combinations indicated, and no longer the full complement of R-genes present in the F1 seed.



Fluorescent particle coverage of canola leaf (three- to five-leaf stage) showing fungicide deposition achieved at this growth stage. (Photograph: Gideon van Zyl)



Fluorescent particle coverage of canola leaf with stem and leaf axil attached (30% flowering stage) showing fungicide deposition achieved at this growth stage. (Photograph: Gideon van Zyl)

50% of the F2 generation may contain the *R*-gene, while the remaining 50% will not contain any resistance gene. Further examples are provided in *Table 1*.

Treatment impact investigated

F2 (retained) seed is, therefore, potentially more susceptible to blackleg compared to commercially produced seed. The result is that a larger variety of races of the pathogen will be able to infect the plants, leading producers to rely more heavily on fungicides for crop protection. This dependency can lead to the development of fungicide resistance. Seed treatments form an integral part of protecting seedlings against blackleg until the three- to five-leaf stage when the first foliar fungicide is applied. Commercially sold F1 seed is already treated with a fungicide seed treatment, but not all producers treat retained seed.

To investigate the impact of retained seed on blackleg, two field trials are being conducted (2023 and 2024) at Langgewens research farm (Swartland) and Uitkyk farm near Riversdale in the Southern Cape (see photograph). Five cultivars are included, which constitute F1 seed of each, as well as the fungicide-treated and untreated F2 seed of each.

Each of these cultivar treatments will receive a fungicide application at the three- to five-leaf stage against blackleg, and the same treatment at the 30% flowering stage against SSR. Alongside these are trial plots that receive no fungicide treatments post-planting. The incidence of both these diseases will be determined pre-harvest. Piet Lombard from the WCDA is also investigating the effect of these treatments on yield and oil content.

Fungicide deposition on canola

Chemical control is essential for managing SSR and very important in the integrated management of blackleg, given the ability of the pathogen to respond to selection pressure and overcome resistance (Sprague *et al*., 2006). Depending on the choice of active ingredients, the costs of a single application can range from approximately R350 to R1 000/ℓ.

Labour, fuel, and maintenance add additional costs for each application. Producers unfortunately often make decisions with cost-effectiveness in mind, and not so much disease control. Ironically, this often results in sub-optimal fungicide deposition and concomitant low levels of disease control.

For the application of foliar fungicides to be effective, it needs to reach its target area, deposition quantity, quality and uniformity must be sufficient to achieve control, and timing of application must be optimal, among several variables. The growth period of cultivars can also significantly affect fungicide efficacy, given the large variation in flowering periods between cultivars. Reaching the target area and achieving adequate

Table 2: Spray volume (ℓ/ha), sprayer speed (km/h), nozzle selection, sprayer pressure, and droplet size (VMD in µm) used per treatment in trial one (four- to six-leaf growth stage) and trial two (30% flowering stage) spray applications.

Trial[a]	Spray volume (ℓ/ha)	Spray speed (km/h)	Nozzle selection[b]	Sprayer pressure (Bar)	Droplet size VMD (µm)[c]
Three- to five-leaf application	100	**9**	TT11002	2,5	Medium
Three- to five-leaf application	150	9	TT11003	3	Medium
Three- to five-leaf application	200	9	TT11004	2,5	Course
30% flowering	100	9	TT11002	2,5	Medium
30% flowering	200	9	TT11003	6	Medium
30% flowering	300	9	TT11005	5	Course

[a]Three- to five-leaf application for control of blackleg disease; 30% flowering for control of Sclerotinia stem rot. [b]Nozzle referral code for turbo TeeJet nozzles (www.teejet.com). [c]Droplet volume median diameter (VMD) (µm) spectrum as classified by ASABE S572,1.

deposition quantity, quality and uniformity is especially difficult in a crop such as canola, given the three-dimensional architecture of the plant at 30% flowering when fungicide application against SSR is commonly done.

To date, no information is available on the fungicide deposition achieved at the three- to five-leaf stage, when fungicides are applied against blackleg, or at 30% flowering when fungicides are applied against SSR. Our research aims to quantify the deposition of fungicides applied to canola at different growth stages, using different spray volumes, tractor forward speeds, and application with a tractor, aeroplane and unmanned aerial vehicles (UAV or drone), to identify practices resulting in optimal fungicide coverage. Additionally, fungicide deposition achieved at the three- to five-leaf stage will be correlated against the blackleg disease severity index, to correlate deposition achieved to level of control.

Spray deposition trials

In 2023, two spray deposition trials were conducted in a uniform canola field at the Tygerhoek research farm near Riviersonderend in the Overberg region. The first trial was conducted when the predominant growth stage of the field reached the four- to six-leaf growth stage (3 July 2023).

The second trial occurred when the predominant growth stage of the field reached the 30% flowering stage (8 September 2023). For each trial, three spray volumes were applied (*Table 2*) at a constant forward speed of 9km/h. All spray treatments were administered using a stable boom sprayer operated at a constant height of 50cm above the target plants.

The spray liquid used included water, the fungicide Prosaro (tebuconazole + prothioconazole) (*www.bayer.com*) at a dose rate of 760mℓ/ha, and yellow fluorescent pigment (40% EC [South Australian Research and Development Institute, Loxton, South Australia]; 3mℓ/ℓ] at a dose rate of 900mℓ/ha for all treatments.

The spray deposition parameters suggest that canola plants in the four- to six-leaf growth stage are spray-friendly. All spray volumes realised acceptable spray deposition parameters when compared to results observed on other grain and vegetable crops treated with a horizontal boom sprayer.

It is important to note that no biological efficacy benchmarks for spray deposition are available on canola for any of the targeted plant diseases such as blackleg (*L. maculans*). However, this study indicates that there is a spray deposition advantage to using spray volumes lower than 200ℓ/ha, down to 100ℓ/ha. The 100ℓ/ha treatment realised the best spray deposition parameters across different parameters. Higher spray deposition quantities often correlate with better disease control, as illustrated by Van Zyl *et al*. (2013) and Rebel *et al*. (2020).

Spray complexity

Deposition quantity values realised in the 30% flowering application were lower compared to the four- to six-leaf stage. This was expected as the fluorescent pigment dose rate per hectare was the same for both trials. However, in this trial the canopies of the plants are now a three-dimensional, larger structure, which makes spraying it more complex. The complexity arises from physical barriers such as branches growing towards light, as well as leaves and flowers acting as filters that intercept incoming droplets.

Despite the lower deposition values observed in this trial, the trend of higher deposition with a lower spray volume was similar to a higher concentration of product per droplet intercepted. It is reasonable to hypothesise that there might be a benefit to going lower than 100ℓ/ha spray volume per hectare but that there will inevitably be a point of diminishing returns. Spray volumes lower than 100ℓ/ha should be included in follow-up studies to establish if lower volumes are viable.

Another trend that was observed in this study was the decrease in spray parameters on the middle and lower canopy positions. This was observed in all three deposition parameters. Spray volume per hectare increase has been ruled out as a solution for this problem with this study.

A possible option that could be considered is using an air-assisted spray machine with fine to very fine spray droplets. Reducing the size of droplets increases the area that could be covered by the volume on an exponential scale. However, smaller droplets lack momentum, making them prone to spray drift.

For this reason, the use of air assistance to deliver droplets into these canopies could increase the chances of leaves and leaf axils intercepting more droplets on the inside of canola canopies. This theory, however, was not supported by previous research done on potato plants, but potato canopies are denser than canola canopies at the 30% flowering stage.

The goal of these spray applications is to protect leaf and stem areas with fungicide, especially where flower petals will fall – serving as a nutrition source for spores of *S. sclerotiorum* and leading to the development of SSR. An accompanying study could explore the risk of lower deposition in lower canopy positions by quantifying petal distribution on top, middle and bottom canopy leaf axils.

Going forward

This study will be repeated this year and in 2025. The research will involve tractor-mounted boom sprayers and UAV applications for the three- to five-leaf application. Various spray volumes and tractor-mounted boom sprayers, UAV applications, as well as aeroplane-based applications will be explored during the 30% flowering stage. The tractor-mounted boom sprayer will apply fungicides at different volumes and forward speeds, while the drone will apply fungicides at different volumes.

We would like to express our sincere thanks to the Oil and Protein Seeds Development Trust for funding our research, as well as the Western Cape Department of Agriculture for funding, facilities, trial sites, and technical assistance.
For more information, email Dr Gert van Coller at Gert.VanColler@westerncape.gov.za, or Lizette Nowers at Lizette.Nowers@westerncape.gov.za or Piet Lombard at Piet.Lombard@westerncape.gov.za.

Mechanisms of ascospore dispersal and disease distribution

By Lisa Rothmann, University of the Free State, Agnese Seminara, University of Genoa, and Mariana van Deventer, Stellenbosch University

Sclerotinia sclerotiorum, an ascomycetous fungal pathogen causing *Sclerotinia* stem rot, has sexual spores known as ascospores. There are two critical functions of ascospores: initiating infection, resulting in pathogen survival through sclerotia formation at the end of the growing season, and reproduction. Sexual reproduction offers *S. sclerotiorum* populations the opportunity to increase their genetic diversity and adaptability.

This article is the second in a series of articles following "The life of ascospores: Their origin from sclerotia, destiny through air, and host infection pathway" (*Oilseeds Focus, December 2023*). This paper is inspired by the recent Biophysics of Spore Dispersal: Ideas for Stopping Plant Disease workshop hosted by The International Centre for Theoretical Physics in Italy, the Forestry and Agricultural Biotechnology Institute, and Innovation Africa from the University of Pretoria.

This article focusses on the underlying mechanism of puffing, specifically, the physics behind forcible spore ejection, and influences on the dispersal and disease gradient.

Spore dispersal mechanisms

There are two chief mechanisms by which spores are dispersed, namely through air and water. In physics, both are considered fluids, although air is a gas and water a liquid. Understanding fluid dynamics (the study of fluids in motion) can assist us in exploring spore movement and infection initiation. Spores can move passively through air, relying on air currents, and travel long distances with minimal effort.

However, to be carried by wind, spores must first reach the wind. In other words, spores need to escape a thin layer of nearly still air surrounding the sporocarp, or apothecium. This boundary layer is roughly a centimetre thick. Although many spores are discharged at accelerations almost unmatched in nature – up to 106g (one million times the acceleration of Earth's gravity) – an individual spore will stop only a few millimetres after discharging due to air resistance and this force, also called drag, is disproportionately high for tiny spores.

Fluid drag dramatically limits the distance spores can travel. Consequently, some fungi have evolved mechanisms to not only eject their spores forcibly, but also develop further adaptations to cross the boundary layer, as with *S. sclerotiorum* (Roper *et al*., 2010).

Figure 1: Apothecia emerging from the soil of (A) canola (photograph: Mariana van Deventer), (B) soya bean, and (C) sunflower canopies (photographs: Lisa Rothmann).

Microscopic peloton

Ascospores of *S. sclerotiorum* are known to work together to ensure they are ejected from the apothecia. In a fraction of a second, hundreds of thousands of spores are ejected, and their collective dynamics generate a wind that propels them tens of centimetres away from the apothecia.

The mechanism is similar to the peloton formation used by cyclists in the Tour de France (where a group of cyclists stay together to reduce air resistance). However, this microscopic peloton is remarkably more effective. Spores travel ten to 20 times further as a group than they do in isolation (Roper *et al*., 2010).

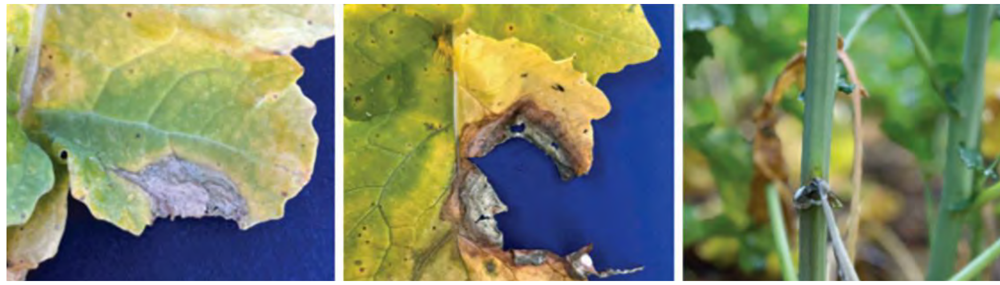
Despite the important role of puffing for effective dispersal, the micro-environmental parameters which cue the ejection and control the frequency of puffing remain largely obscure.

The dispersal gradient describes how the concentration of inoculum, such as ascospores, varies with distance from the source, irrespective of the presence or susceptibility of host plants. Within a crop canopy, physical obstructions and microclimate conditions can significantly influence this gradient (*Figure 1*).

Factors such as soil type, moisture and temperature, row spacing, planting density, and canopy structure are crucial in determining how effectively ascospores escape from the canopy.

We would like our future research to explore these triggering mechanisms more deeply, focussing on how different aspects of crop canopy architecture impact puffing events and the subsequent dispersal.

Figure 2: Infected petals that fall onto leaves and result in infections and inoculum foci for disease development. (Photographs: Lisa Rothmann)



Inoculum affects disease gradient

The disease gradient is heavily influenced by the amount of inoculum present in the field, with disease incidence often clustering around areas where sclerotia and apothecia are spatially aggregated. In row crops such as dry and soya beans, higher levels of *Sclerotinia* stem rot are typically associated with the proximity of apothecia to infected plants. These concentrated areas of disease, known as disease foci, indicate an environment conducive to disease, the presence of available inoculum, and susceptible host tissue.

Research on stem rot infection in canola fields reveals a different dynamic. Studies have highlighted the importance of extrinsic sources of inoculum, such as ascospores from outside the field, in disease initiation, as infections were observed even in the absence of germinated sclerotia (Gugel and Morrall, 1986; Boland and Hall, 1988).

Infected petals play a crucial role in the epidemiology of canola stem rot. Extrinsic inoculum infects flowers located above the canopy. When these flowers senesce and fall onto the plant tissue – stems, leaves, and internodes – they initiate disease within the canopy (*Figure 2*).

Our research group at Stellenbosch University is currently exploring the presence of ascospores in canola fields and pathogen quantification.

For more information, send an email to Dr Lisa Rothman at lisa.ann.rothmann@gmail.com.

Soya beans: Growth and development

By PR Janse van Rensburg, agronomist, Pioneer

The maturity group influences the duration of the developmental stages in soya beans. Late-maturing soya bean varieties tend to develop more leaves and progress more slowly from one developmental stage to the next, while early-maturing varieties may develop fewer leaves and progress more quickly through the developmental stages.

Factors influencing growth stages

- **Temperature:** The rate of plant development for any soya bean variety, whether early or late maturing, is directly linked to temperature. This means the duration between developmental phases will vary along with temperatures in and between growing seasons.
- **Photoperiod (day length):** Soya bean plants are sensitive to photoperiod, or day length, which regulates the timing of flowering. Different soya bean varieties respond differently to photoperiod: some will flower amid shorter days, while others require longer days to begin flowering.

Vegetative stages explained

- **Emergence (VE):** The soya bean seed begins germination by absorbing around 50% of its weight in water.
- **Cotyledon (VC):** The cotyledon supplies the nutrient needs of the young plant during emergence and for approximately seven to ten days afterwards. The cotyledon loses approximately 70% of its weight. If one cotyledon is lost during this time, the impact on the growth rate is minimal. However, the loss of both cotyledons at the VE or VC stages restricts seedling development, potentially reducing yields by eight to nine percent.
- **Three leaves (V3):** Most of the nitrogen (N) required by the soya bean plant is supplied through N-fixation. N-fixation bacteria in the roots convert atmospheric N_2 into forms usable by the plant. Bacteria enter the plant through the root hairs. Nodules form shortly after the VE stage, but active N_2 nodules and the N_2 fixation process do not start until the V2 and V3 stages. The fixed amount of N increases steadily until around the R5,5 stage. Healthy nodules, which are pink or red inside, actively bind N, while brown, white or green nodules do not. The bacteria in these nodules can meet most of the plant's N requirements.
- **V2 to V3:** If the plant is broken below the cotyledon node, it will die because there are no axillary buds below this point.
- **Six leaves (V6):** The plant can still recover from damage at this stage; 50% leaf loss at this stage will only reduce the yield by 3%.

Reproductive stages explained

- **Beginning bloom (R1):** Vertical roots grow rapidly and will continue to do so until the R4 to R5 stages.

Table 1: Vegetative stages of a soya bean plant.

Vegetative stages	Average number of days between stages	Title	Description
VE	Seed to VE: Ten days	Emergence	Cotyledons above the soil surface.
VC	VE to VC: Five days	Cotyledon	Unifoliate leaves unfold so leaf edges are not touching.
V1	VC to V1: Five days	First trifoliate	Fully developed leaves emerged and opened.
V2	V1 to V2: Five days	Second trifoliate	Plants have three nodes with two trifoliate leaves unfolded.
V3	V2 to V3: Five days	Third trifoliate	
V4	V3 to V4: Five days	Fourth trifoliate	
V5	V4 to V5: Five days	Five trifoliate	
V6	V5 to V6: Five days	Sixth trifoliate	
V(n)	V6 to Vn: Three days	nth trifoliate	n = number of nodes with fully developed leaves.

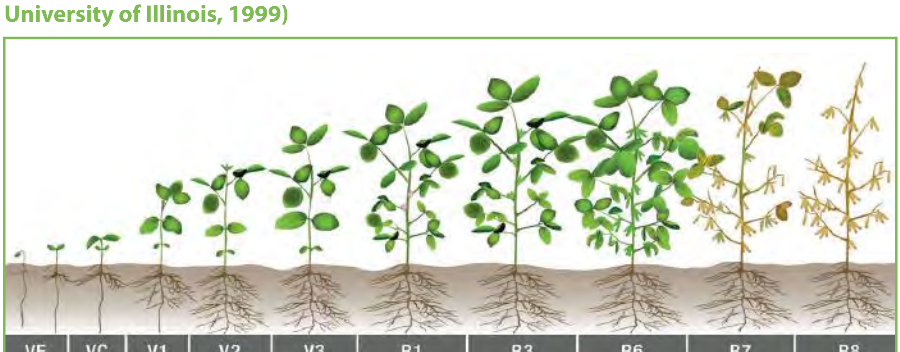
Table 2: Reproductive stages of a soya bean plant.

Reproductive stages	Average number of days between stages	Title	Description
R1	R1 to R2: Three days	Begin flowering	One open flower at any node on the flowering stem.
R2	R2 to R3: Ten days	Full bloom	Open flower at one of the two top nodes on the main stem with a fully developed leaf.
R3	R3 to R4: Nine days	Beginning pod	A pod on one of the four upper nodes, 0,5cm long.
R4	R4 to R5: Nine days	Full pod	A pod 2cm long at one of the four uppermost nodes on the main stem.
R5	R5 to R6: 15 days	Beginning seed	Seed is 3mm long on one of the four uppermost nodes on the main stem.
R6	R6 to R7: 18 days	Full seed	A pod containing a green seed that fills the pod cavity at one of the four uppermost nodes on the main stem.
R7	R7 to R8: Nine days	Beginning maturity	One normal pod on the main stem has reached the mature pod colour (tan or brown).
R8		Full maturity	95% of pods have reached mature pod colour. Five to ten days of dry weather are required to dry the seeds to < 15% moisture.

Secondary roots and root hairs proliferate near the soil surface. Soya bean flowering always starts at the third to sixth node on the main stem.

- **Full bloom (R2):** An open flower appears at one of the two top nodes on the main stem, and at least one of these nodes has a fully developed leaf. The soya bean plant has accumulated approximately 25% of its total dry weight and nutrients and has reached roughly 50% of its mature height. Around 50% of the total mature node number has been established. The R2 stage also marks the beginning of a rapid accumulation of nutrients and dry matter, which will continue through the R6 growth stage. Defoliation of 50% of the plant at this stage will reduce yield by 6%.
- **Beginning pod (R3):** As the plant matures from R1 to R5, its ability to recover after stressful conditions diminishes.
- **Full pod (R4):** The soya bean plant is highly susceptible to stress (moisture, light, temperature, nutrient deficiencies, etc.). Any significant stress occurring from R4 to R6 will reduce yield more than the same stress at any other development period. This is because flowering is complete, and no new flowers can be produced to compensate for aborted young pods and seeds under stressful conditions.
- **Beginning seed (R5):** Root growth slows down as seed development commences. Around the midpoint of this stage, the plant reaches its maximum height, node number, and leaf area. Nitrogen fixation peaks and then begins to drop. Seeds start to accumulate weight rapidly.
- **Midway between R5 and R6:** The accumulation of dry weight and nutrients in the leaves, stems and petioles peaks, and the redistribution to the seed begins. The process of seed dry weight accumulation continues until the middle of R6. Stress can affect both the rate and duration of dry weight accumulation during seed filling. Seed filling during this stage requires significant water and nutrients. Soil moisture limitations can reduce nutrient availability by inhibiting root growth in dry soil. Leaf loss of 100% at this stage can reduce yield by 75%.
- **Full seed (R6):** Total pod weight peaks during this stage. The growth rate of the seeds and the entire plant is rapid but will slow down shortly after R6. Leaf yellowing begins shortly after R6 and continues until R8. Root growth is complete by the midpoint between R6 and R7.
- **Beginning maturity (R7):** The soya bean plant turns visibly yellow as all the green colour from the seeds and pods is lost. Soya bean seeds contain approximately 60% moisture at maturity. Stress at this stage or later has minimal impact on yield.
- **Full maturity (R8):** 95% of the pods have reached their mature colour on the soya bean plant and usually dry within five to ten days.

Figure 1: An illustration of the growth stages of a soya bean plant. (Source: University of Illinois, 1999)



The environment in which a soya bean plant grows greatly influences its development. Seed viability and environmental stress can affect the duration between growth stages. A soya bean plant grown at low density will branch out extensively and develop into a large plant. Increasing plant density will increase plant height while reducing branching and the number of pods per plant.

For more information, contact Pioneer at info.rsa@pioneer.com or visit *www.pioneer.com/za.*

Optimal timing for sunflower planting

Sunflower in South Africa is often planted as an alternative grain crop, especially in seasons when precipitation is low or delayed for maize or soya bean. The crop's capacity to withstand drought conditions and tolerate both high and low temperatures are significant advantages.

The planting date for sunflowers is typically determined by weather conditions, available moisture, and the total hectares and number of crops a producer must plant. Environmental conditions, including temperature during the planting period, have a major influence on sunflower's ability to germinate, grow, and develop. Therefore, the planting date plays an equally important role in managing production risks as it does for any other crop.

Sunflower is ideal for South African producers in the summer rainfall regions due to its capacity to withstand drought, tolerate fluctuating temperatures, and adapt to different planting dates.

Harness sunflower's potential

According to Charles Basson, a sunflower breeder and product placement lead at Syngenta, producers should plant sunflower within the optimal planting window to realise the crop's full potential. "Planting at the right time allows the crop to make full use of natural resources in line with optimal environmental conditions and physiological growth stages. This ensures good seed germination, seedling establishment, optimum root system development, growth, and yield. Planting at the optimal time also supports plant establishment, allowing them to absorb essential nutrients from the soil.

"Late sunflower plantings are more likely to be subjected to adverse conditions during their development, including seed or seedling exposure to high December or January temperatures, and pollination or seed development occurring under rapidly decreasing temperatures.

"Although sunflower can germinate at temperatures as low as 4°C, optimal germination and development will occur at soil temperatures between 12 and 20°C. Soil temperatures above 30°C can be detrimental for seedlings. The best temperature for growth and development is between 18 and 33°C, while optimal seed production occurs at temperatures between 21 and 24°C."

Sunflower planted as a main crop should be sown between October and November, and not later than December, he says. "Planting sunflower later in the season, especially during January, will influence the yield as well as the oil content potential."

Yield-influencing factors include not planting at the optimum planting dates, planting density, field selection (soil pH), fertilisation, hybrid selection, environmental factors such as temperature, rain, pests, and diseases, and planting sunflower as a catch crop.

Syngenta's contribution

The focus of Syngenta's sunflower breeding and product development is to provide products that will benefit the entire industry. "Hybrids containing the latest genetics with a specific focus on high oil percentage and herbicide tolerance are now part of our testing programme. The results that we observe in the field are encouraging," says Basson.

Syngenta's Sensako sunflower breeding programme focusses on the following attributes:

- Oil percentage: Early selection in the programme focusses on achieving a high oil percentage.
- Agronomic type: Sunflowers are evaluated across various environments and planting dates according to plant height, head size, standability, head angle, and days to flowering and maturity.
- Disease tolerance.
- Herbicide resistance.
- Grain yield.
- Seed production.

"In the past, the focus used to be on grain yield only. The new focus is on hybrids with high oil content, which can contribute to better profitability for growers and processors alike," says Basson.

The current oil-content standard for sunflower grain is between 36 and 38%, but with SY 3970 CL and SNK 270 CL, producers have been achieving 42 to 50% oil in the past few years. "There are several new hybrids in the Syngenta pipeline, and producers can look forward to products that will not only yield high oil content, but also perform very well in terms of grain yield."

Plant population

Plant population plays a key role in the realisation of oil percentages in sunflower. In Syngenta's trials, various densities (30 000 to 70 000 plants/ha) were planted to observe the impact on sunflower hybrids. By planting different densities of the same hybrid and comparing them, Syngenta aimed to discern significant differences in growth, yield, oil content, and overall performance. The collected data enables the team to make better recommendations. Quality information helps producers to manage risks more effectively.

Syngenta was able to identify optimal planting densities for each of the hybrids in its pipeline, SY3970CL and SNK270CL, as well as one of our new experimental hybrids being tested in the pre-commercial phase. The team gained valuable insights that will ensure more precise recommendations for producers to contribute to maximising Syngenta sunflowers' overall productivity and ensure increased return on investments.

Visit *www.syngenta.co.za* or *www.sensako.co.za* for any enquiries.

The risks of planting farm-retained canola seed

By Piet Lombard, Dr Johann Strauss and Lisa Smorenburg, Western Cape Department of Agriculture

Canola is a *Brassica* crop of the cabbage and mustard family. It is grown in winter, and the seeds are crushed to produce edible oil. Within the industry there are questions regarding the possible dangers and financial implications of using farm-retained seed.

A hybrid cultivar (F1) is bred from two lines, namely a male sterile line and a restorer line. Each line is very pure and, consequently, offspring that come from them always exhibit the same characteristics. However, retained seed (or F2) no longer possesses the same combination of genes. This article focusses on a local study, but similar findings were reported by Potter *et al.* (2014) in Australia.

Summary of local data:

- Seed yield decreases ranged from 7,2 to 11,5% in 2023 and 7,2 to 24,1% in 2022 (7 to 17% in Australia).
- The average decline in seed yield per trial was 9,2% in 2023 and 12,2% in 2022.
- Oil content decrease was 0,8% for both seasons.
- Blackleg disease infection in 2022 increased from 11% for company seed to 20,2% for farm-retained seed.
- The reduction in gross margin/ha was R2 103 in 2022 and R1 410 in 2023.

Figure 1: Internal blackleg infection of the different cultivars (company seed as the control). F1 is indicated in green and farm-retained seed (F2) in red.

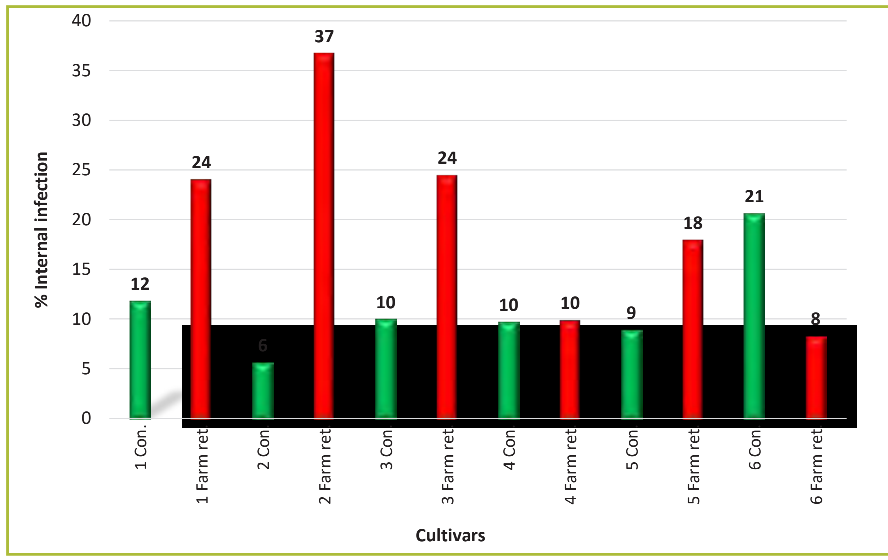
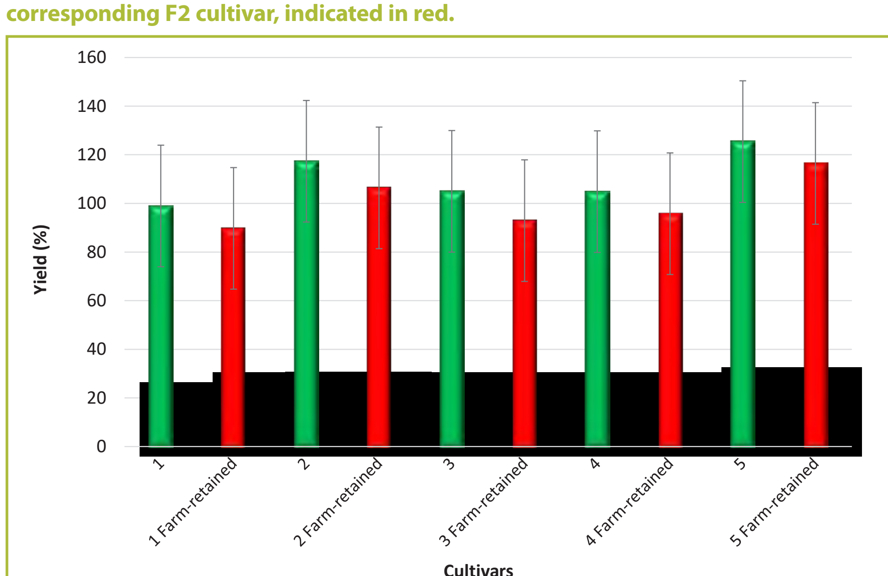


Figure 2: The percentage of seed yield in 2023 for company seed (F1 in green) and the corresponding F2 cultivar, indicated in red.



What is a hybrid cultivar?

A hybrid is an individual that is the result of a cross between two inbred parents. The result, called an F1 hybrid, was created to exploit the phenomenon of hybrid vigour.

Materials and methods

This article summarises two years of local data, comparing it with data from Australia. All local data was collected in the Swartland canola production area at Langgewens Research Farm, between Moorreesburg and Malmesbury, during the 2022 and 2023 growing seasons.

Six (2022) and five (2023) hybrid canola cultivars (F1) and their corresponding farm-retained cultivars (F2) were planted in a split-plot design with three replications at Langgewens. One-half of the trial received fungicide treatment at the four- to five-leaf stage. Plant counts were taken 21 days after germination and immediately after harvest. Various parameters were recorded, including flowering dates, blackleg severity (*Leptosphaeria* spp.), seed yield, and seed oil content.

Blackleg infection

The best defence against blackleg is cultivar resistance. Blackleg survives on canola stubble, producing fruiting bodies that contain large quantities of spores capable of travelling several kilometres via air. Farm-retained seed (F2) no longer possesses the same combination of blackleg resistance genes, consequently making it more susceptible to blackleg infection.

In 2022, the internal blackleg infection at Langgewens differed significantly between farm-retained seed (20,2%) and company seed (11%); however, there were differences between cultivars (*Figure 1*). In Australia, retained seed consistently exhibited higher levels of blackleg infection. Blackleg is controlled primarily through good agricultural practices and chemical control, adding considerably to the production cost (Schreuder *et al.*, 2021).

Seed yield

Seed yield decreases ranged from 7,2 to 11,5% in 2023 and 5,5 to 24,1% in 2022 when comparing retained seed yield to the trial mean (*Figure 2*).

During the 2023 growing season, there were no significant differences between company and farm-retained cultivars.

Table 1: The negative economic effect of planting the six F1 hybrid canola cultivars in 2022.

Entry and type	Percentage seed yield of company seed as 100%	Loss of gross income (1,7t/ha in 2022 @ R10 139/t as on 24 November 2022) (gross margin)
Cultivar 1 (CI)	75,9	R4 154
Cultivar 2 (Conv)	92,8	R1 241
Cultivar 3 (TT)	87,4	R2 172
Cultivar 4 (TT)	87,7	R2 120
Cultivar 5 (CI)	88,7	R1 948
Cultivar 6 (Conv)	94,5	R948
Company seed (F1)	100	R0
Farm-retained seed	87,8	R2 103

However, each F2 cultivar showed a decline in seed yield. When the data of the cultivars was combined, the yield of the farm-retained seed declined by 14,9% (farm-retained seed with a fungicide seed treatment) and 21,5% (farm-retained seed with a post-plant blackleg treatment) compared to F1 cultivars that also received a post-plant blackleg fungicide treatment.

Oil content

At Langgewens, the oil content of the farm-retained seed was, on average, 0,8% less (7% moisture) in both 2022 and 2023. In Australia, the oil content of the farm-retained seed was lower than that of the company seed at all localities tested (Potter *et al.*, 2021).

Economic impact on the producer

The average decline in seed yield per trial was 12,2% in 2022 and 8,9% with the same treatment as in 2023. The potential loss in gross income during 2022 ranged from R948 to R4 154/ha (*Table 1*). During 2023, the variation between cultivars was less pronounced, but gross income ranged from -R1 104 to -R1 763. On average, the potential loss in gross income/ha was R2 103 in 2022 and R1 410 in 2023.

Farm-retained canola seedlings (F2) to the left versus company seedlings (F1) with enhanced growth vigour.

Conclusion

The local canola industry reduces South Africa's reliance on imported vegetable oil and oilseed cake. Canola is utilised for both animal feed and oil for human consumption, contributing positively to food security. This sector supports food security directly for human consumption and indirectly through the livestock industry. A domestically self-sufficient sector in oil and oilseed cake production proves advantageous for the country, leading to reduced transportation costs and a decrease in the need for imports.

The utilisation of farm-retained seed (F2) resulted in significantly decreased crop yields. The benefits of using company seed (F1) outweigh the potential cost savings attributed to farm-retained seed. Concerns also arise due to the heightened risk of blackleg disease pressure in the upcoming growing season when opting for farm-retained seed with low blackleg resistance over commercial seed for planting.

For more information, send an email to Piet Lombard at Piet.Lombard@westerncape.gov.za, Dr Johann Strauss at Johann.Strauss@westerncape.gov.za or Lisa Smorenburg at Lisa.Smorenburg@westerncape.gov.za.

Canola cultivar selection

Selecting the right canola variety for your farming business has always been a challenging decision. Choosing the correct variety and technology that fits into your crop rotation system involves various factors to consider such as yield, days to maturity, chemical application, and weed control.

The question has always been how to compare different factors for variety selection across the technologies, namely Conventional (CV), Clearfield (CL), Triazine Tolerant (TT), and Clearfield + Triazine Tolerant (CT). How should we compare apples with apples?

However, how do you compare different factors for variety selection across technologies such as Conventional (CV), Clearfield (CL), Triazine Tolerant (TT), and Clearfield + Triazine Tolerant (CT)?

The new Hyola innovation systems technology trial design, initially developed by the private seed company Pacific Seeds (a subsidiary of Advanta Seeds), has been thoroughly reviewed and further statistically enhanced by the University of Wollongong (UOW) team of senior Prof Brian Cullis and Dr Alison Smith. This enhancement aims to provide the most accurate statistical analysis for multi-technology canola performance, both at single sites and multi-environment trials (MET).

iClasses methodology

Advanta Seeds employs a factor analytic (FA) linear mixed model for MET analysis using statistical analysis software that offers advanced capabilities for analysing complex data sets called ASReml with iClasses.

The groups shown in the MET outputs are referred to as interaction classes (iClasses). These iClasses are groups of trials that capture patterns of variety-by-environment (VE) interaction. Unlike traditional MET analysis, which clusters trials based on a dendrogram of trial relatedness, the iClasses methodology developed by UOW provides a more accurate comparison of all varieties and technologies across different seasons and growing environments in Australia.

The enhanced design summarises various predictions for individual environments using iClass technology. iClasses are groups of environments that differentiate varieties based on their interaction patterns with the environment.

The FA model used in the analysis forms four iClasses, grouping trials into environments based on genotype-by-environment interactions. This approach calculates the overall yield performance for each variety within each iClass, averaging the VE predictions over environments in iClass.

Single-site trials only demonstrate the relative ranking of varieties for a specific trial, season, location and table of specifications, providing a once-off result. This applies to single or multi-technology trials and does not focus on a single environmental result.

To compare two varieties (*Figure 1*):

- Locate the row for the variety you are interested in and compare it to the column of another variety.
- The colour of the square where the row and column intersect indicates if there is a significant difference in yield.
  - A red square means there is no significant difference.
  - A green square means there is a significant difference.
  - A blue square means the variety was not grown at the trial site, so only predicted* yields are available.

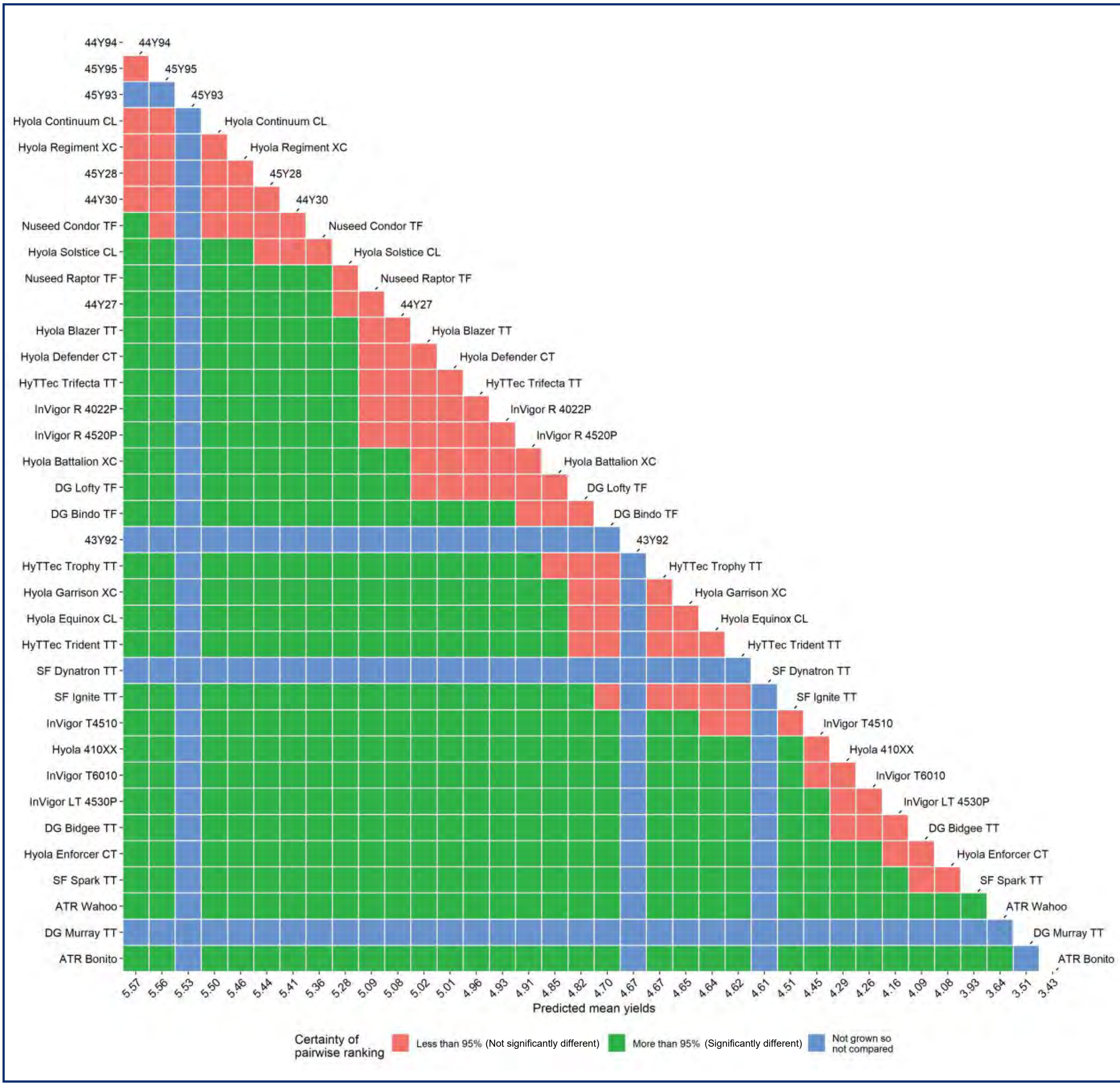
Advantages to growers

Justin Kudnig, national canola technical manager at Pacific Seeds Australia, says: "This exciting new venture now provides

Benefits of Hyola

- Provides accurate comparisons of yield performance across all canola varieties and herbicide technologies with the same design.
- Ensures confidence that all varieties, including stacked hybrids, are treated with the appropriate herbicides for each technology at registered rates and timings.
- Allows for the discovery of the benefits of new innovative technologies alongside existing industry-based trials that use only single technology analysis.
- Helps role-players to understand the profitability and integrated weed management implications of different canola technology systems, while delivering the latest agronomic research across diverse growing environments.

Figure 1: An example of data generated by the Advanta Seeds Hyola innovation system analysis over 30 single sites. The x-axis shows the yield (t/ha) ranked from high to low, left to right for each variety listed in the column.



more informed statistically valid information on cross-technology canola variety yield performance comparisons, which is being presented to all canola growers, agronomists and advisors by the Pacific Seeds canola technical team."

Duan Viljoen, business head for Southern Africa, states: "The canola industry is growing rapidly, and as industry leaders in hybrid canola seed, it is our responsibility to ensure that our producers have all the latest tools and data at their disposal to make the correct selections that will optimise yield and return on investment."

The Hyola innovation system analysis allows Advanta Seeds to replicate the already 87 500 trial plots currently conducted by Pacific Seeds in Australia and utilise the system with local trials and results for more accurate comparisons in South African conditions.

Advanta Seeds has already generated results of trials over nine sites on 640 plots in the Western Cape in 2023 and is planning to double the number this year to provide a platform for producers to make more informed decisions based on accurate data. Advanta Seeds not only focusses on yield and disease resistance, but also on placing more emphasis on analysing and breeding for oil percentage.

For more information, contact Gert Els, portfolio manager, on 082 413 9728 or visit *www.advantaseeds.com*.

CRISPR-Cas9-mediated editing of *GmARM* improves resistance to multiple stresses in soya bean

By Tingting Luo, Chongxuan Ma, Yuanhang Fan, Zhendong Qiu, Ming Li, Yusu Tian, Yuzhuo Shang, Chang Liu, Qingqian Cao, Yuhan Peng, Shuzhen Zhang, Shanshan Liu and Bo Song

Climate, human activities, and other environmental factors continuously alter plant habitats, which, in turn, result in plant exposure to biotic and abiotic stresses that can delay their growth and development while reducing crop yield and quality (Nadarajah, 2020; Ashraf, 2014).

Approximately 20% of global irrigated farmland is adversely affected by soil salinisation, making salt-alkali stress one of the most serious abiotic stresses (Phang *et al.*, 2008; Chen *et al.*, 2022). At present, saline-alkaline areas are widespread, increasing the gravity of the secondary salinisation problem. That is why the increase in saline-alkaline areas has become an important factor restricting agricultural development. To mitigate this restriction, the primary method for upscaling the production potential of saline-alkaline areas involves breeding crop varieties that can adapt to this adversity.

Phytophthora soya, a common phytopathogen that causes root rot in soya bean, reduces soya bean production by 10 to 40%, sometimes reaching up to 100% (Chandra *et al.*, 2022; Zhang *et al.*, 2010). By 2050, the global population size is expected to exceed 9,5 billion, with grain consumption expected to increase by approximately 100 to 110% (Alexandratos and Bruinsma, 2012; Ray *et al.*, 2013).

To meet the increasing global food demands, maintain food security, and improve crop productivity under adverse climatic conditions, more stress-resistant crop varieties need to be identified and cultivated. However, traditional methods of crop improvement, such as hybridisation, population-based selection, and marker-assisted selection, are laborious and time-consuming (Breseghello and Coelho, 2013; Collard and Mackill, 2008).

In this regard, clustered regularly interspaced short palindromic repeats-Cas9 (CRISPR-Cas9) technology provides an effective way for targeted genome editing to improve research in functional genomics while opening various avenues to study reverse genetics.

Surviving stress

CRISPR-Cas9 technology has been widely used in a variety of crops, such as rice, wheat, and maize. Nonetheless, most of the previous studies have analysed the effects of one kind of stress on a single plant species, although, in their natural environment, plants are often faced with several types of stress. Huang *et al.* demonstrated that *OsNCED3* plays a pivotal role in resistance to various abiotic stresses in rice (Huang *et al.*, 2018). Similarly, Mukherjee *et al.* showed that under salt stress and other abiotic stress conditions, the overall growth, photosynthetic performance, and grain yield of transgenic *PcCFR* rice plants were better than those of non-transformed lines (Mukherjee *et al.*, 2021).

Tran *et al.* revealed that when the proline-rich sequence recognition domain of *HyPRP1* was removed, tomato plants exhibited improved tolerance to both abiotic and biotic stresses (Tran *et al.*, 2023). Ali *et al.* (2019) used biotechnological methods to increase leaf ascorbic acid levels to help widely grown high-yield rice varieties adapt to a variety of abiotic stresses.

During growth and development, soya bean plants are susceptible to both abiotic and biotic stressors. However, to survive under adverse stress conditions, soya bean varieties have evolved unique physiological and molecular mechanisms that combine the differential expression and regulation of specific stress-resistance genes. In addition, over time, soya bean plants have developed distinctive and complex signal transduction and gene regulation systems in response to various environmental stresses, and these systems have become the focus of numerous investigations (Mutava *et al.*, 2015).

Identifying genes

Soya bean 7 S globulin α-subunit is a major soya bean sensitising protein. We used Dongnong 47 (DN47; α-subunit normal type), a high-oil-yielding soya bean variety from China's Heilongjiang Province, as the parent in the rotation and α-subunit deletion type as the donor parent. Using these types, we obtained a pair of α-subunit deletion type near-allelic lines with a genetic background response rate of more than 99,49 % in the BC4F5 generation through four rounds of backcrossing and three generations of genetic background selection, which were named cgy-2- NIL (NIL), and then analysed the genetic effect of α-subunit deletion genes (Song *et al.*, 2016).

Previous studies have demonstrated that the expression of soya bean β-conglycinin α-subunit genes is controlled at the transcriptional and post-transcriptional levels (Harada *et al.*, 1989). Therefore, NIL and DN47 were subjected to differential joint comparative analysis of lncRNA and mRNA expression profiles.

Then, a few differentially expressed genes were screened and combined with lncRNA sequencing data to identify a special gene, *Glyma.20G158500,* which was regulated by three lncRNAs (MSTRG.113768, MSTRG.119811, and MSTRG.95869) (Tian *et al.*, 2023). Additionally, gene ontology annotation indicated that this gene was involved in responding to multiple stress pathways. Thus, we hypothesised that this gene might respond to biotic and abiotic stresses and was named *GmARM*.

Few studies have demonstrated that the expression of *GmARM* in soya beans increased under stress conditions (Kandoth *et al.*, 2011; Reis *et al.*, 2020; Lu *et al.*, 2021). In this study, we screened genetically stable *GmARM*-edited plants and analysed their growth and adaptability under various stresses, including salt-alkali stress and *Phytophthora* root rot infection. The findings of this study showed that *GmARM*-edited plants exhibited tolerance to multiple biotic and abiotic stresses, indicating the importance of *GmARM* in the development of a wide variety of stress-resistant crops.

Discussion

NILs are defined as a group of lines with similar genetic backgrounds except for genetic differences in the target traits (Kooke *et al.*, 2012). They reduce unnecessary manipulations and play an important role in plant breeding, molecular biology, and proteomics studies (Kim *et al.*, 2021). In this study, we used high-throughput sequencing technology to compare and analyse the differences in NILs at the gene level. Moreover, a differentially expressed gene (named *GmARM*, encoding a low temperature-induced 65kDa protein) was screened using the transcriptome sequencing data. Using lncRNA sequencing, we found that this gene was regulated by three lncRNAs, namely MSTRG.113768, MSTRG.119811, and MSTRG.95869.

GO annotation indicated that *GmARM* was involved in the ABA signalling pathway and could respond to ABA, cold, salt, and drought stress. As *GmARM* was highly upregulated in response to cold, drought, dehydration, and ABA (Reis *et al.*, 2020; Rodrigues *et al.*, 2015; Kandoth *et al.*, 2011), we hypothesised that *GmARM* might be involved in responses to both biotic and abiotic stresses, and thus selected this gene as the subject of this study.

Application of CRISPR-Cas9

The random integration of foreign genes in plant chromosomes may lead to the destruction of endogenous genes, gene silencing, or other adverse phenomena, limiting the applications of traditional transgenic technology. In recent years, with the development of gene editing technology, the CRISPR-Cas9 system has been widely used to study the functions of several genes in various crops, including soya bean. Jacobs *et al.* used CRISPR-Cas9 technology to conduct site-directed mutagenesis in soya bean for the first time, which laid the foundation of soya bean genome editing (Jacobs *et al.*, 2015).

Han used CRISPR-Cas9 to knock out the flowering gene E1 and obtain an early flowering homozygous mutant, which further supported the breeding of precocious transgene receptors suitable for high latitudes (Han *et al.*, 2019). Cheng *et al.* (2019) used CRISPR-Cas9-mediated site-specific mutation in *GmLHY* to reduce plant height and shorten internode length in soya bean, providing a basis for analysing the potential mechanism of the regulatory network of soya bean plant height. Thus, in this study, an endogenous gene of soya bean was edited using the CRISPR-Cas9 technology.

Soya bean saline-alkali tolerance

Gene editing was successfully achieved in soya bean using the CRISPR-Cas9 technology in this study, which was consistent with previous results (Sugano *et al.*, 2020). The results of multi-generation screening of transgenic plants showed that transgenic plants obtained using the CRISPR-Cas9 technology could be stably preserved, and the altered traits could be inherited.

We also found that the agronomic traits of transgenic plants did not change much compared to the control, and the transgenic seeds did not exhibit physiological aberrations. By phenotypic identification of the offspring, we verified that the gene-edited plants showed increased resistance to salt stress, alkali stress, and *Phytophthora* root rot. These results not only provide a basis for the application of CRISPR-Cas9 technology in soya bean but also promote the use of this technology in soya bean breeding.

To date, several genes involved in salt stress response have been identified and their functions elucidated, but only a few salinity-tolerance genes have been used to improve crop varieties. Salt-tolerant transgenic plants usually show abnormal development (Yoshida *et al.*, 2014). However, in this study, we used CRISPR-Cas9 technology to obtain transgenic plants with adequate resistance to salt and alkali stress that developed normally, and there was no significant difference in agronomic traits between the transgenic and the control plants.

The natural environment is very complicated, and crops are affected by multiple environmental factors during their growth and development. Here, the results showed that the survival rate of transgenic soya bean plants under salt and alkali stress was significantly higher than that of the control plants, indicating that editing *GmARM* could effectively improve the saline-alkali tolerance of soya bean plants. However, this study did not systematically verify and compare the degree of tolerance of *GmARM*-edited plants to salt and alkali stress, and thus further studies are needed to verify this hypothesis.

Na^+ and H^+ reverse transport-related genes *GmNHX1* and *GmST1* and K^+ inflow-related gene *GmAKT1* are potential candidates for generating salt- and drought-tolerant crops (Sun *et al.*, 2019; Wang *et al.*, 2020; Zhao *et al.*, 2015). In this study, *GmARM* upregulated these three genes, suggesting that *GmARM* might be involved in the regulation of these transport pathways in plants under salt stress.

ABA response-related genes *GmNCED1* and *GmFDL19* were also upregulated in this study (Veremeichik *et al.*, 2022; Li *et al.*, 2017), indicating that *GmARM* knockout upregulated the positive regulator of salt stress *GmNCED1*. Additionally, *GmFDL19* was upregulated through the regulation of the ABA pathway, and thus the salt tolerance of transgenic plants was improved.

In addition to the stated genes, this study also analysed the expression levels of

GmWRKY13 and *GmERF3*, which belong to two salt stress-related transcription factor families, and the results also showed slight upregulation, which was consistent with the results of previous studies (Zhou *et al.*, 2008; Zhang *et al.*, 2009). Therefore, we hypothesised that these two genes were regulated by *GmARM*.

In contrast, under alkali stress, only *GmNHX1* and *GmNCED1* were upregulated in the six editing types, and the expression levels of the remaining genes were inconsistent, which may be attributed to the different gene-editing types. However, the endogenous effect of different gene-editing conditions on soya bean is still unclear and requires further investigation.

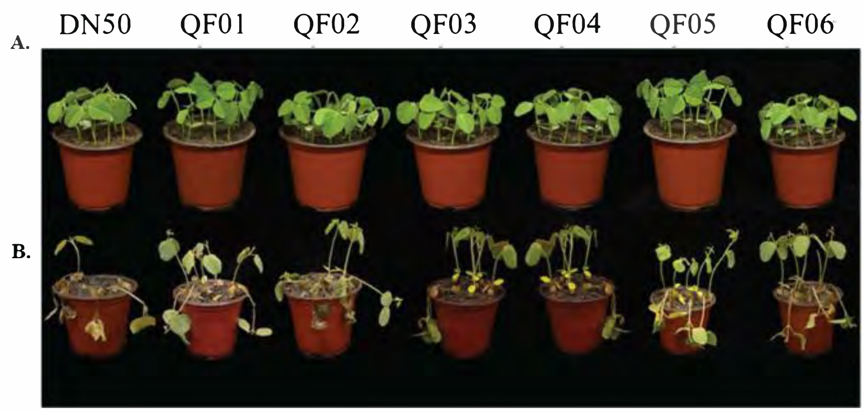
Resistance response

Phytophthora root rot of soya bean can occur at all growth stages and is particularly important to obtain pathogen-resistant germplasm resources, but traditional breeding practice cannot effectively solve this issue (Wang and Wang, 2018). Transgenic technology can make up for the shortcomings of traditional breeding, shorten the breeding cycle, and directionally change the characteristics of varieties (Xu *et al.*, 2021).

Both *CYP82C4* and *GmERF5* respond to *Phytophthora* infection, as the expression levels of both genes are significantly increased in knockout plants after infection by *Phytophthora* (Dong *et al.*, 2015). The expression levels of salicylic acid (SA) signalling pathway-related genes *GmPR10* and *GmNPR1* were also significantly higher than those of the control plants, suggesting that *GmARM* may be involved in the SA-mediated signal transduction pathway.

The expression levels of *GmWRKY22* and *GmWRKY40* were also significantly higher than those of the control plants. Wang *et al.* found that cotton *GhWRKY40* can interact with *GhMPK20* to participate in the resistance response (Wang *et al.*, 2014), whereas WRKY transcription factors can participate in the resistance signal transduction pathway mediated by SA, jasmonic acid (JA), and ethylene (ET), suggesting that *GmARM* may be involved

Figure 1: Resistance to infection after pathogen inoculation of the hypocotyl. A: Plants before inoculation; B: Plants six days after inoculation; C: Evaluation of anti-sensitivity six days after inoculation.



C. **Evaluation of resistance after inoculation with bacteria by the hypocotyl wound inoculation method**

Lines	DN50	QF01	QF02	QF03	QF04	QF05	QF06
Description of rank	S	I	S	I	I	I	I
Survival rate	0,10	0,40	0,33	0,57	0,50	0,60	0,47

in SA, JA, and ET-mediated signal transduction pathways.

Nonetheless, there were some differences in the resistance response of the six editing types to *P. soya*. We thus hypothesised that, on the one hand, the inoculated fungal mass, amount, and wound depth were not completely consistent in the hypocotyl inoculation method used in this study, which may have had an impact on the experiment. On the other hand, the use of CRISPR-Cas9 technology resulted in six editing types, which would have led to differences in plant response to stress conditions. However, further investigation is necessary to verify these hypotheses.

In this study, DN50 seedlings were exposed to salt and alkali stress and *Phytophthora* infection. We successfully verified that *GmARM* was induced by all three stress conditions. The study also showed that *GmARM* was differentially expressed over time and under different stress conditions. These results indicated that this gene was involved in different stress response mechanisms under varying stress conditions.

As editing *GmARM* improved the resistance of plants to salt and alkali stress and *Phytophthora* infection, we suggest that *GmARM* could provide soya bean with the ability to resist various abiotic and biotic stresses. Therefore, the integration of *GmARM* will serve as a good opportunity for cultivating soya bean varieties with tolerance to multiple stresses.

Conclusion

Biological and abiotic stresses affect plant growth and development, causing a decrease in crop yield and quality. Soya bean is sensitive to various stresses. Our findings showed that the knockout of *GmARM* using CRISPR-Cas9 technology improved soya bean stress resistance. In T3 plants, the transgenic bean plants showed resistance to salt and alkali compared to the wild type. At the same time, in T3 plants, the transgenic soya bean plants showed resistance to *Phytophthora* soya compared to the wild type.

Therefore, the investigation of *GmARM* serves as a good direction for cultivating soya bean varieties with tolerance to multiple stresses. Further studies are needed to reveal the complex multiple stress resistance.

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Groundnut production: Herbicides and associated challenges

By Prof Charlie Reinhardt

Symptoms of herbicide damage on plants can vary from subtle (difficult to diagnose) to obvious. Diagnosis of herbicide damage on crop plants is best left to those skilled in the art. (Photograph: Prof Charlie Reinhardt)

Groundnuts (*Arachis hypogaea*), known as peanuts in the United States (US), are produced in tropical and subtropical regions as it originates in South America. Portuguese seafarers likely introduced groundnuts to Africa in the 15th century during their voyages to Asia. Today, the bulk of global groundnut production takes place in Africa and Asia.

Production in South Africa

Commercial groundnut production in South Africa takes place on sandy or sandy loam soils in the Western Free State, Northern Cape, and North West provinces. In subsistence farming, groundnut is an important food crop in KwaZulu-Natal and Mpumalanga. Groundnut production in South Africa peaked at 393 000ha in 1969/70. Since then, production has gradually declined, with a noticeable downward trend evident since 2002/03.

Most of the world's commercially cultivated groundnut varieties belong to one of three variety groups: *hypogaea* (commonly known as Virginia or runner type), *fastigiata* (Valencia type), and *vulgaris* (Spanish or upright type). Runner (Virginia) types are considered unsuitable for South Africa due to their high water requirements and long growing periods. Spanish types, with upright (bunch) growth habits and relatively short growth periods, are considered best adapted to South African conditions.

A fairly recent addition to the groundnut section of the South African Variety List is the cultivar, Schubert, bred in the US in collaboration with Texas A&M University. This cultivar, which includes traits from Virginia, Valencia, and Spanish types, is registered to SA Peanuts and performed very well in the Agricultural Research Council's (ARC) cultivar evaluation trials conducted in 2022/23.

Production imperatives

As a rule, groundnut production requires light soils, such as sandy or sandy loam, which facilitate unimpeded taproot penetration and the development of an extensive root system. In sandy soils, there is less resistance for the reproductive parts (pegs or anchors) to penetrate the soil and a lower risk of pod-bearing pegs breaking during harvesting. However, soil compaction is a serious risk in sandy soils with a high small-sand-particle fraction and/or low organic matter content, leading to poor soil structure.

Based on guidelines from the former Department of Agriculture, Forestry and Fisheries (DAFF) and the ARC, other ideal soil and environmental characteristics for groundnut production include:

- Soil pH (water) of 5,5 to 7.
- Non-saline soils.
- Optimum germination temperatures of 18 to 30°C (germination decreases in temperatures above 33°C).
- Suitable temperatures for vegetative growth of 20 to 35°C (the physiological system cannot function normally in temperatures above 35°C).
- Day temperature of 27°C is best for flowering. For pod formation, a warm day temperature of 29°C and a cool night temperature of 23°C are optimal.
- The recommended planting date is from mid-October to the end of November.
- Planting depth of 5 to 7cm.
- Rapid seed germination and seedling emergence are crucial, among others, because they impact crop tolerance to soil-applied herbicides.

Weed management

Weeds, particularly their interference with groundnut growth and development, are serious crop productivity constraints, alongside other biological threats such as insects and pathogens. Annual row crops are particularly vulnerable to weed interference because the disturbed soil environment coupled with the early season's high levels of nutrition, soil moisture, and sunlight invite weed proliferation from the outset.

Therefore, it is crucial to perform pre-plant, pre-emergence, and even early post-emergence weed control in annual row crop systems.

Unlike soya bean and maize, groundnut has a low and slow-growing canopy, making it prone to competition for light from weeds. Given its long growing period (140 to 160 days), groundnut may be affected by late-emerging weeds, as early applied herbicides seldom last that long. However, herbicides with long residual activity in the soil risk leaving residues that can affect the next season's susceptible crop.

Zero and reduced tillage systems depend on herbicides since mechanical weed control falls away or is restricted in such systems. Unfortunately, over-dependence on herbicides, especially those with a single mechanism of action (MOA), has aided herbicide resistance evolving in certain weed species (*www.weedscience.org/*).

Herbicide strategies

Diverse herbicide types support groundnut production in South Africa. The 22 registered types (*Act 36 of 1947*) are classified into six different groups based on their MOA, also called site of action (SOA).

The MOA or SOA identifies the life process a herbicide inhibits, leading to the plant being damaged or killed. In many cases, the SOA involves a specific enzyme essential for plant growth and development. Herbicide resistance in weeds can develop through natural (not herbicide-induced) mutation at the SOA, e.g. where an enzyme slightly altered at the molecular level still functions normally but is no longer susceptible to the herbicide.

The six herbicide MOAs registered for use in groundnut are:

(i) Long-chain fatty acid inhibitors, e.g. metolachlor, acetochlor.
(ii) Acetyl CoA carboxylase inhibitors, e.g. clethodim, cycloxydim.
(iii) Acetolactate synthase inhibitors, e.g. imazethapyr, diclosulam.
(iv) Protoporphyrinogen oxidase inhibitors, e.g. flumioxazin, fomesafen.
(v) Photosystem 2 inhibitors, e.g. terbutryn, bendioxide.
(vi) Microtubule inhibitors, e.g. trifluralin, pendimethalin.

The herbicides listed under (i), (ii) and (vi) are specialist grass herbicides, while those under (iii) and (iv) control mainly broadleaf weeds, and those under (v) are specialist broadleaf herbicides. This diversity in herbicide MOAs bodes well for successful herbicide resistance management, which demands the use of preferably two or more MOAs used together (herbicide mixtures) or sequentially during a growing season.

Recommendations and use

Even before preparing herbicide spray solutions and application, high precision in advisor and user actions is called for. Attention to detail must commence with strict adherence to instructions, warnings, and recommendations on the product label. For example, it is illegal (*Act 36 of 1947*) to deviate from the registered dosages and safe waiting periods for planting susceptible follow-up crops.

Advisors and/or users responsible for not recommending or using a herbicide product as demanded by the label instructions will have no recourse for compensation from the registration holder in cases of poor weed control or crop damage, both of which can lead to yield loss.

In groundnut production, which is restricted to sandy soils low in clay and organic matter content, it is important to be aware of the high herbicide activity in such soils. Clay minerals and the humus fraction of soils adsorb herbicide molecules on their surfaces, allowing for the gradual uptake of soil-applied herbicides by plants. This prevents herbicides from overwhelming a crop's ability to metabolise (degrade) them. This ability of crop plants, which some weeds lack, explains herbicide selectivity.

Overdosing can overwhelm and compromise a crop's natural ability to metabolise the herbicide rapidly. For example, the use of broadleaf herbicides such as diclosulam and imazethapyr in groundnuts depends on their rapid degradation within the plant system. Any external factor that limits this ability will lead to crop damage caused by the herbicide. Overdosing also nullifies the label-recommended waiting periods for susceptible crops, which must be extended in such cases, but for how long is anybody's guess. Simply put, registered dosages and waiting periods must be strictly adhered to.

Herbicide damage to crops

Herbicide selectivity, i.e. the ability of a herbicide to control weeds effectively without harming the crop, is relative and not absolute. This means there are limits to herbicide selectivity. The surest way to invite crop damage is to exceed the registered (label-recommended) dosages. Unintentional, damaging mistakes are possible during the preparation of spray solutions and application, but there is no excuse for deviating from the registered dosages and prescribed waiting periods for susceptible follow-up crops.

Crop-damaging interactions between herbicide selectivity and environmental factors such as soil properties, soil moisture, and temperature are more common than most people realise or can detect. For example, it has been scientifically proven that the mechanism through which heat and/or drought stress damage crops is the formation of highly oxidative superoxide radicles (e.g. hydrogen peroxide H_2O_2). This forms when energy-rich electrons released from the stress-interrupted photosynthesis process react with oxygen molecules in plant cells.

This same mechanism is involved when triazine herbicides (e.g. atrazine and terbuthylazine) damage and kill weeds. Therefore, plants suffering heat and/or drought stress may be predisposed to herbicide damage due to their lowered ability to metabolise the herbicides because their physiological system is already under strain. Herbicide damage to crops can be subtle yet economically significant. The rule of thumb among herbicide specialists is that yield losses of up to 20% can occur without the human eye detecting it.

Charlie Reinhardt is a professor in agronomy at North-West University and research leader in the South African Herbicide Resistance Initiative (SAHRI) at the University of Pretoria (*www.up.ac.za/sahri*). Contact him on 083 442 3427 or at dr.charlie.reinhardt@gmail.com.

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STRONGARM® 840 WG: Protect your groundnut crops

By Henry Hoek, category marketing manager of herbicides, Corteva Agriscience South Africa

At Corteva Crop Protection, we offer an innovative range of product solutions that protect your crops in a sustainable manner, maximising both yield and success for our farmers. The Corteva Crop Protection Heart of Agriculture team focusses on our people, products, and farmers, who play important roles in the global production and security of food.

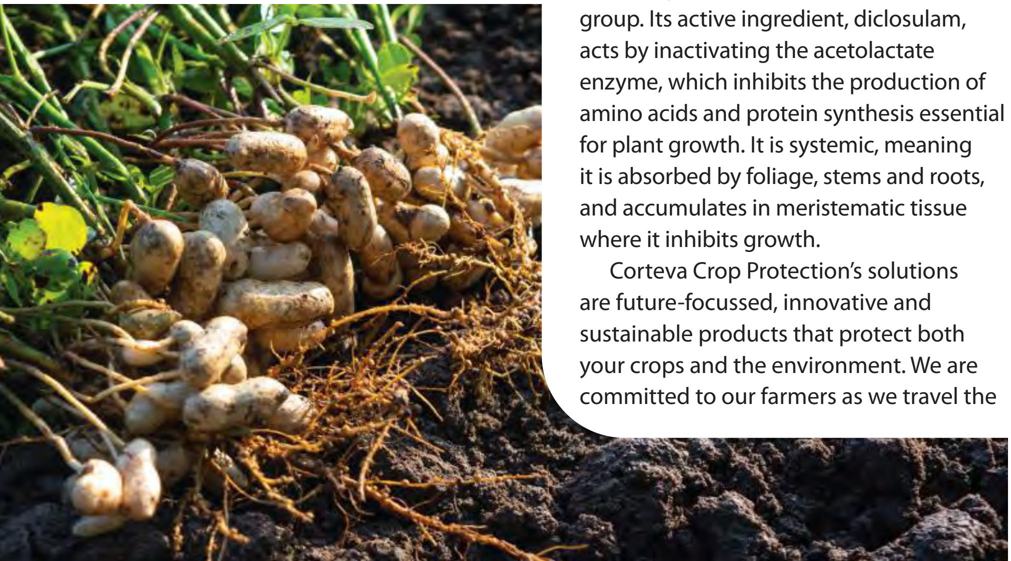
We understand the challenges our farmers face in achieving their goals profitably, successfully, and sustainably. Therefore, we are constantly developing new ways to best serve them and the agricultural industry as a whole.

One such successful product for groundnuts is STRONGARM® 840 WG (Reg no L 8663). This water-dispersible granule herbicide is designed for use in tank mixtures, as recommended by the label, and for the pre-emergence control of annual grasses, broadleaf weeds under certain conditions, and yellow nutsedge in crops (as indicated on the label).

Grass and broadleaf weed issues

- They compete with crops for sunlight, space and water.
- They leach important nutrients from the soil, robbing crops of valuable minerals.
- They reduce crop growth, thereby negatively affecting yield.

STRONGARM® 840 WG is highly effective, offering long residual action with no herbicide residue at harvest. It is suitable for crop rotation practices, requires low usage rates, and can be tank-mixed with other herbicides as recommended on the label.



Getting the best from Strongarm® 840 WG

- Must be used as a tank mix with complementary products as recommended, to ensure adequate weed control and resistance management.
- When combined with Relay® SUPER 900 EC Acetohlor, Alachlor™ 384 EC, Alachlor™ 480 Scor Metagan Gold™, it should be applied before the crop emerges, as recommended.
- When creating tank mixtures with STRONGARM® 840 WG and other herbicides, carefully follow the warnings, precautions, usage restrictions, and directions for use specified on the relevant labels.

Mode of action

STRONGARM® 840 WG belongs to the triazolopyrimidine sulfonanilide chemical group. Its active ingredient, diclosulam, acts by inactivating the acetolactate enzyme, which inhibits the production of amino acids and protein synthesis essential for plant growth. It is systemic, meaning it is absorbed by foliage, stems and roots, and accumulates in meristematic tissue where it inhibits growth.

Corteva Crop Protection's solutions are future-focussed, innovative and sustainable products that protect both your crops and the environment. We are committed to our farmers as we travel the agricultural journey towards a positive, more sustainable farming future. Corteva Crop Protection truly is at the heart of agriculture.

Key benefits of STRONGARM® 840 WG

- Highly effective and selective pre-emergence herbicide, particularly for controlling *dubbeltjie* in groundnuts.
- Controls a variety of grass and broadleaf weeds.
- Good tool to manage problematic weeds such as *dubbeltjie* in groundnuts.
- Can be soil-applied (surface, pre-plant, or pre-emergence) to suit no-till, minimum till, and conventional tillage farming practices.
- Highly effective with long residual action.
- Suitable for crop rotation practices with low usage rates.
- Leaves no herbicide residue at harvest.
- Can be tank-mixed with other herbicides as recommended on the label.

To learn more about our crop protection products and solutions, visit *www.corteva.co.za* or follow us on Facebook, LinkedIn, Instagram, and our YouTube channel.

The essence of boron: Invaluable as a significant plant nutrient

By Prof Robin Barnard, chief technical advisor, Fertasa

Boron (B) plays a key role in the soil biome and its primary function in agriculture is to ensure growth and healthy dicotyledonous plants such as sunflowers, barley, cashews, groundnuts, and beans.

In addition to carbon, oxygen and hydrogen, B is one of 13 nutrient elements (including nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, manganese, copper, zinc, and chlorine) that play a major role in cell-wall biosynthesis, as well as the structure and integrity of the plasma membrane, which is essential for plant health and many growth factors. A deficiency in B typically results in reduced plant height, rolling and whitening of leaf tips, and plant die-off.

Boron as a plant element

Plants differ in their B requirements. Crops such as cereals, citrus, maize, sorghum, and wheat need relatively low amounts, while lucerne, canola, and sunflower require higher levels. Cotton, spinach, and sweetcorn fall somewhere in between.

Soil conditions have an important influence on B availability, with mineralogy, texture, pH, organic matter, and water content (moisture) all playing a significant role. Boron is required by plants for several essential functions, including regulation of metabolism, pollen viability, and flower and seed production.

Deficiency symptoms manifest in different ways but are well-known for most crops. When a B deficiency is suspected, soil application of a suitable B fertiliser (typically sodium salts of boric acid, such as borax, tetraborate, and sodium pentaborate) should be considered. This can be broadcast or hard placed; alternatively, it can be applied as a liquid foliar spray. Due to the relatively small amounts of B that are normally applied, proper distribution must be achieved, as the range between deficiency and toxicity is the narrowest of all nutrient elements.

Note that application levels and methods should be determined based on the advice of a qualified advisor or consultant.

Reports and observations

It has been noted that B deficiencies are on the increase, and therefore regular soil analysis, combined with plant tissue analysis, should form an integral part of a responsible and sustainable production programme. The current situation regarding B in South Africa has raised concerns among agriculturists, especially regarding the potential ban on B. Such a ban would not only have catastrophic financial implications, but also negatively impact food security and related societal aspects.

In South Africa, fertilisers are regulated by the registrar of the *Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act 36 of 1947)*, as amended. This office has requested documentation on the efficacy, necessity and safety of B, in light of the potential prohibition of B-containing fertilisers from 1 June 2024.

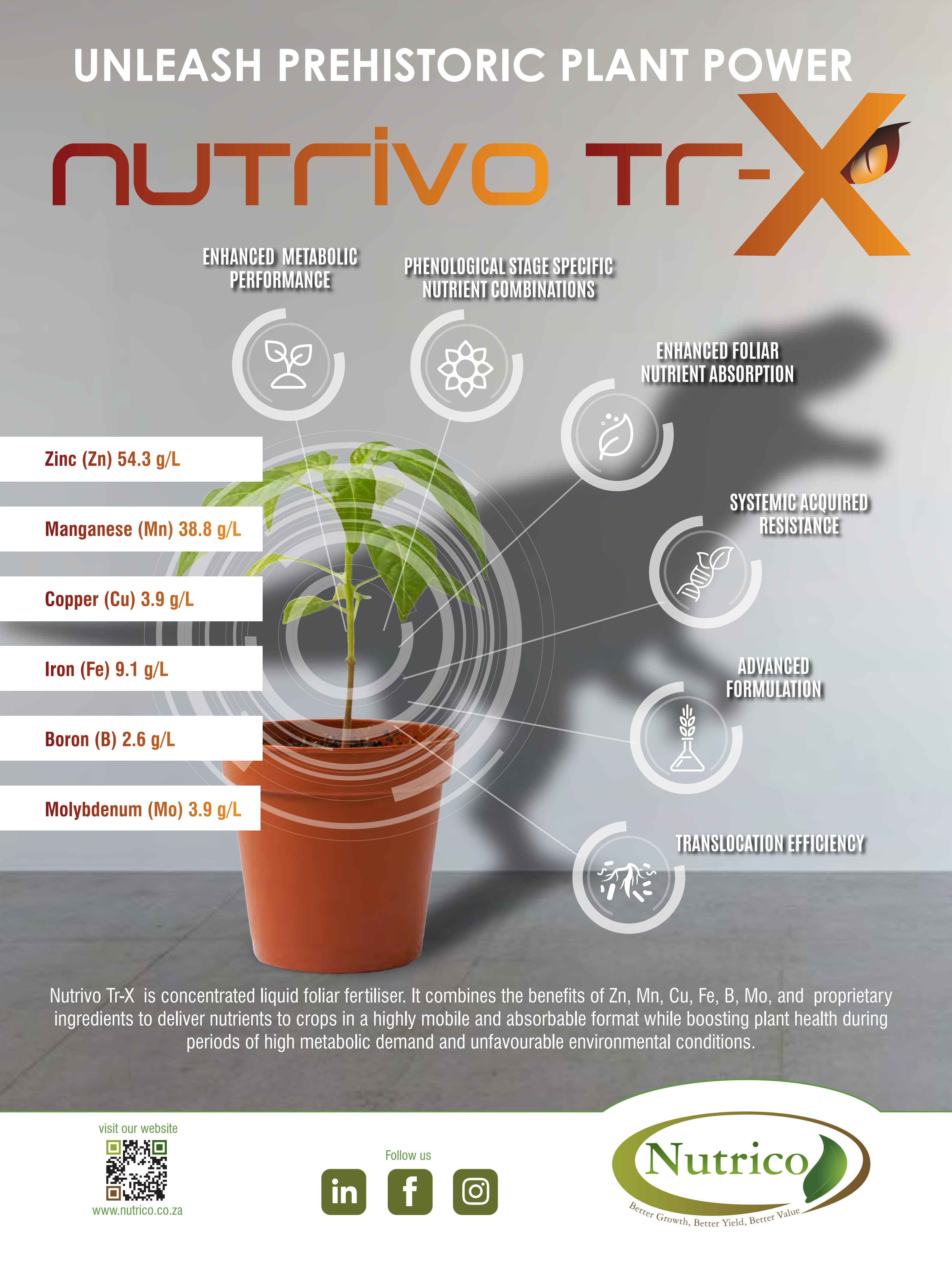
In response, the Fertiliser Association of South Africa (Fertasa) commissioned a toxicological report from INFOTOX to provide supporting documentation. They recommended the following:

- A comprehensive risk assessment conducted by INFOTOX confirmed insignificant health risks for the carcinogenic, mutagenic, and reprotoxic chemical (CMR) categories associated with B in fertilisers.
- Boron is an essential micronutrient for the growth and development of healthy plants in agriculture. Since the early 1920s, the importance of B has been recognised and it has been applied in fertilisers across the world since then.
- INFOTOX has not identified any health risks to humans, animals, or ecosystems due to the use of B in fertilisers. Therefore, it is unnecessary to implement precautionary measures in addition to the normal procedures applied in the fertilisation of plants at farmlands. There is no significant basis to prohibit or restrict the use of B in fertilisers because of hazards identified in animals for B in the CMR categories.

Final thoughts

It is the considered opinion of the Fertasa board of directors that the documentation conforms to all the necessary conditions stated by the registrar of *Act 36 of 1947* to allow the use of B-containing fertilisers in South Africa. The registrar has confirmed that the intended deadline date for the possible prohibition of B-containing fertiliser, which was 1 June 2024, has been extended pending the evaluation of the documentation and final decision.

For more information and references, send an email to Prof Robin Barnard at robin@fertasa.co.za, or Dr Pieter Haumann at pieter@fertasa.co.za.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ENHANCED FOLIAR NUTRIENT ABSORPTION
SYSTEMIC ACQUIRED RESISTANCE
ADVANCED FORMULATION
TRANSLOCATION EFFICIENCY
Zinc (Zn) 54.3 g/L
Manganese (Mn) 38.8 g/L
Copper (Cu) 3.9 g/L
Iron (Fe) 9.1 g/L
Boron (B) 2.6 g/L
Molybdenum (Mo) 3.9 g/L
Nutrivo Tr-X is concentrated liquid foliar fertiliser. It combines the benefits of Zn, Mn, Cu, Fe, B, Mo, and proprietary ingredients to deliver nutrients to crops in a highly mobile and absorbable format while boosting plant health during periods of high metabolic demand and unfavourable environmental conditions.
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From flower to flourish: Molboro Tr-X™ targeted nutrition

By Dr Anneli Heyns, Nutrico

Analogous to the varying dietary requirements throughout the human lifespan, plants exhibit stage-specific nutritional demands. This is particularly pronounced during the flowering phase, a pivotal period for oilseed crops. Oilseeds require specific nutrient influxes to optimise flower and seminal development, ultimately influencing the final crop and oil yield during harvest.

At Nutrico, we understand the unique nutritional demands of oilseeds during flowering. Drawing from over 20 years of research and expertise, we have developed new-generation nutrition products and programmes that optimise plant growth and maximise harvest potential.

Flowering requirements

Providing a balanced and steady nutrient supply at each growth stage is essential for optimal performance, particularly in oilseed crops – the flowering stage plays an integral role in seed set and, ultimately, oil yield. Uniform flowering ensures that enough flowers are available for pollination, increasing the chances of successful fertilisation and seed development.

During the oilseed flowering stage, the focus shifts towards producing healthy seeds rich in oil. Supplying the right nutrients during this pivotal time allows the plant to channel energy efficiently towards seed development. Even when plants exhibit no obvious vegetative growth deficiencies, micronutrient shortages can markedly reduce crop yield. Therefore, proactive or preventive nutrient management during flowering stages is non-negotiable.

Molboro Tr-X™ nutrition

Molboro Tr-X™ is a tailored approach to plant nutrition, providing the optimal balance of nutrients during critical flowering. This liquid fertiliser combines the benefits of concentrated levels of boron (B: 73g/ℓ), molybdenum (Mo: 26g/ℓ), cobalt (Co: 1g/ℓ) and proprietary ingredients aimed at enhancing plant resistance activation and optimising metabolic efficiency.

Boron, Mo, and Co play essential roles in processes such as pollen formation, pod development, and nitrogen fixation – all key factors for successful seed set and maximising the oil content within seeds.

Expertly manufactured by Tandem Translocation and Resistance eXpression (Tr-X)™ technology to deliver nutrients to crops in a highly mobile and absorbable format while boosting plant health during periods of high metabolic demand and unfavourable environmental conditions, in-house field trials have indicated that Molboro Tr-X™ is an industry leader when it comes to return on investment.

Providing crops with Molboro Tr-X™ nutrition during flowering ensures the plant has the right building blocks to:

- Develop healthy flowers that attract pollinators and lead to successful seed set.
- Fill seeds with the maximum amount of oil, boosting overall yield.
- Maintain strong plant health to avoid diseases that cripple oil production.

Practical applications

Molboro Tr-X™ is conveniently formulated so that each 1ℓ/ha provides an optimal blend of B, Co, Mo and important biostimulants (including amino acids and seaweed extracts). This formulation supports crops during stages of high metabolic demand and stress. Apply Molboro Tr-X™ at 1ℓ/ha in autumn, and up to 1ℓ/ha at the start of flowering as either a seed treatment or a foliar spray application.

To achieve optimal yield results, use Nutrivo Tr-X™ during the emergence and canopy development growth stages as a precursor to Molboro Tr-X™ nutrition.

Table 1: Molboro Tr-X™ application recommendations.

Crop	Rate/ha	Rate/100ℓ
Beans: Soya, dry, green, peanut, lupine, lucerne	0,5-4ℓ	0,25-1ℓ
Summer grains: Maize, sorghum, sweet corn, silage	0,5-4ℓ	0,25-2ℓ
Winter grains: Wheat, oats, barley, canola	0,5-4ℓ	0,25-2ℓ
Oil crops: Sunflower, canola	0,5-4ℓ	0,25-2ℓ

For more information, contact Nutrico on 011 392 4072 or 021 807 5922 or visit *www.nutrico.co.za*.

Combined application of boron and zinc improves seed and oil yields and oil quality of oilseed rape

By Muhammad Ehsan Safdar, Rafi Qamar, Amara Javed, Muhammad Ather Nadeem, Hafiz Muhammad Rashad Javeed, Shahid Farooq, Aleksandra Głowacka, Sławomir Michałek, Mona Alwahibi, Mohamed Elshikh and Mohamed Ahmed

The production of edible oil is of utmost importance in fulfilling the domestic demand and industrial requirements of a country. Additionally, it holds the potential to emerge as a significant contributor to employment opportunities.

Insufficient availability of nutrients, particularly micronutrients, is a significant constraint in oilseed rape production. Micronutrients play a crucial role during the vegetative and reproductive growth of plants. High-yielding cultivars produce low yields despite nitrogen, phosphorus and potassium application, which can be attributed to the insufficient utilisation of micronutrients. The optimal yield potential of high-yielding cultivars can be realised through the application of micronutrients in conjunction with macronutrients.

Chaudry *et al*. reported that the application of micronutrients, specifically zinc (Zn) and boron (B), significantly increased wheat yield compared to the control group, whether applied individually or in combination, while Mandal *et al*. indicated a significant correlation between the application of fertiliser and the physiological growth process.

Growth and development

Zinc is a vital micronutrient required for the growth and development of crop plants. It is a constituent of carbonic anhydrase and elicits aldolase, both of which are imperative for carbon metabolism. Additionally, it is a constituent of diverse biomolecules, including lipids and proteins, and functions as a cofactor for auxins, thereby exerting a significant influence on nucleic acid degradation.

Zinc is an essential constituent of numerous enzymes and is compulsory for their activation. Consequently, Zn deficiency limits carbohydrate digestion, induces injuries to the pollen tube, and reduces yield.

The primary cause of Zn deficiency in crops is the reduced solubility of Zn in soils, which is somewhat more significant than the reduction in the overall amount of Zn. Soil application of Zn to oilseed rape has been found to increase branching, the number of pods, and seed production. Zinc deficiency in the topsoil significantly hampers agricultural productivity. The decrease in Zn levels in plants induces the generation of reactive oxygen species (ROS) within plant tissues, which disrupts the integrity of cell membranes and impedes the normal functioning of cells.

Boron is another essential micronutrient and necessary for the growth of crop plants. However, it can be observed that B levels are rapidly decreasing in yermosols or aridisols. Boron deficiency is the second most important micronutrient constraint in crop production after Zn. Boron is an important component for various biological processes in plants, including but not limited to the growth and development of pollen tubes, the maintenance of membrane integrity, seed production, and pollination.

The primary roles of B include the breakdown of nucleic acids, carbohydrates, proteins, indole acetic acid, and phenol, which are involved in the synthesis of

plant cell walls and the maintenance of membrane integrity. Additionally, B plays a key role in cellular division and the control of carbohydrate and protein metabolism, and these processes influence the reproductive phase and development of seeds. Boron deficiency in soil leads to the erratic growth of seedlings and reduced photosynthesis.

Furthermore, B deficiency limits root elongation and deforms flowers and fruits due to inadequate cell division in the meristematic region. Conversely, a sufficient B supply improves root development. Nevertheless, an excess or deficiency of B impedes physiological and morphological functions in plants.

Biofortification techniques

The implementation of biofortification techniques in oilseed crops, specifically targeting the incorporation of nutritionally significant elements such as B and Zn, has emerged as a promising strategy to address the issue of micronutrient deficiency in developing nations. Agronomic biofortification of micronutrients can be achieved through three primary approaches, i.e., seed priming, foliar, and soil application.

These methods are characterised by their rapid nutrient delivery, economic feasibility, and ease of implementation. Soil application of micronutrients is a widely employed agronomic technique to enhance both the yield and nutritional quality of food crops. Nevertheless, the excessive application of micronutrients can lead to crop toxicity by disrupting the equilibrium between soil solution and adsorption sites.

Usman and Mohamed observed that the application of Zn, either alone or in combination with B elevated Zn levels in plants. An increased Zn concentration leads to higher flowering and a reduction in fruit drop.

Potential vs actual yield

Numerous studies have investigated the impact of B and Zn on crop yields, either individually or in combination. However, the potential synergistic or antagonistic effects of soil-applied B and Zn (either alone or in combination) on the growth and yield of oilseed rape have never been studied. Additionally, the underlying physiological mechanisms have not been explored in the semiarid environments characterised by calcareous soils. Hence, the current study investigated the impacts of soil-applied B and Zn (alone or in combination) on the growth, physiological, and biochemical attributes; seed and oil yields; and oil quality of oilseed rape.

It was hypothesised that the growth, physiological, and biochemical attributes; seed and oil yields; and oil quality of oilseed rape would be significantly altered by the soil application of B and Zn. It was further hypothesised that the combined application of B and Zn would improve the growth, physiological, and biochemical attributes; seed and oil yields; and oil quality of oilseed rape compared to their individual application. The results of this study would help to improve the seed and oil yields and oil quality of oilseed rape in semiarid environments characterised by calcareous soils.

Discussion

Micronutrients are required in low amounts by plants, and their deficiencies exert significant negative impacts on the growth, yield, and quality of the produce. Sole and combined application of B and Zn significantly affected growth, seed yield, yield attributes, B and Zn contents in leaves, and oil yield and quality, as well as the physiological and antioxidant characteristics of oilseed rape, as hypothesised.

Similarly, the combined application of B and Zn resulted in higher improvements in these traits compared to their individual application. The highest improvements in all traits were recorded with the B2 + Zn8 treatment during both years of this study. Overall, the combined application of B and Zn significantly increased the yield and yield-related attributes of oilseed rape in the current study. This could be attributed to the higher synthesis of assimilates, their improved mobility to potential sinks, and enhanced efficiency in pollination and seed development.

Kanwal *et al*. reported that optimum B and Zn application to the root zone caused a significant and consistent increase in the yield and yield-related traits of oilseed rape. Our results are in agreement with Aref and Rehman *et al*. who reported that the synergistic impact of these two micronutrients improved plant height, seed yield, and yield characteristics under low B and Zn availability in the soil. Plants uptake the required amount of B if B and Zn are supplemented in B-deficient soils, which improves plant development.

Additionally, the soil application of B and Zn resulted in a higher photosynthetic rate and chlorophyll content, ultimately leading to an increase in dry matter and subsequent growth and production. Boron plays a crucial role in synthesising chlorophyll molecules required for photosynthesis. Sufficient B concentration in the current study probably facilitated chlorophyll synthesis, thereby resulting in enhanced leaf pigmentation and vitality. Zinc is involved in the activation of enzymes that are essential for the process of chlorophyll synthesis.

The higher chlorophyll and photosynthesis under the B2 + Zn8 treatment are thought to be the result of enzyme activation, which resulted in better chlorophyll synthesis and subsequently improved photosynthesis.

Crop growth and yield

The application of optimum B and Zn doses significantly improves the growth and yield of crop plants. Boron and Zn application has been found to have a significant impact on the translocation of photo-assimilates from the source (i.e., leaves) to other plant parts and the promotion of pollen tube elongation, ultimately resulting in an increased number of siliques. Rehman *et al*. and Potarzycki and Grzebisz reported that B + Zn application improved the number of siliques per plant due to the higher number of flowers, the appropriate development of pollen and the pollen tube, pollination, and seed formation.

It is well described that the application of B and Zn increases the number of seeds per silique and 1 000-seed weight. Several research studies have reported that the combined application of B and Zn can enhance seed production by increasing yield characteristics. The deficiency of these nutrients impedes the development of the petiole and peduncle cells, resulting in diminished growth, seed yield, and yield characteristics.

Furthermore, a lower plant height at varying B + Zn concentrations may indicate a sensitive differentiation between deficiency and toxicity, thereby impeding the growth and yield characteristics of the plant without any apparent symptoms. The reduction in plant growth, seed yield, and yield traits observed in the control group or low/higher doses of B + Zn can be attributed to a decrease in enzymatic reactions that regulate cell division and elongation.

Conversely, excessive levels of B + Zn can lead to an imbalance of various enzymes, ultimately resulting in a reduction in plant height, seed yield, and yield traits. The application of B2 + Zn10 resulted in enhanced uptake of both B and Zn by the leaves, indicating a synergistic relationship between these nutrients. However, the higher/excessive consumption of B and Zn reduced the growth and yield characteristics.

Fatty acid synthesis

The observed enhancement in the yield and quality of oil under B2 + Zn8 may be attributed to the participation of micronutrients in the synthesis of elevated levels of fatty acid compounds. The combined application of B and Zn may have contributed to the increase in oil content in seeds through the potential impact on the protein content of leaves. Therefore, the optimal utilisation of B and Zn has the potential to enhance the seed oil content.

Although B and Zn are crucial for the growth and development of oilseed rape, their application does not directly affect the fatty acid composition of oilseed crops. These micronutrients play a crucial role in facilitating diverse enzymatic processes that are integral to photosynthesis. The increased photosynthetic activity has the potential to result in the elevated production of carbon precursors that can be utilised for the synthesis of fatty acids. The improved fatty acid profile of the oilseed rape oil in the current study can be linked to improved photosynthesis and, subsequently, the production of carbon precursors, which are utilised by plants for the synthesis of fatty acids.

Protein and soluble sugar

The highest protein concentration, soluble sugar concentration, chlorophyll concentration, photosynthesis rate, stomatal conductance, and transpiration rate were recorded under the B2 + Zn8 treatment during both years.

Zinc plays a crucial role in the structural composition and catalytic mechanisms of proteins and enzymes, thereby significantly contributing to plant development and exhibiting a favourable impact on growth. Consequently, Zn deficiency in plants may result in a reduction in protein and soluble sugar concentration in grains and lower amino acids in plant parts. Higher protein concentration and soluble sugar concentration observed under B2 + Zn8 could impede the mobility of antioxidant enzymes, which causes oxidative destruction to protein and soluble sugar.

Boron plays a crucial role in the maintenance of structural integrity, particularly concerning the vascular tissues responsible for the transportation of water. The regulation of B levels has the potential to impact stomatal conductance and the intra-plant movement of water. Sufficient Zn concentrations can regulate stomatal conductance and effectively manage transpiration. The optimum Zn and B supply in the current study improved the protein concentration, soluble sugar concentration, chlorophyll concentration, photosynthesis rate, stomatal conductance, and transpiration rate by improvements in these processes.

Stomatal conductance and transpiration rates

In the current experiment, B and Zn application improved chlorophyll contents and the photosynthesis rate, while higher rates of B + Zn reduced chlorophyll concentration, which might be attributed to the toxicity of these nutrients. Similar outcomes were obtained by Akta *et al*. who concluded that an increase in B and Zn contents decreased the chlorophyll contents in leaves. Lower stomatal conductance and transpiration rates were recorded in Zn- and B-deficient plants during both years in the current study, which might be attributed to the destruction of the vascular bundle.

An impairment of the xylem vessels decreases the movement of water from the roots to the leaves, thereby impacting the stomatal conductance and transpiration rate. On the other hand, phloem impairment can impede the transportation of essential nutrients and sugars, thereby exerting an indirect influence on stomatal conductance and photosynthetic processes. Reduced transpiration rate and stomatal conductance under B and Zn deficiency in the current study are due to these processes. Pinho *et al*. also concluded that a linear relationship persists among stomatal conductance and transpiration rates and micronutrient availability.

Han *et al*. stated that B application (2kg/ha^{-1}) increased stomatal conductance and reduced intercellular CO_2 absorption. Enhancements in physiological characteristics may lead to better crop growth due to the initiation of various physiological processes that result in increased seed production and improved oil quality. However, B and Zn deficiencies cause yellowing of the foliage and necrosis.

Oxidative stress

In the present study, peroxidase and superoxide dismutase activity was lower under B2 + Zn8, indicating that there was low oxidative stress in this treatment. Antioxidant enzymes play an active role in reducing the detrimental effects of ROS species on photosynthesis and photorespiration. The highest peroxidase and superoxide dismutase activities were recorded for the control treatments, indicating that deficiency of B and Zn caused oxidative stress in plants. Nevertheless, B and Zn application lowered oxidative stress, as evidenced by the reduced activities of these enzymes.

Conclusions

The combined application of B and Zn (2 and 8kg/ha^{-1}, respectively) in soil could be successfully used to improve the yield, yield-related attributes, and oil quality of oilseed rape. Significantly higher oil yield and quality were recorded under the B2 + Zn8 treatment. The combined application of B and Zn significantly improved the physiological characteristics and activities of antioxidant enzymes. Therefore, successful enhancements in the yield, yield-related characteristics, and oil quality of oilseed rape can be achieved through the combined application of B and Zn at rates of 2 and 8kg/ha^{-1}, respectively, under semi-arid climatic conditions.

This article was shortened for use in *Oilseeds Focus*. For the complete article and references, visit *www.mdpi.com/2073-4395/13/8/2020.*


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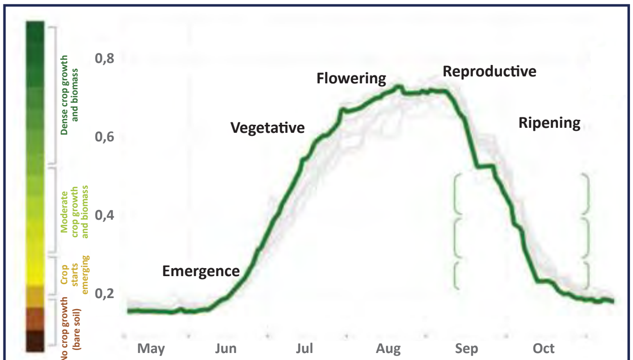
syngenta

Resources for a better canola crop

The success of a canola season largely depends on timing. You can only harvest when the crop is ripe but pods that shatter prematurely or at different times can undermine an entire season's investment when the precious seeds go to waste. Plants are not machines with an on/off switch, but chemical ripening can solve the problem – provided you get the timing right.

Chemical ripening, or desiccation, involves using herbicides and is a goldilocks process that cannot occur too early or too late. Spraying too early means the seeds are still green and their chlorophyll content too high. Spraying too late, when the crop is overripe, can cause accelerated shattering and ruin a harvest.

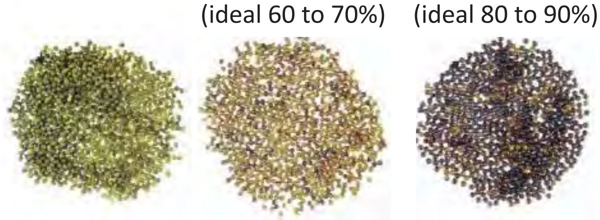
Figure 1: Use of crop growth index (NDVI) to determine ripening.



Expected % ripening according to the crop growth index (NDVI):
NDVI>0,50: According to expectation the crop would not have ripened yet.
10 to 20% for NDVI between 0,40 and 0,50.
30 to 50% for NDVI between 0,30 and 0,40.
>50% for NDVI less than 0,30.

Figure 2: Timing of swathing and desiccation spraying according to seed colour.

Too early	Swath	Dessicate
<40%	40 to 70% (ideal 60 to 70%)	70 to 90% (ideal 80 to 90%)



The optimal time is when 80 to 85% of the pods have yellowed, and the seeds inside have turned brown.

Although it sounds simple enough, canola is a tricky customer. The crop is notorious for uneven ripening and pods that tend to shatter. Growers therefore have to monitor their fields closely.

Technology to the rescue

Cropwise Operations, Syngenta's all-in-one digital farming platform, provides satellite images and information that enable crop monitoring using the normalised difference vegetation index (NDVI). NDVI is a standard index that indicates the extent of crop growth and biomass. When plotted on a season-long graph, it illustrates the heartbeat of the crop.

A value below 0,2 indicates bare soil and 0,7 or higher indicates maximum vegetative growth. *Figure 1*'s period and peak reveal the crop's productivity, closely linked to yield potential.

As the crop begins to lose its green leaf colour and ripens, the NDVI drops. This drop signals that harvest readiness is imminent and can be used as a guideline for the optimal time to apply a desiccation treatment. The calculation is as follows: Seeds start changing colour when the NDVI drops below 0,5, with 30% discolouration at an NDVI of 0,4 and 50% at 0,3.

However, the NDVI can never be more than a guideline. Field observation is the only way to determine the exact timing for spraying, especially considering the sideshoots that significantly contribute to yield. Therefore, as you walk your field, collect representative samples from both the main stems and the sideshoots of plants.

Desiccation is particularly beneficial in dense stands and when lodging is a risk. Remember to spray according to your capacity to harvest, as harvesting must take place within ten days of the application (as short as four to seven days under certain weather conditions) to prevent dry pods from shattering.

A valuable resource

Now that we have addressed the 'when', let us focus on the 'what', specifically Syngenta's resource for canola growers, REGLONE®.

REGLONE® is a fast-acting, non-volatile, water-based contact herbicide. It is highly effective for the desiccation and defoliation of canola, ensuring even ripening, reducing pod shattering, eliminating the need for swathing, and lowering harvesting costs. Additionally, desiccation can eliminate late-germinating weeds.

One of REGLONE®'s most important features is that it does not bind to the oils in the seed, thus ensuring food safety. The product also has an extremely low leaching index and soil microbes break it down into natural components such as water, CO_2 and ammonia.

Due to its contact action, REGLONE® must properly cover and penetrate the canopy to be effective. Results are also often better when you spray in conditions of low light intensity (i.e., early morning or late afternoon) and high humidity. Remember to always follow the label instructions, especially in terms of dosage, safe handling, the use of a wetting agent, and withholding periods.

For more information, visit *www.syngenta.co.za* or phone 011 541 4000.

Shining a light on soya bean meal quality

By William Greenwood and Jae Kim, AB Vista

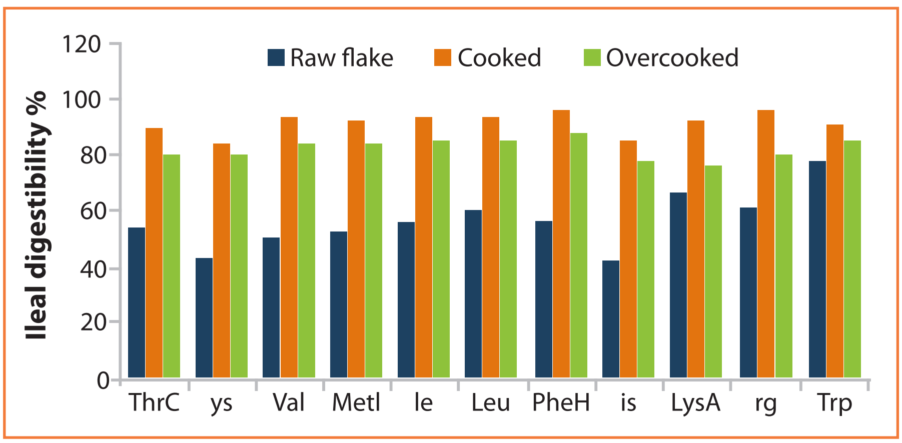
Given current soya bean meal price volatility and environmental pressures, feed producers need to have a deep understanding of its nutritional composition to optimise its inclusion in the feed and compare different suppliers.

Historically, feed producers have focussed on determining the macro-nutrient content of soya bean meal (e.g. moisture, protein, oil, crude fibre and ash) to optimise the feed formula. More recently, companies can also check more advanced nutritional parameters, such as amino acids, non-starch polysaccharide content and phytate-phosphorus.

Soya bean meal processing impacts the quality of the material, and it is now possible for feed producers to check additional protein quality indicators that can be used as a guide to check the impact of processing on soya bean meal quality, including reactive lysine content and urease activity.

Rapid analysis of these additional parameters has become available thanks to recent advancements in near-infrared reflectance technology, which is a cost-effective alternative to traditional chemical testing to check the nutritional composition of feedstuffs.

Figure 1: Ileal digestibility of soya bean meal amino acids (raw flake, cooked and overcooked form) when fed to caecectomised roosters.



Meal production

Soya bean meal production involves different steps with a range of pressures and temperatures applied to extract oils, remove anti-nutrients (e.g. trypsin inhibitors) and increase digestibility, with the most sensitive step for quality control being the desolventising-toasting (D-T) operation.

Detecting both undercooked and overcooked soya bean meal is important for feed producers to discriminate low-quality soya bean meals. The American Soya Bean Meal Association compared the ileal digestibility of amino acids in raw soya bean flake, properly cooked soya bean meal and overcooked soya bean meal in caecectomised roosters (*Figure 1*).

Table 1: A comparison summary of soya bean meal quality parameters.

	TIA	UA	KOH	PDI	Reactive:total lysine
Underprocessing	Very appropriate	Very appropriate	Low use	Appropriate	Not appropriate
Overprocessing	Not appropriate	Not appropriate	Appropriate	Low use	Very appropriate
Target values	<2,5 or <5mg/g	<0,05 or 0,30pH rise	78 to 84%	40 to 45%	>90%
Comment	Difficult	Most common	Most common	Simple method	Difficult

The study demonstrated that the ileal digestibility of all amino acids is compromised when soya bean meals are either undercooked or overcooked.

Quality check methods

Common tests for feed producers to check soya bean meal quality include:

- **Trypsin inhibitor activity (TIA):** The destruction of TIA during D-T operation is highly correlated with the destruction of urease activity and can be used as a method to detect underprocessed material.
- **Urease activity (UA):** The most common method to detect underprocessed soya bean meal, this test involves analysing the pH change due to the presence of urease. If the soya bean meal is underprocessed, there should be more urease enzyme present and there will be a greater pH rise. It is an indirect method commonly used in the industry to roughly estimate TIA, as detection is difficult and expensive. UA correlates with TIA as both enzymes are similarly deactivated at a range of heat treatments. Typically, UA is quoted in urease index units (U), and industry expectation is 0,05 to 0,3U.
- **KOH solubility:** Used to detect overcooked soya bean meal by measuring nitrogen solubility in 0,2% KOH solution. Raw soya bean meal is 100% soluble in 0,2% KOH, but the optimum quality lies between 78% (overcooked) and 84% (undercooked).
- **Protein dispersibility index (PDI):** The amount of soya bean meal protein dispersed in water after blending a soya bean meal sample in water with a high-speed blender. Optimum quality is a PDI value of 40 to 45%.
- **Reactive lysine:** Total and reactive amino acid content and digestibility are reduced during the toasting process. Lysine is a sensitive marker of overprocessing as the free amino group on its sidechain is exposed and reacts readily with sugars and fats if the temperature and moisture allow, making the lysine unusable by the animal. The reactive lysine content is a measure of the free amino groups remaining and thus the availability of the lysine for protein synthesis. Optimum values are above 90% reactive:total lysine ratio.

Overprocessed meal

KOH solubility and PDI may not be sensitive tools to detect overprocessed soya bean meal. Batal *et al*. (2000) checked the impact of feeding processed soya bean meal on broiler performance. Although KOH and PDI decreased with autoclaving time as expected, broiler performance was not affected, suggesting these methods of screening soya bean meal quality may not be reliable tools to predict the true impact of soya bean meal quality on animal performance.

The United States Soya Bean Export Council also stated that KOH protein solubility is not sensitive enough to gauge the level of heat processing that a soya bean meal product has undergone, indicating that KOH solubility only provides qualitative and not quantitative information regarding a degree of overprocessing.

Reactive lysine

During the D-T process in soya bean meal production, the carbonyl group of sugars (reducing sugars) can react with the amino group of lysine, creating a mixture of poorly characterised Maillard products. In addition, lysine can also react with other nutrients such as fats, polyphenols, vitamins and other food additives, creating unspecified compounds (*Figure 2*).

The issue with this chemical reaction is that a part of lysine detected as total lysine in high-performance liquid chromatography analysis is not bio-available for lean tissue anabolism or other biological functions, as the heat-damaged lysine is excreted through urine even if it is digested and absorbed in the small intestine.

Based on data collected worldwide, the reactive:total lysine ratio and UA can be shown based on the country of sample origin.

Practical application

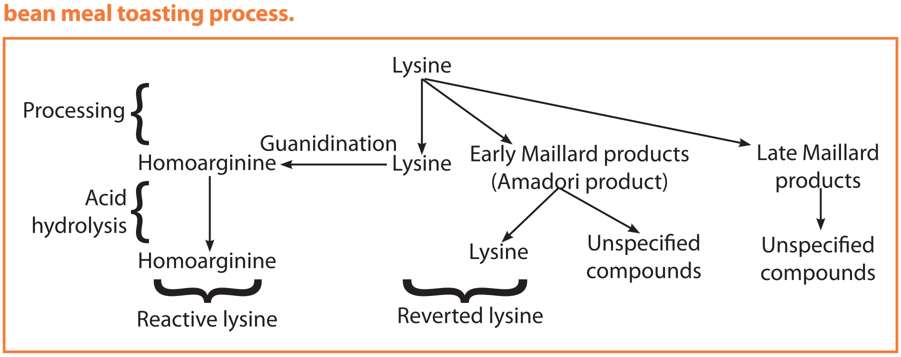
It can be predicted that approximately 15% of all soya bean meal samples could be deemed overtoasted (reactive:total lysine ratio <90%). This means feed producers should consider supplementing their feed containing this material with additional amino acids to ensure the feed contains the correct amino acid levels.

These results can be used in combination to create conversion factors in order to adjust expected standardised ileal digestibility amino acid content in the feed formulation system.

Conclusion

The various steps in soya bean meal production have an impact on the quality of the material. Traditional methods to check the impact of soya bean meal processing on quality may not be sensitive enough for use in practical situations, and urease activity and reactive lysine are the most appropriate methods to detect under- and overprocessed soya bean meal, respectively.

Figure 2: Formation of Maillard products and unspecified compounds during soya bean meal toasting process.



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A review of soya bean processing byproducts and their use in swine and poultry diets

By Katelyn Gaffield, Robert Goodband, Joel DeRouchey, Mike Tokach, Jason Woodworth, Gordon Denny and Jordan Gebhardt

Due to its importance in animal feed, soya bean meal has been extensively studied to optimise its use in livestock diets. Despite extensive research, the industry has not fully characterised specific areas of soya bean processing such as the inclusion of soya bean byproducts added back to soya bean meal during processing.

Soya bean processing byproducts can encompass a large variety of materials including weeds and foreign material, soya bean hulls, gums, soap stocks, lecithins, spent bleaching clays, and deodoriser distillates. Despite the potential for being added back to soya bean meal when a crushing plant is integrated with an oil refinery, there is currently limited information on the composition of many of these soya bean processing byproducts and their subsequent effects on soya bean meal quality and animal performance.

Therefore, there may be opportunities for a new area of research focussed on soya bean processing byproducts and their optimal use within the livestock feed industry. This review summarises the current information on soya bean byproducts with a focus on identifying the areas with the greatest potential for future research in swine and poultry nutrition.

Soya bean processing

The soya bean oil milling industry developed out of the demand for soya bean oil both for human consumption and industrial application (Shurtleff and Aoyagi, 2004). This demand is expected to grow as the production of sustainable biofuels is rapidly expanding (Wightman, 2021). This increase in demand will increase not only the production of refined soya bean oil, but also the byproducts produced throughout the oil extraction process.

The main outputs of soya bean processing are crude soya bean oil and soya bean meal. Crude oil is not viable for use in many applications, such as human consumption. Therefore, a sequence of further processing steps must be completed to refine the oil. Consequently, multiple additional byproducts are produced, which must find a market or appropriate disposal method.

Efficient soya bean processing begins with the quality of incoming soya beans. Despite the importance soya bean harvesting, handling, and storage have on the quality of the resulting products, soya bean processors have minimal control over these initial factors (Erickson, 1995a). Understanding the variability of incoming soya beans allows processors to adjust processing steps appropriately. Even small changes in soya bean oil or soya bean meal production can have large impacts on soya bean processing byproducts.

Adding byproducts devoid of protein to soya bean meal would dilute the percentage of protein in that batch potentially leading to missed specifications and increased risk of claims. Therefore, this presents an immediate challenge when aiming to characterise the composition of byproducts and their use in animal diets as their presence in soya bean meal is inconsistent throughout the industry and can be impacted by multiple factors.

Byproducts in nonruminant diets

Weeds and foreign material

Although representing a small portion of soya bean meal, weeds and foreign material can have a notable impact on animal growth performance and health. Weeds and foreign material are composed of plant parts, broken beans, weed seeds, dirt, whole beans, pods, insects, and maize (Lin, 1996). Foreign materials can potentially impact the nutritional value of soya bean meal, even at low inclusion levels, due to their high fibre content and potential for antinutritional factors.

In modern soya bean processing, it is uncommon to add weeds and foreign materials back to the soya bean meal. Weeds and foreign material screened from the soya beans are typically either added to pelletised soya bean hulls or disposed of as waste.

Soya bean hulls

Soya bean hulls constitute approximately 5% of the total soya bean and, as a result, are the greatest amount of byproduct produced during soya bean processing (Ferrer *et al*., 2016; Liu and Li, 2017). Soya bean hulls are composed of varying amounts of cellulose, hemicellulose, lignin, pectin, and proteins. Therefore, hulls are

Table 1: Summary of soya bean processing byproducts and their use in monogastric diets.

Soya bean processing byproduct	Added back to soya bean meal	Estimated amount added back to soya bean meal	Common uses	Potential implementation in monogastric diets
Weeds and foreign material	No	–	Added to soya bean hulls or disposed of in landfill.	None.
Soya bean hulls	No	–	Ruminant feedstuffs, wastewater treatment, and industrial applications.	Dietary fibre source.
Soya bean gums	Yes	0 to 2%	Lechitin production or added back to soya bean meal.	Through soya bean meal or as an energy source.
Soya bean soap stocks	Yes	0 to 2%	Acidulated for animal feed applications or added back to soya bean meal.	Through soya bean meal, as an energy source or as a pigment for poultry.
Lechitins	No	–	Food applications, livestock feed, and pharmaceuticals.	As an antioxidant or emulsification additive.
Spent bleaching clays	Yes	Up to 0,5%	Added back to soya bean meal as a flow agent, poultry feed ingredients, or disposal in a landfill.	Through soya bean meal or poultry feed additive.
Deodoriser distillates	No	–	Antioxidant or pharmaceutical applications.	None (high demand in other markets).

lignocellulosic materials that are high in fibre and contain elevated peroxidases (Liu and Li, 2017).

In addition to potential uses in industrial applications (treatment of wastewater and production of filaments), most hulls will end up in animal diets either through being added back to soya bean meal or in the form of loose or pelletised soya bean hulls (Woerfel, 1995a).

Due to the low-energy and high-fibre content of soya bean hulls, they are not commonly fed in swine diets (NRC, 2012). Past literature shows a consistent reduction in gain:feed ratio as nursery pigs are fed increasing levels of soya bean hulls (Kornegay, 1978; Kornegay *et al*., 1995). This response is largely driven by the dilution of energy as more soya bean hulls are added to the diet.

In addition to diluting the energy content of the diet, soya bean hulls may also have a negative impact on digestibility. Dilger *et al*. (2004) observed that when feeding up to 9% soya bean hulls, a 0,2% decrease in ileal digestibility of indispensable AA may occur for every 1% of added soya bean hulls. This agrees with the data of Kornegay (1978) and Bruce *et al*. (2006) who observed decreases in energy and protein digestibility when soya bean hulls were fed to growing pigs.

Despite the diluted energy and potential reductions in digestibility, soya bean hulls may have practicality in gestating sow diets, specifically within group housing systems. Fibrous ingredients, such as soya bean hulls, have the potential to manage the satiety of gestating sows when fed at greater than 100g of soluble fibre per day, ultimately helping limit aggression toward pen mates (Wensley *et al*., 2022).

High-fibre diets have shown the potential to reduce cannibalism in poultry production systems, potentially serving as a feasible replacement for beak trimming in laying hens (Hartini *et al*., 2002). Furthermore, feeding soya bean hulls has consistently shown improvements in organ development, indicated by increased gizzard and intestinal weights, potentially leading to the benefits in growth performance seen when fed at moderate levels to birds (Tejeda and Kim, 2020; Jha and Mishra, 2021).

Ultimately, soya bean hulls are likely to be pelletised and marketed as a separate byproduct stream which can act as a dietary fibre source in monogastric diets but are most commonly used in ruminant feeds.

Soya bean gums and soap stocks

Soya beans generate the highest percentage of gums compared to other vegetable oils, making this an important byproduct for soya processors (Erickson, 1995b). The composition of gums is influenced by multiple factors including the quality of incoming soya beans, differences in processing procedures, and the age and efficiency of plant machinery. Although it will vary across the industry, the *Practical handbook of soy oil processing and utilization* outlines the general composition of gums as 35% soya bean oil, 17% phytogycolipids, 16% phosphatidyl choline, 14% phosphatidyl ethanolamine, 10% phosphatidyl inositol, and 7% carbohydrates (Erickson, 1995b).

Gums and soap stocks are both products commonly added back to soya bean meal. It is most economical to include these byproducts back into the soya bean meal to reduce the cost of transportation or disposal when a crushing facility is integrated with an oil refinery. Both gums and soap stocks will contain free fatty acids and phospholipids, ultimately allowing them to potentially be used as a source of energy in livestock feed (Gerde *et al*., 2020). One challenge with characterising the effects of adding soya bean gums and soap stocks back to the soya bean meal is the variation in composition and quantity.

Studies have aimed to evaluate the use of gums and soap stocks in monogastric diets. Soap stocks have been heavily studied by the poultry industry due to their potential as a low-cost energy source that could also successfully act as a pigment (Menge and Beal, 1973; Vieira *et al*., 2006; Borsatti *et al*., 2018).

Specifically, poultry studies have indicated that replacing animal and vegetable fats and oils with dried soya bean soap stock (Menge and Beal, 1973)

or replacing degummed oil with acidulated soya bean soap stock (Vieira *et al*., 2006) resulted in similar performance, indicating soya bean byproducts may act as an adequate energy source in poultry formulations. Feeding soap stocks led to improved shank pigmentation indicating an additional benefit as a pigmenter (Menge and Beal, 1973).

The swine industry has also investigated the impact of soya bean gums and soap stocks on growth performance and digestibility. Bruce *et al*. (2006) characterised the effects of soya bean gums and soap stocks when added back during processing on the digestibility of soya bean meal in swine. They aimed to utilise quantities of gums and soap stocks representative of those typically added back to soya bean meal. This included evaluating both 1 and 3% added gums to soya bean meal as well as 0,5 and 1,5% added soap stocks to soya bean meal. They observed that increasing levels of gums and soap stocks added to soya bean meal decreased the apparent ileal and standardised ileal digestibility of crude protein and amino acids (Arg, His, Leu, Lys, Phe, Val, Ala, and Gly).

Gums and soap stocks contain residual oil from the refining process and thus may serve as a potential energy source for swine and poultry. A study using up to 8% olive oil soap stock observed no significant effect on average daily gain (ADG) or feed efficiency of growing pigs (47kg). When olive oil soap stock was fed to finishing pigs (57kg), both an increase in ADG and an improvement in feed efficiency were reported (Rojas-Cano *et al*., 2014).

Further research is needed to characterise the composition, variation, and nutritional value of soya bean gums and soap stocks before they can be utilised in monogastric diets.

Lecithin

Lecithin is derived from further processing soya bean gums. If soya bean processors are producing lecithins, the soya bean gums produced during degumming will then be de-oiled and will go through alcohol fractionation (Gerde *et al*., 2020). The most difficult step in lecithin production is drying. The gums must go from approximately 50 to less than 1% moisture through a highly controlled heating process.

Lecithin can act as an emulsifier and antioxidant which has increased its demand in baking and food, cosmetic, and industrial applications (Erickson, 1995b). Lecithin may also be used in animal feeds. The addition of lecithins has the potential to interact with added fats which is thought to improve fat digestion. However, multiple studies have failed to find a positive response in both digestibility and growth performance when lecithins were added to swine diets (Overland *et al*., 1993a, 1993b; Soares and Lopez-Bote, 2002; Gatlin *et al*., 2005; Kerr and Shurson, 2017).

Ultimately, the inclusion of soy lecithins in nonruminant diets will largely be driven by price with the benefits in poultry outweighing the benefits in swine diets.

Spent bleaching clay

Spent bleaching clay is the residual product of acid-activated earths used to remove oxidation products, remaining soaps, and residual pigments from soya bean oil. The quantity of earths or clays produced during bleaching will change depending on oil quality (Gerde *et al*., 2020).

Although steps are taken to minimise oil loss, some residual oil remains in the used earths. Some oilseed processors will add spent clays to soya bean meal as a flow agent up to the allowable inclusion of 0,5% (Smallwood, 2015; NOPA, 2021). Furthermore, processors can slurry the spent bleaching earths with crude oil and add it back to the extractor to maximise the recovery of oil (Dijkstra, 2020).

Smith (1984) observed that bleaching clays from canola processing could be fed to swine at up to 10% of the diet for 17 days without affecting growth performance or feed intake. Another study fed up to 7,5% spent bleaching clay from canola refining to broilers without negative effects on health or growth and observed a positive effect on pellet hardness (Blair *et al*., 1986). Although past literature does not report any negative effects of spent bleaching clays in swine or poultry diets, this research has been limited with most studies conducted more than 30 years ago.

Deodoriser distillate

Deodorisation is the final step in oil refining and removes volatile compounds using a distillate system to provide oil with a bland flavour, odour, and colour. This process typically removes between 95 and 98% of tocopherols and sterols in the final oil (Woerfel, 1995a). The byproduct, deodoriser distillate, is valuable as it contains 4% tocopherol and 6% sterols (Gerde *et al*., 2020).

Tocopherols are used as antioxidants and sterols are used to manufacture pharmaceuticals (Woerfel, 1995a). Due to their demand in human health and nutrition, these byproducts are more valuable in those industries and are less likely to be added to the soya bean meal to be used as animal feed.

Conclusion

Multiple byproducts are produced during soya bean processing and oil refining which must find a market or proper disposal method. These products can include weeds and foreign material, soya bean hulls, gums, soap stocks, lecithin, spent bleaching clay, and deodoriser distillates. Limited information exists throughout the soya bean processing industry on the composition and quantities produced of each byproduct.

While previous research has helped establish feeding values for some of these byproducts, more up-to-date information is needed. Both gums and soap stocks have shown a potential to act as an energy source in livestock diets, but there is limited information on the variation and quantities of gums and soap stocks produced and how they affect both poultry and swine performance. Therefore, these two soya bean processing byproducts have been identified as having the most potential value and need for additional research.

This article has been shortened for inclusion in *Oilseeds Focus*. For the complete article and references, visit *www.academic.oup.com/tas/article/doi/10.1093/tas/txae063/7645329* or email Katelyn Gaffield at gaffield@ksu.edu.

Global oil market: Significant shifts anticipated

By Christiaan Vercueil, economist, and Lerato Ramafoko, intern agricultural economist, Grain SA

The global oilseed production landscape for the 2024/25 season is poised for significant shifts, with overall output projected to increase. The global production forecast has been raised by 4,5 million tonnes, bringing the total to 690,5 million tonnes. This increase is driven largely by an uptick in soya bean and rapeseed production, although it is partially offset by declines in sunflower seed, cotton seed, peanuts, and palm kernel production.

Soya beans are a key contributor to this increase, with global production expected to reach 428,7 million tonnes – an increase of 6,9 million tonnes from earlier forecasts. This growth is attributed to higher yields and expanded planting areas in several countries, including the United States (US), Ukraine, Russia, India, and Benin. The US, in particular, anticipates a robust soya bean output of 4,6 billion bushels, up 154 million from the previous forecast due to increased acreage and improved yields.

Rapeseed production is also rising, with global output expected to reach 88,8 million tonnes, an increase of 0,9 million tonnes. This growth is largely due to expanded cultivation in Russia.

Conversely, sunflower seed production is facing challenges, with global output projected to decline by 2,3 million tonnes to 52,5 million tonnes. Adverse weather conditions in key producing regions such as Ukraine, Russia, the European Union (EU), Turkey, Serbia, and Moldova have significantly impacted yields. *Figure 1* depicts oilseed production from top world producers for 2023/24.

In recent months, oilseed markets have experienced notable price volatility, with significant fluctuations observed across key commodities such as canola, palm oil, sunflower oil, and soya bean oil. These price movements have been influenced by a complex array of factors. *Table 1* highlights some of these factors and *Figure 2* illustrates price changes in the last two months.

Local market

In the current market, South African soya bean prices are uncompetitive, especially compared to countries such as the US, Brazil, and Argentina. Local soya beans are trading above export parity due to major decreases in local production. Consequently, deep-sea exports are unlikely this season.

Soya beans are trading at R8 350/tonne, while export parity (from Durban Port to Randfontein) is at R6 479, R6 640 and R6 748/tonne for the US, Argentina and Brazil, respectively. According to the National Crop Estimates Committee's sixth

Figure 1: Production of oilseeds in 2023/24 in top oil-producing countries.

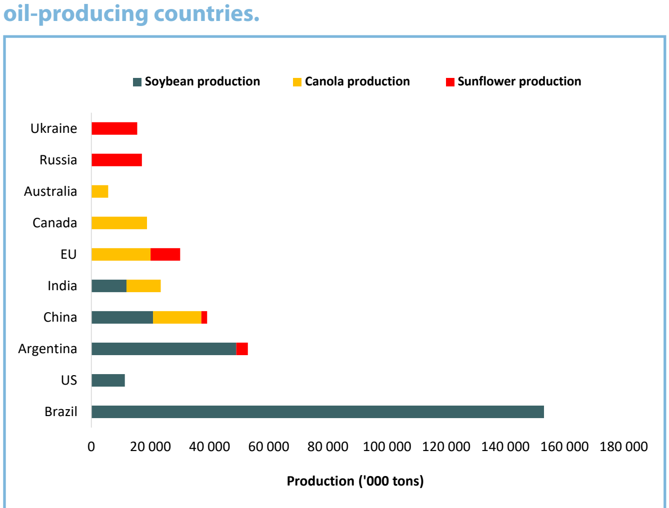


Figure 2: Comparison between oilseed prices. (Source: United States Department of Agriculture)

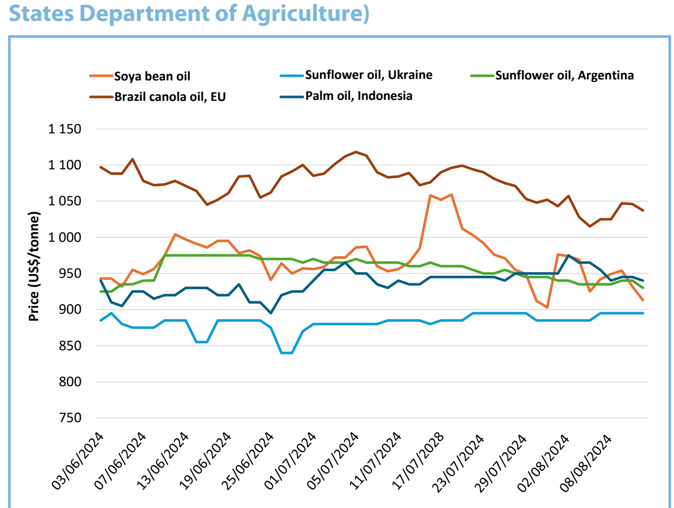


Table 1: Factors influencing commodity price movements.

Increases	Decreases
Supply constraints: Adverse weather conditions in key production regions, such as drought or excessive rainfall, have reduced crop yields for sunflower, canola, and soya beans. **Strong remand:** There has been a robust demand for biofuels, especially in the US, which has driven up the prices of soya bean and sunflower oils. **Geopolitical tensions:** Ongoing conflicts, particularly in the Black Sea region, have disrupted the export flows of sunflower oil, created supply shortages and boosted prices. **Currency fluctuations:** The weakening of local currencies in key producing countries against the US dollar has made oilseed exports more expensive.	**Improved harvest expectations:** In some regions such as the US, soya bean has yielded better-than-expected harvests. **Market corrections:** Following periods of rapid price increases, markets often experience corrections, where prices fall as traders take profits or reassess market fundamentals. **Export restrictions:** In some cases, governments have implemented export restrictions to ensure domestic supply, leading to a temporary surplus in the global market and a subsequent drop in prices (i.e. Argentina's producers restricting exports during periods of high inflation and/or low prices).

Figure 3: Prices of whole soya beans delivered in Randfontein. (Source: Grain SA)

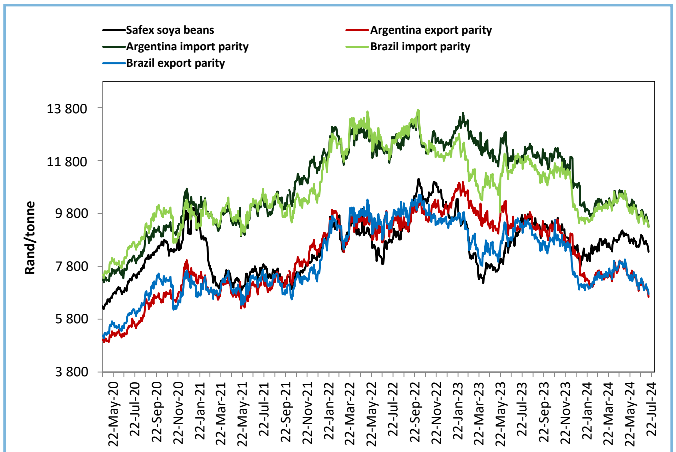


Figure 4: Prices of EU sunflower seed delivered in Randfontein. (Source: Grain SA)

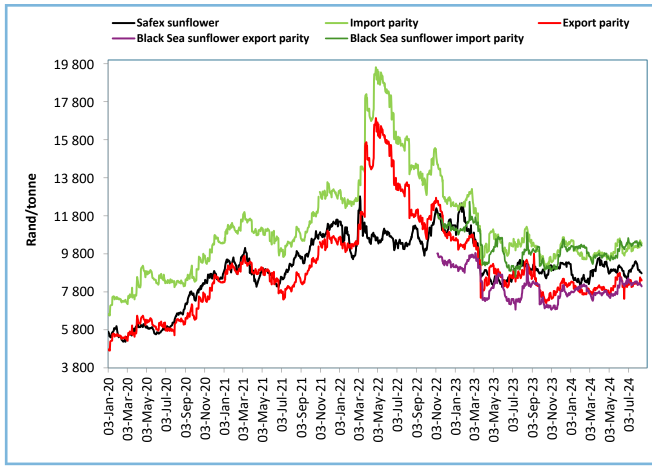
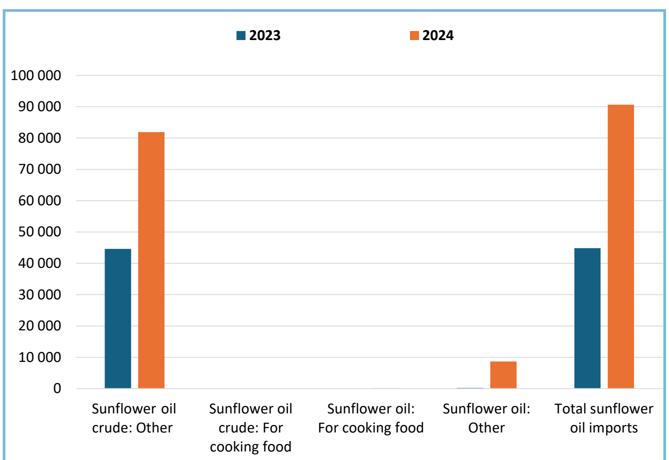


Figure 5: Sunflower oil imports 2023 vs 2024. (Source: YTD June)



crop estimate, local soya bean production is estimated at 1 778 790 tonnes, down from the final crop of 2 770 000 tonnes in the previous season.

Soya bean crushing for oil and oilcake has not slowed down significantly compared to the previous season.

Local crushing at the end of June this year totalled 569 851 tonnes compared to 578 591 tonnes, a 1,5% decrease from the previous season.

Soya bean exports (whole soya beans and products) accumulated to 103 676 tonnes at the end of June this year, compared to 195 553 tonnes at the end of June last year. Whole soya bean exports accounted for 53 788 tonnes, with Vietnam taking 27 658 tonnes, followed by Zimbabwe on 23 723 tonnes. Botswana, Mozambique, and Eswatini accounted for the rest.

Soya bean ending stocks are also estimated to be significantly lower than the previous season, with ending stocks estimated at 103 527 tonnes at the end of the 2023/24 production season compared to 320 637 tonnes in the 2022/23 season.

Increased sunflower oil imports

In the local market, sunflower prices are above export parity. Lower international prices have resulted in increased imports of sunflower oil, putting pressure on local sunflower oil prices as it is more profitable for crushers to import rather than crush local product. This trend may persist until cheaper sunflower oil is no longer available in the international market.

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South Africa's soya value chain: Key drivers and trends shaping the future

By Prof Ferdi Meyer, managing director, Bureau for Food and Agricultural Policy

The success of the South African soya bean value chain over the past decade has been well documented. Essentially, a favourable investment environment coupled with clear policy mandates from the Department of Trade, Industry and Competition prompted the private sector to invest in over two million tonnes of crushing capacity in the early 2010s.

These investments, combined with extensive cultivar trails and the introduction of a technology levy paid by producers to incentivise seed companies to provide South African producers with access to the latest seed technology, ignited rapid expansion in production.

The South African soya bean industry has been one of the fastest-growing agricultural sub-sectors over the past two decades. Production increased from just 264 000 tonnes on 165 000ha in 2008 to over 2,7 million tonnes on 1,1 million ha in 2023. Consequently, the crushing levels of soya beans also increased, and in 2023, for the first time in history, South Africa produced sufficient soya bean meal to meet local demand and replace all imports of soya meal. Furthermore, South Africa exported 597 000 tonnes of soya beans in the 2023/24 marketing season.

El Niño brings drier conditions

In the current marketing season (2024/25), the drier El Niño weather patterns have negatively impacted soya bean yields, especially in the western production regions. The National Crop Estimates Committee estimates South Africa's

Figure 1: South African soya bean production, consumption, trade and prices: 2013 to 2033.

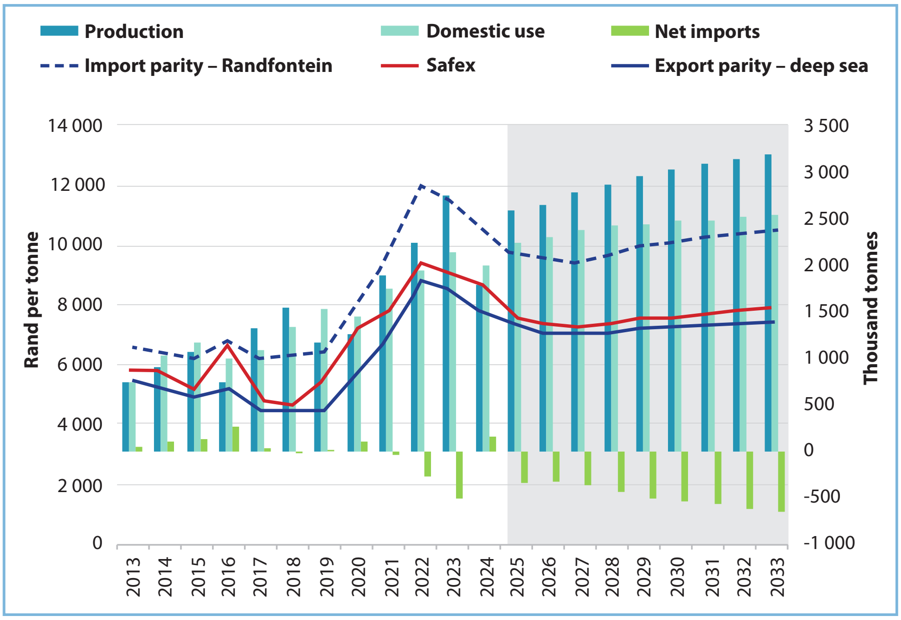
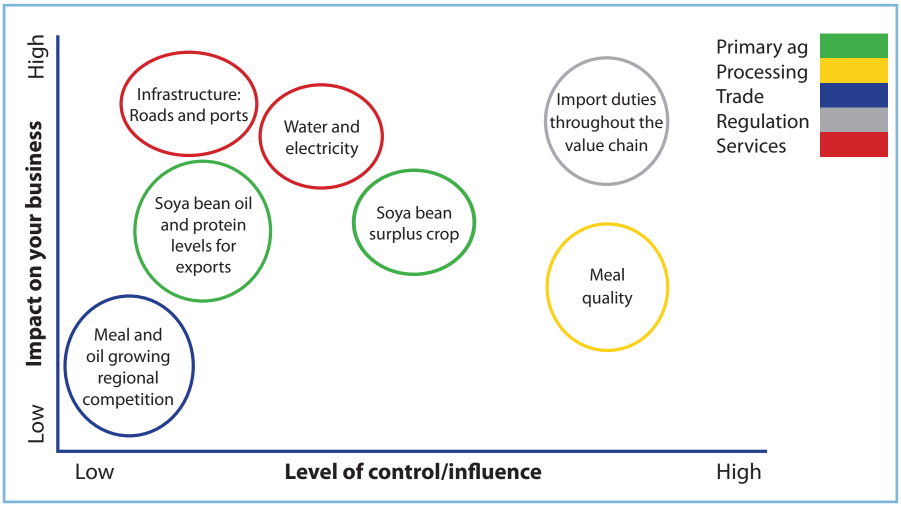


Figure 2: Key drivers of own business.



soya bean crop at just under 1,8 million tonnes, with an average national yield of 1,6t/ha, which is still a reasonable yield considering the severity of the drought. Consequently, South Africa will not be self-sufficient in soya bean meal this marketing season, and feed mills, mainly in the Western Cape, will rely on imported soya bean meal.

However, in the medium to long term, the latest baseline projections by the Bureau for Food and Agricultural Policy (BFAP) suggest that under normal weather conditions, soya bean production will continue to grow, and South Africa will produce exportable surpluses of soya beans and possibly soya bean meal (*Figure 1*).

Self-sufficiency and prices

The transitioning of the local industry from import dependence to self-sufficiency implies that local prices are trading closer to export parity levels. Consequently, local soya beans are trading at approximately 30% below the value of imported beans. This has boosted crushing margins and volumes significantly, putting crushers in a position to offer significant discounts compared to import parity prices of soya bean meal.

Over the past season, local soya bean meal prices have been trading well below import parity prices, benefiting the local intensive livestock industries' overall profitability and relative competitiveness. However, a more consistent switch to exportable surpluses and export parity-based pricing in future will expose any inefficiencies and challenges in the soya bean value chain. In short, the value chain will have to become more efficient to compete consistently in global markets at export parity levels.

An integrated approach

Over the years, the Protein Research Foundation (PRF) has contributed significantly to the success of the country's soya bean industry. Initially, the PRF identified overall productivity and competitiveness at the farm level as one of the key drivers (low-hanging fruit) to unlock growth in the soya bean value chain. However, the focus has gradually shifted to a more integrated value chain approach as farm-level productivity rates have been rapidly improving and more focus is required beyond the farm gate.

Figure 3: Key drivers of industry: Market development.

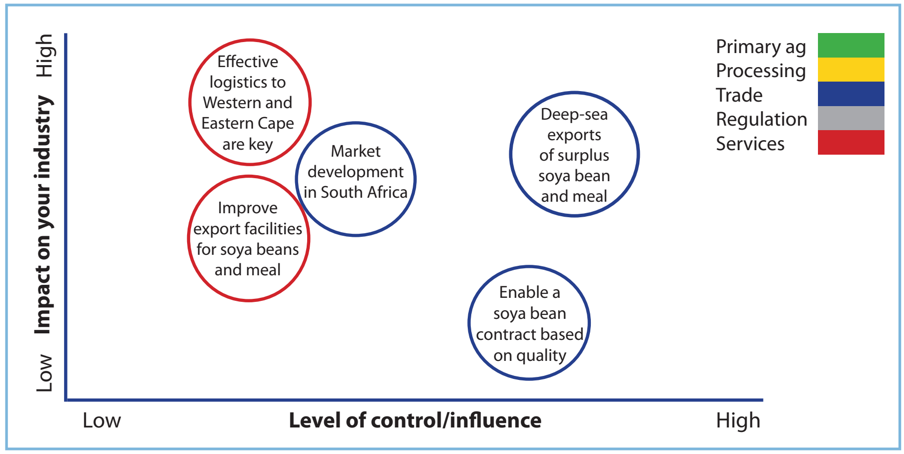


Figure 4: Key drivers of the industry: Global influence.

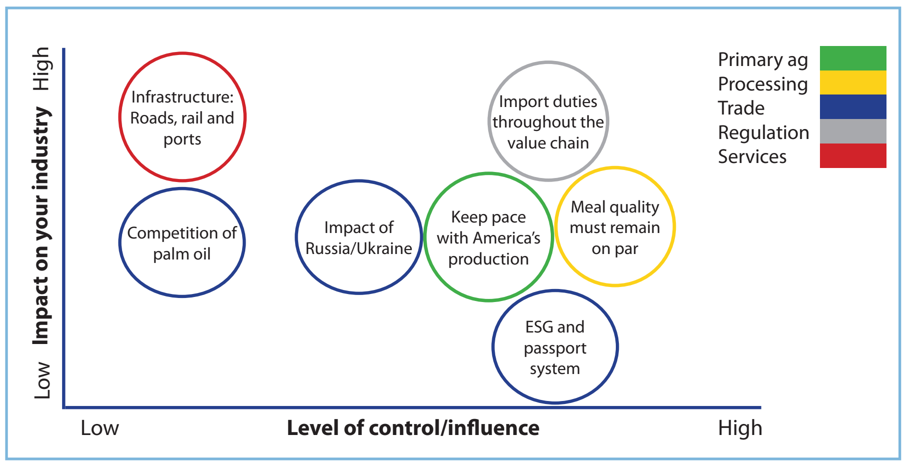
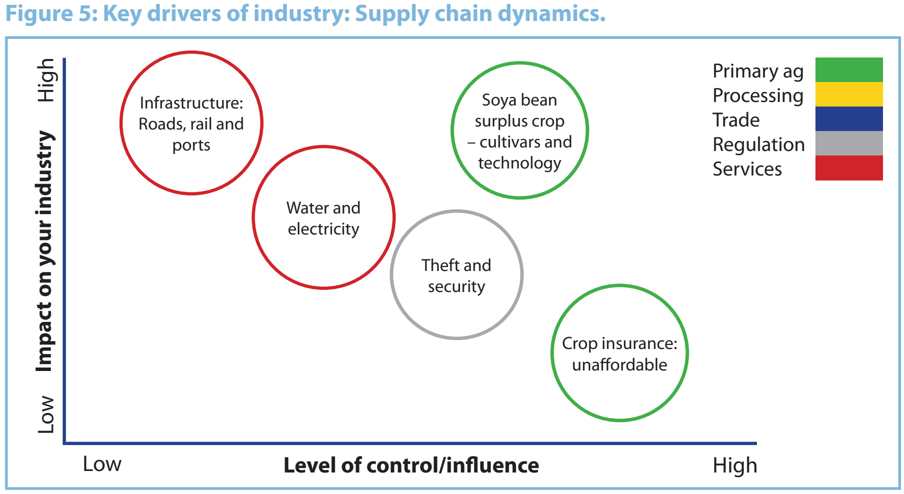


Figure 5: Key drivers of industry: Supply chain dynamics.



In December 2018, the PRF launched the Soybean Value Chain Initiative (SVC), providing a discussion platform for all stakeholders in the soya bean value chain, related segments in agriculture and government. This platform aims to deepen insights into the interconnectedness and linkages between different nodes in the value chain. Through this platform, strategic matters are tabled and debated, and potential solutions or action points are carefully considered and implemented collectively.

The vision of the SVC initiative is to unlock the full potential and overall


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Table 1: PRF soya bean value chain survey instrument.

a) Organisational focus – your own business	
List the key drivers that will influence your business in South Africa currently, medium term and long term (with a focus on protein for animal feed [oilseeds] if possible).	
b) Industry focus – oilseeds/animal feed/livestock	
Market development	How do you see the South African market develop (and potentially regional markets) and how does this influence your trade environment?
Global influences	What would you regard as the most prominent/impactful global influences?
Supply chain dynamics	Identify the key drivers that will influence supply chain dynamics.
New technologies	Which new technologies and potential adoption thereof will be most disruptive in future?
Business environment	Do you anticipate any major shifts in stakeholder dynamics/ partnerships/engagements (government and private sector, global versus regional versus local) in future?

Figure 6: Key drivers of industry: New technologies.

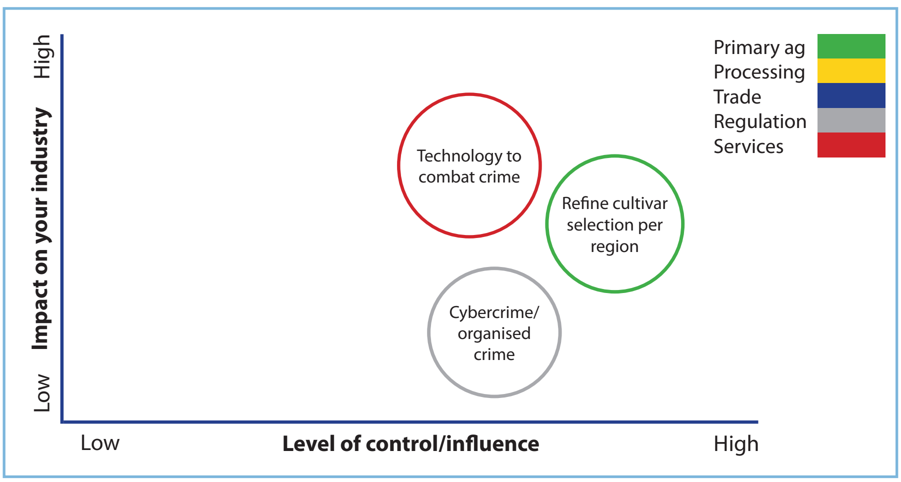
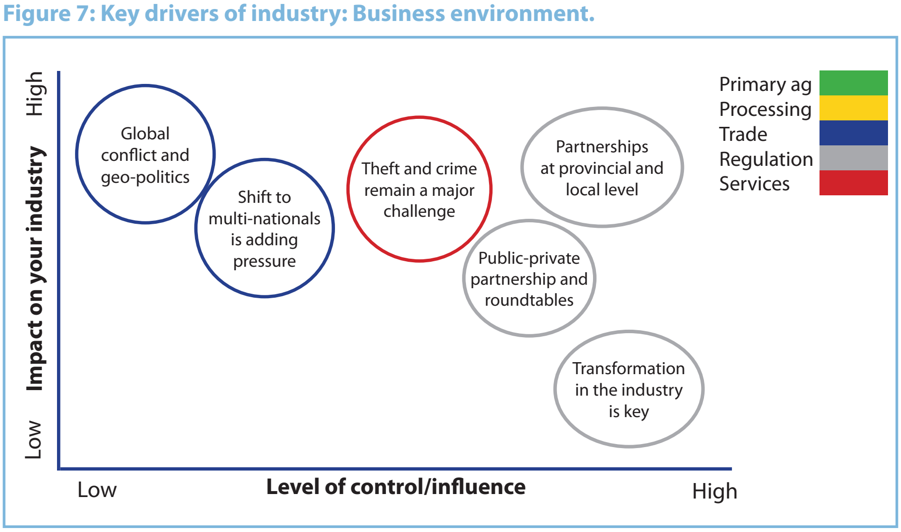


Figure 7: Key drivers of industry: Business environment.



competitiveness of the soya bean value chain and related industries by focussing on long-term competitiveness, resilience and adaptation within a constantly chaining business and political environment.

As part of the SVC initiative, the PRF has recently launched a survey among key stakeholders in the soya bean value chain, from input suppliers through to crushers, feed mills, and livestock operations. Survey participants were requested to identify the key drivers of change for their businesses and the industry. *Table 1* provides a summary of the survey instrument.

Survey participants were also requested to plot their answers on a figure where the y-axis indicates the level of impact a specific driver has on their business/industry and the x-axis indicates the level of control/influence the value chain has on a specific driver. The results from the survey were summarised and are presented in the figures in this article. The colour schemes were applied to indicate at which node in the value chain the respective drivers will have an influence and could be addressed.

Navigating complexities

Survey results indicate that a combination of market trends, geo-political dynamics, and local service-related challenges are shaping a far more complex reality for the South African soya bean value chain. The collapse of our road and rail network, port facilities, and electrical grid has put all our agriculture and agro-processing value chains on the back foot.

When it comes to grains, oilseed, and livestock production, South Africa is a very small player in the global market. These inefficiencies are becoming the biggest drivers of South Africa's relative competitiveness in global markets. Robust partnerships and dialogue among all stakeholders in both the private and public sectors are key to providing the necessary focus and prioritisation of specific actions that will enable South African value chains to prosper, create jobs, and drive inclusive growth in these complex global dynamics.

Prof Ferdi Meyer is a trustee of the Protein Research Foundation and chair of the Soybean Value Chain.
He is also the managing director at BFAP and an extraordinary professor in agricultural economics at Stellenbosch University.
To contact him, send an email to ferdi@bfap.co.za.

World oilseed markets and trade, July 2024: Increase in global oilseed production

Issued by the United States Department of Agriculture's Foreign Agricultural Service

Mexico's soya bean meal imports are expected to continue rebounding from the nine-year low seen in 2022/23, reaching the second-highest total ever at over two million tonnes in 2024/25. Limited domestic soya bean production makes Mexico structurally dependent on imports for livestock feed. Feed manufacturers evaluate the cost of utilising domestically crushed soya beans versus importing meal to supply their operations. The 2023/24 marketing year has seen strong import demand for soya bean meal supplied by the United States (US) due to competitive prices.

In 2022/23, lower soya bean meal imports in Mexico were attributed to high prices resulting from reduced global supplies. In the same period, Argentina, historically the world's top soya bean meal exporter, experienced a significant drought that reduced soya bean yields and exportable supplies. Consequently, soya bean meal prices increased relative to soya beans, and Mexico's feed industry turned to domestic crushers to support the growing demand from their livestock-producing customers. To support larger crush volumes, Mexico increased soya bean imports to record levels in 2022/23.

In 2023/24, several factors eased global soya bean meal availability and pressured prices. First, a rebound in Argentina's soya bean production allowed for crush to return to normal levels. Also, record Brazil soya bean meal exports and rising US crush increased global exportable supplies. Lower meal prices and continued expansion in the Mexico livestock industry is increasing demand for meal in 2023/24. As a result, Mexico's soya bean meal imports are up by 24% while soya bean imports are relatively flat.

The outlook for 2024/25 is bound by many of the same fundamentals seen in 2023/24. Large US soya bean crush and higher Brazil soya bean production are expected to continue. Growing Mexican livestock and poultry production is expected to drive further increases in Mexico's soya bean meal consumption. Both soya bean and soya bean meal imports are forecast to continue expanding. Soya bean imports are expected to reach a record in 2024/25, while soya bean meal imports are anticipated to reach the second-highest level on record.

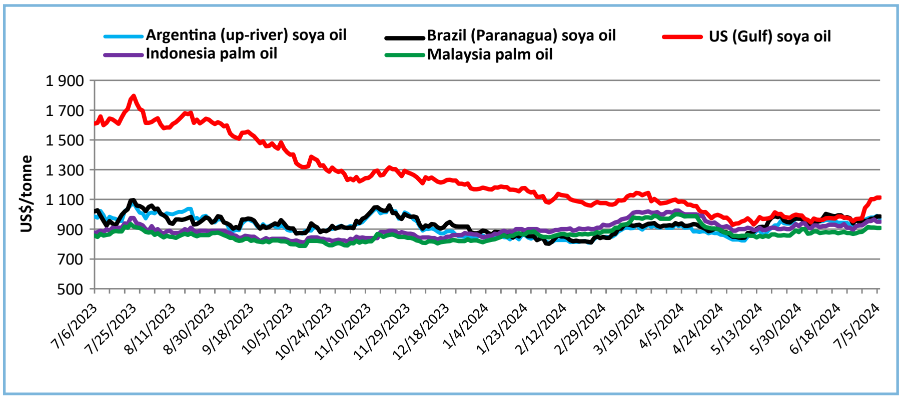
Table 1: Outlook changes for 2023/24 (all figures in thousand metric tonnes). Trade pace to date.

Country	Commodity	Attribute	Previous	Current	Change
Argentina	Oilseed, soya bean	Exports	4 600	5 600	1 000
Argentina	Oilseed, soya bean	Imports	6 500	6 700	200
Australia	Oilseed, rapeseed	Exports	4 600	4 900	300
Brazil	Meal, soya bean	Exports	21 100	21 800	700
Brazil	Oil, soya bean	Exports	1 800	1 400	-400
Brazil	Oilseed, soya bean	Exports	102 000	103 000	1 000
Brazil	Oilseed, soya bean	Imports	600	750	150
China	Meal, soya bean	Exports	1 000	1 300	300
China	Oil, palm	Imports	5 900	5 400	-500
China	Oil, sunflower seed	Imports	1 450	1 250	-200
China	Oilseed, rapeseed	Imports	3 400	3 700	300
China	Oilseed, soya bean	Imports	105 000	108 000	3 000
European Union	Meal, sunflower seed	Exports	750	900	150
European Union	Meal, soya bean	Imports	15 800	16 100	300
European Union	Oilseed, soya bean	Imports	14 300	13 800	-500
India	Oil, sunflower seed	Imports	2 900	3 100	200
Indonesia	Oil, palm	Exports	26 750	26 000	-750
Iran	Meal, soya bean	Imports	1 600	2 500	900
Malaysia	Oil, palm	Imports	800	550	-250
Paraguay	Oilseed, soya bean	Exports	6 650	6 850	200
Thailand	Meal, soya bean	Imports	3 150	3 000	-150
Thailand	Oilseed, soya bean	Imports	3 900	3 700	-200
Turkey	Oil, sunflower seed	Imports	1 275	1 475	200

China ramps up soya bean imports

In July this year, the United States Department of Agriculture (USDA)

Figure 1: Soya bean and palm oil export prices. (Source: International Grains Council)



increased its 2023/24 forecast for China's soya bean imports by three million tonnes, reaching a record 108 million. This large import volume is driven by falling soya bean export prices, pressured by robust South American supplies.

Due to the strong pace of exports to date, the USDA also increased Brazil and Argentina's soya bean export projections for the October 2023 to September 2024 marketing year by one million tonnes each to 103 million and nearly six million tonnes, respectively. Brazil's local year exports (2023/24, January to December 2024) remain unchanged at 97 million tonnes.

Larger 2023/24 carrying supplies in October 2023 allowed Brazil to continue exporting substantial volumes at highly competitive prices during the traditional US shipping window last autumn. With another large harvest coming to an end in the Southern Hemisphere and the devaluation of the Brazilian real, soya bean export prices are back to a downtrend, accelerating China's buying in May and June.

Combined soya bean exports from Brazil and Argentina to China between August and June are estimated at 74 million tonnes. In contrast, US exports to China during the same period dropped to nearly 25 million tonnes, more than a 20% decline compared to the previous year.

Market focus is expected to shift from South America to US harvest progress and crop size. With highly competitive Brazil prices, another year of abundant Brazil carryout, and new record production prospects for the Southern Hemisphere in 2024/25, US soya bean exports may continue to experience greater competition post-harvest.

Overview of 2024/25

The global oilseeds production forecast increased by approximately 300 000 tonnes to 686,1 million in July, largely the result of an improved outlook for Canadian rapeseed, along with higher production of US cottonseed and peanuts. However, reductions in Russian sunflower seed and US soya bean outputs lowered the net global production increase. Oilseed trade increased 500 000 tonnes driven by higher Canadian rapeseed exports. Oilseed ending stocks are forecast slightly higher with greater carryout of rapeseed, peanut, and sunflower seed more than offsetting lower soya bean ending stocks.

Global crush is reduced due to lower sunflower seed utilisation. Global meal trade is down by nearly 300 000 tonnes, primarily due to decreased sunflower seed meal exports from Russia and Ukraine. Global vegetable oil trade is down slightly on lower sunflower seed oil exports from these countries.

The projected US season-average farm price for soya beans decreased by 10c to US$11,10 per bushel.

Overview of 2023/24

The global oilseeds production estimate increased by almost 400 000 tonnes due to greater rapeseed, peanut, and sunflower seed production in China. This increase more than compensates for the lower soya bean production in Argentina and reduced rapeseed production in India. Global oilseeds trade is almost three million tonnes higher, largely due to increased soya bean exports from Argentina and Brazil, primarily to China.

Global oilseeds ending stocks have slightly increased due to a larger carryout of soya bean, sunflower seed, and rapeseed. The oilseed crush estimate has been raised by 400 000 tonnes due to greater peanut and rapeseed utilisation.

Global meal trade has increased by over one million tonnes, driven by higher soya bean meal exports from Brazil and China. However, the vegetable oil trade has decreased by over 900 000, mainly due to the lower palm and soya bean oil trade. The projected US season-average farm price for soya beans is down 5c to US$12,50 per bushel.

Export prices

In June, soya bean prices were pressured as the US crop progressed under favourable weather conditions. US soya bean meal prices declined in tandem with soya bean prices. The combination of higher US soya bean oil exports in April and May, as well as a rally in palm oil prices in Malaysia, strengthened US soya bean oil prices (*Figure 1*). In Brazil, the decline of the real against the dollar encouraged producers to boost soya bean sales. This led to an acceleration in China purchases and increased Brazil exports in June.

Although Brazil and Argentina's soya bean prices followed US declines, South America remained more competitive on the global market. A weaker real is likely to encourage more Brazil exports and continue to put pressure on future sales in the US.

Soya bean meal prices in South America followed the downtrend in soya beans. Both Brazil and Argentina continue to supply significant amounts of meal to global markets as crush increased following the influx of harvested soya beans. Soya bean oil prices in South America recorded a slight uptick in July, most likely following US and Malaysian price hikes.

For more information and the full report, visit *www.fas.usda.gov*.

Sagis AGM spotlights grain industry challenges and highlights

By Elmarie Smit, Plaas Media


Zuvuyo Ngejane, chairperson of the Maize Trust, was appointed as the new Sagis chairperson. Here he is with Oliver Flake, minister counsellor for Agricultural Affairs at the United States Embassy, Dr Erhard Briedenhann, outgoing chairperson of Sagis, and Bernard Schultz, general manager of Sagis.

The 27th annual general meeting of the South African Grain Information Service (Sagis) was recently held at the Woodhill Country Club in Pretoria.

Outgoing chairperson, Dr Erhard Briedenhann, presented the annual report for the 2023/24 financial year, shedding light on the impact of current global instability and conflicts on grain availability in regions such as Ukraine, Russia, and the Middle East. He emphasised that food security in especially Africa has come under threat. The drought in Southern Africa during the 2023/24 season has impacted crops negatively, turning many countries from net exporters to net importers. This has also reduced South African exports significantly, South Africa being a major grain-producing country in the region.

It is encouraging and a tribute to robust structures created historically, that South Africa still has formal and unbiased agricultural information available to the market provided by institutions such as Sagis, a resource many countries envy. Data supplied by Sagis plays an important role in planning and decision-making within the grain and oilseeds supply chain, including improved risk management. The institution needs to be nurtured and cherished for future generations.

Under the microscope

Sagis was established in November 1997, following the deregulation of marketing and control boards in South Africa, to supply the grain and oilseeds industry with essential market information. The four industries served by Sagis are maize (white and yellow separate), oilseeds (sunflower, soya bean, canola and groundnuts), winter grains (wheat, barley and oats), and sorghum.

Before deregulation the control boards of the four industries managed the information service. The *Marketing of Agricultural Products Act, 1996 (Act 47 of 1996)* brought an end to single-channel marketing and the control boards. However, role-players realised the importance of reliable information for the functioning of a free market and co-operated to establish Sagis.

Sagis' main task is to publish monthly data and information on nine types of grains and oilseeds produced in the country. Over the years, the industry has requested more detailed data related to grains and oilseeds to be collected and published. Users of Sagis information can be categorised into three main sectors: primary producers, traders/processors, and policymakers.

According to the annual report, all Sagis statutory measures were extended for another four years on 2 February 2024. The Ashton CA (SA) Group conducted an audit at Sagis for the 2023/24 financial year, resulting in an unqualified audit report. Highlights of the financial year included a 2,75% increase in membership fees, a 56,3% increase in interest received, and a 5,8% increase in administrative expenses.

An American perspective

Oliver Flake, minister counsellor for Agricultural Affairs at the United States Embassy in South Africa, also shared an interesting outlook on maize, wheat, and soya beans. He stated that global maize prices are expected to decline even more with an expected increase in exporter stocks. Record global production of maize, soya bean, and wheat is expected for the coming year, while current record global wheat consumption exceeds the record production levels.

Flake also highlighted production changes in Ukraine, which have positively impacted oilseed prices.

For more information, visit *www.sagis.org.za*.

Breaking down the AfCFTA

By Bruce Takefman, FDI Insights

The African Continental Free Trade Area (AfCFTA) is a trade agreement that has already proven to be a game-changer for global trade. Covering nearly the entire African continent, the AfCFTA was brokered by the African Union (AU) and signed on 21 March 2018 in Kigali, Rwanda. The agreement aims to establish a single market for goods and services in Africa, facilitate the free movement of people, and spur economic growth and development across the continent.

With 54 signatories, the AfCFTA is the largest free-trade area in terms of the number of member states, second only to the World Trade Organization. It is also the largest in terms of population and geographic size, encompassing over 1,3 billion people across Africa.

This ambitious trade pact creates a single market for goods and services across member states and deepens the economic integration of Africa. It is expected that the trade area created by this agreement could have a combined gross domestic product of approximately US$3,4 trillion.

Events that shaped the AfCFTA

Although trade under AfCFTA commenced on 1 January 2021, it is important to note that the process leading up to this point was a lengthy one, spanning several years. The agreement itself was signed in 2018, but it took many years of negotiations, consultations, and deliberations to reach that point. Roots of the AfCFTA trace back to the 19th session of the AU in 2012, where African heads of state and government came to the decision to establish a free trade area across the continent by 2017.

Official negotiations for the AfCFTA were launched in 2015 by African heads of state and government at the 25th Ordinary Session of the AU. These negotiations continued until March 2018, where the agreement was signed at the tenth Extraordinary Session of the AU Assembly of Heads of States and Government, where 44 of the 55 AU member states signed the agreement establishing the AfCFTA.

Almost exactly a year following the signing of the agreement, the AfCFTA entered into force on 30 May 2019. The operational phase of the AfCFTA was launched during the 12th AU Assembly in July 2019. At the time, 27 countries had ratified the AfCFTA, while 28 others had signed but not yet ratified. As of February 2023, 46 of the 54 signatories have deposited their instruments of ratification for the agreement, making them state parties to the agreement.

AfCFTA's key objectives

According to the World Bank, the AfCFTA agreement aims to provide broader and deeper economic integration across the continent as well as attract investment, boost trade, provide better jobs, reduce poverty, and increase shared prosperity in Africa.

General objectives

- Lay the foundation for the establishment of a Continental Customs Union.
- Liberalising intra-African trade.
- Resolve the challenges of overlapping memberships in regional economic communities and expedite the regional and continental integration processes.
- Enhance the competitiveness of the economies of state parties within the continent and global market.
- Contribute to the movement of capital and natural persons and facilitate investment.
- Promote and attain sustainable and inclusive socio-economic development, gender equality, and structural transformation of the state parties.
- Promote industrial development through diversification and regional value chain development, and agricultural development.

Framework protocols

To actualise these general objectives, the AfCFTA lays out seven framework protocols for all state parties to adhere to:

- Eliminate tariffs and non-tariff barriers to trade in goods progressively.
- Liberalise trade in services progressively.
- Co-operate on investment, intellectual property rights, and competition policy.
- Co-operate on all trade-related issues.

Table 1: Operational tools of the AfCFTA.

Rules of origin	Online tariff negotiation portal	No tariff barriers mechanism	Pan-African payment and settlement platform	African trade observatory
Criteria that confer to a specific product 'an economic nationality'. These rules determine the minimum level of processing of a product on the continent, so that it benefits from advantages provided by the AfCFTA agreement.	A tool that aims to facilitate and accelerate the harmonisation of data needed for negotiations, and to support the preparation and submission of offers based on countries' priorities, in accordance with AfCFTA's tariff liberalisation schedule.	An online mechanism for the notification, monitoring, and elimination of non-tariff barriers under the AfCFTA. The tool is accessible via *www.tradebarriers.africa/*.	A digital payment system that will help companies to clear and settle intra-African trade transactions for goods and services in their local currencies.	An online platform that will collect, process, and analyse intra-African trade data and other related information.

- Co-operate on customs matters and the implementation of trade facilitation measures.
- Establish a mechanism for the settlement of disputes concerning their rights and obligations.
- Establish and maintain an institutional framework for the implementation and administration of the AfCFTA.

Each protocol sets out a specific agenda, describing what exactly is intended, the timeline for achieving it, and benchmarks for assessing the results.

Furthermore, to operationalise the agreement, five operational tools have been adopted, as set out in *Table 1*.

Impact of the AfCFTA

The significance of the AfCFTA cannot be overstated. The agreement has a broad scope and ambitious goals for the continent. The AfCFTA presents a significant prospect for African countries, as it has the potential to transform markets and economies throughout the region.

It is projected to have a positive impact on the output of various sectors such as services, manufacturing, and natural resources, which would translate to increased economic growth and development. Estimates suggest that the AfCFTA has the potential to boost intra-Africa trade by 52,3% by eliminating import duties and double this trade if non-tariff barriers are also reduced. Furthermore, the AfCFTA is expected to expand Africa's economy to US$29 trillion by 2050.

The full implementation of the AfCFTA could significantly improve the lives of people across the African continent. According to the World Bank, the AfCFTA could lift 30 million Africans out of extreme poverty and boost the incomes of almost 68 million others who live on less than US$5,50 a day, boost wages for skilled workers by 9,8% and for unskilled workers by 10,3%, and spur larger wage gains for women, estimated at 10,5% compared to 9,9% for men.

The agreement will not only have enormous continental impacts, but also significant global impacts. As the largest free trade area in the world in terms of membership, population and geographic size, this agreement is a game-changer for global trade.

Furthermore, the agreement could boost Africa's income by US$450 billion by 2035 (a 7% increase) while adding US$76 billion to the income of the rest of the world and increasing Africa's exports by US$560 billion, with most of this growth expected in the manufacturing sector.

The agreement has the potential to significantly boost economies, reduce poverty, promote gender equality, and improve governance. With the potential to expand Africa's economy to US$29 trillion by 2050, the AfCFTA is transforming the African economy and becoming a model for cross-border co-operation worldwide.

This article has been adapted for use in *Oilseeds Focus*. Read the full article at *www.researchfdi.com/resources/articles/breaking-down-the-afcfta-what-you-need-to-know-about-africas-latest-trade-initiative/*.

Innovative soya solutions: Meeting community needs

By Dr Brandon van Rooyen, manager, Food Innovation Lab, University of the Free State

The University of the Free State (UFS) and the Oil and Protein Seeds Development Trust (OPDT) are funding a new transformation project. It is divided into two main focus areas and is highly interdisciplinary.

The primary focus is on developing nutritious snacks and beverages to address both under- and overnutrition in South Africa. The second is promoting small-, medium-, and micro-sized enterprises in low-income communities by training and educating them on the benefits of soya as food source, and how to process it into income-generating products. This initiative not only uplifts communities financially, but most importantly allows community members to access affordable and nutritious food choices.

This initiative is directed by Prof Wilna Oldewage-Theron, professor in nutrition at Texas Tech University and research fellow at UFS. She collaborated with the Food Innovation Lab at UFS to develop a range of commercially viable, low-cost, high-protein snacks and dairy analogues from the humble soya bean. The Food Innovation Lab was envisioned by Prof Johan van Niekerk, department head at the Faculty of Natural and Agricultural Sciences at UFS. I'm leading the development of these exciting new products with my industry expertise in product development and commercialisation.

Identifying a need

UFS joined the project at the beginning of 2023. Initially, we developed roasted soya nut snacks and soya-based mincemeat analogues. This year, we expanded the project further. During a community engagement initiative at the Best is Good Enough Academy in the Vaal region, we identified a need to develop soya milk-derived products.

The community was eager to create new and exciting products from the affordable soya milk they could easily produce. In response, we went back to the drawing board and devised a plan to meet their needs.

A range of products

We have successfully developed low-cost, high-protein milk drinks from soya milk in a variety of exciting flavours. Furthermore, we created a range of yoghurts from soya milk, some of which contain real fruit.

During the process of extracting soya milk from soya beans, a fibrous byproduct called okara is produced. This byproduct, which contains protein and other nutrients, is usually discarded, although being perfectly good for human consumption. We utilised the okara to form a dough, which we then used to make *vetkoek* and a variety of savoury biscuits.

Beyond the novelty of our new soya products in terms of taste, flavour and appearance, significant research and development went into ensuring their commercial viability while maintaining low costs. We also managed to retain all the nutritional benefits offered by raw soya milk.

Health benefits

Soya beans, used to make soya milk, are packed with nutrients and are naturally free of saturated fats. Most importantly, they are high in protein. Soya protein is particularly beneficial as it contains all essential amino acids for human growth and development, which are often not available in sufficient quantities from other plant sources.

Essential amino acids are the building blocks for muscles and essentail for body development. In low-income

Dr Brandon van Rooyen, lecturer at the Department of Sustainable Food Systems and Development at the University of the Free State and manager of the Food Innovation Lab, is a member of the team that is developing new soya products.

The UFS team developed a range of yoghurts from soya milk, some of which contain real fruit.

Soya beans, used to make the soya milk, are packed with nutrients and naturally free of saturated fats. Most importantly, they are high in protein.

communities, protein deficiency is common due to limited access and high costs. The products we have developed will be essential to address these community nutritional requirements.

Furthermore, over-nutrition is characterised by the overconsumption of high-energy, low-nutrient foods. This is prevalent in these communities, leading to health issues such as high blood pressure and insulin resistance, even in young children. Our products aim to combat this national crisis many South Africans face.

Price comparison

How do the prices of this new range of high-protein, soya 'dairy' alternatives compare to that of similar products in stores? For the quality and protein content provided by the product, few alternatives offer similar nutritional benefits at such a low cost. One kilogram of dried soya beans can produce 2kg of soya milk. Depending on market prices, 1kg of soya beans typically costs less than R10, highlighting its financial benefits over meat, dairy, and eggs.

Distribution outlets

Currently, we are actively involved in educating communities regarding the benefits of soya milk as a dairy alternative. With schools already producing their own soya milk, we are now conducting market research and optimisation developments based on consumer feedback. So far, they have been very well received. Our goal is to see these products available in all schools, hospitals, and retail stores.

Project participants and partners

In addition to Profs Oldewage-Theron and Van Niekerk, and Dr Van Rooyen, several other researchers contributed to the project. They include Dr Dolapo Adelabu, research fellow, Vuyelwa Nkoi, PhD student and researcher, and Khezwo Nematshema, MSc student and researcher.

Our funder, OPDT, has played a continued role in our success and furthering of soya products within communities. UFS has also supported this project as it falls within the goals for UFS Vision 130.

In July this year, UFS hosted the South African Association for Food

The product range includes low-cost, high-protein milk drinks from soya milk in a variety of flavours.

Science and Technology along with key industry partners from the Free State. During the workshop, the Innovation Lab presented its latest products, sparking productive discussions regarding the commercialisation and large-scale production of these soya products.

Future plans

In a bid to address food and nutritional security, we will continue optimising these products, and provide the best quality products to communities in need. We encourage communities and industry to get involved and contact us and build a better tomorrow, today.

For more information, send an email to Dr Brandon van Rooyen at vanrooyenbb@ufs.ac.za, or Prof Johan van Niekerk at vniekerkja@ufs.ac.za.

(Photograph: www.freepik.com)

Tofu: Potential health and economic gold mine

By Susan Marais, Plaas Media

According to statistics, 70% of South African females over the age of 15 are overweight and in 40% of cases, they are considered obese – these figures are based on official data provided to the World Obesity Forum by the South African government.

South Africa's female population ranks as the 25th most obese out of 200 countries, with an obesity rate of 47,35%. The male population ranks 131st with an obesity rate of 14,5%. Among girls, the obesity rate is 9,08%, placing them 98th, while boys have an obesity rate of 5,13%, ranking 160th.

While some might argue that these figures are not alarming, South Africa was named the unhealthiest country on earth by the *Indigo Wellness Index* in 2019 – the index tracked the health and wellness status of 151 countries. A lack of dietary diversity was one of the key reasons for this result. On average, South Africans consume twice the recommended amount of meat and three times fewer vegetables. Furthermore, high blood pressure is the most common non-communicable health issue among South Africans.

Although the situation in South Africa is dire, it is not unique to the country. Dr Tedros Adhanom Ghebreyesus, director-general of the World Health Organization, stated during the Conference of the Parties 28 that the world's food systems are harming the health of people, contributing to over 30% of greenhouse gas emissions, and accounting for almost a third of the global disease burden. "Transforming food systems is essential by shifting towards healthier, diversified, and more plant-based diets," he said.

This is where soya beans and tofu come in. Not only do soya bean plants pull carbon dioxide from the air through photosynthesis, but recent studies show that the consumption of isoflavones found in soya and soya products have numerous health benefits.

Heart health study

The association between soya product consumption and the risk of cardiovascular death in Chinese individuals, with and without a history of cardiovascular disease (CVD), was examined in a study by Wang *et al.* (2021) and published in the *European Journal of Nutrition*.

The analysis included 487 034 individuals free of CVD and 22 923 individuals with a history of CVD at the study's baseline. Data on soya product consumption was collected by a food frequency questionnaire. The Cox proportional-hazards model was used to obtain the hazard ratios (HRs) of cardiovascular mortality associated with soya product consumption among people with and without a history of CVD at baseline.

During the follow-up period, 12 582 cardiovascular deaths were recorded among people without a history of CVD, and 2 860 among those with a history of CVD. Compared to those who never or rarely consumed soya products, the multivariable HRs (95% confidence interval [CI]) were 1,02 (0,96 and 1,08) for those who consumed soya products monthly, 1,01 (0,95 and 1,07) for those who consumed soya products one to three days per week, and 0,95 (0,88 and 1,04) for those who consumed soya products more than four days per week.

For cause-specific mortality, soya product consumption was inversely associated with mortality from acute myocardial infarction (HR [95% CI] = 0,75 [0,61 and 0,92]). Among people with a history of CVD, higher soya product consumption was not associated with cardiovascular mortality.

Consuming soya products four or more days per week was associated with a significantly lower risk of mortality from acute myocardial infarction compared to people without a history of CVD who never or rarely consumed soya products. Among people with a history of CVD, higher soya product consumption was not associated with cardiovascular mortality.

Soya lowers CHD risk

An article published in the April 2020 edition of the American Heart Association's journal, *Circulation*, examined the impact of soya consumption on heart disease and cancer risk. Titled "Isoflavone intake and the risk of coronary heart disease in US men and women", the study analysed data from 74 241 women from the *Nurses' Health Study* (NHS, 1984 to 2012), 94 233 women from the *NHS II* (1991 to 2013), and 42 226 men from the *Health Professionals Follow-Up Study* (1986 to 2012), all who were free of cardiovascular disease and cancer at baseline.

Dietary data were updated every two to four years using a validated food frequency questionnaire. Nonfatal myocardial infarction and coronary heart disease (CHD) deaths were adjudicated by reviewing medical records, death certificates, and other medical documents.

The study documented 8 359 incident CHD cases during 4 826 122 in-person follow-up visits. Consumption of tofu, but not soya milk, was inversely associated with the risk of CHD. Researchers compared those who consumed tofu more than once per week with those who consumed it less than once per month.

The study's researchers concluded that a higher intake of isoflavones and tofu was associated with a moderately lower risk of developing CHD.

Nutritional value of tofu

British nutritionist, Jo Williams, describes tofu as a popular bean curd that is derived from soya beans. "It is made by curdling fresh soya milk, pressing it into a solid block and then cooling it, in much the same way that traditional dairy cheese is made with milk." Tofu is a staple in Thai and Chinese cuisine, and can be prepared in various ways.

Williams highlights the fact that tofu is a complete protein source rich in protective plant compounds and nutrients. It may alleviate peri-menopausal symptoms, support heart health, manage cholesterol, and regulate blood sugar levels. In addition, tofu can potentially benefit bone health, improve mood, and reduce the risk of certain cancers.

Regarding its nutritional profile, a 100g serving of steamed tofu provides 73 kilocalories of energy. It contains 8,1g of protein, 4,2g of fat (including 0,5g saturated fat, 0,8g monounsaturated fat, and 2g polyunsaturated fat) and 0,7g of carbohydrates.

"The calcium levels of tofu may vary, so check labels and look for a product that's 'calcium set' – this means calcium chloride (E509) or calcium sulphate (E516) has been added to the product," says Williams.

Safety concerns

There has been some controversy surrounding the consumption of soya in recent years, with some animal protein studies suggesting a link between soya beans and certain cancers. "However, the European Food Safety Authority has concluded that soya isoflavones do not adversely affect the thyroid, breasts, or uterus in postmenopausal women."

Williams notes that tofu is generally considered safe for most people, except those with a soya allergy. Soya beans may interfere with thyroid gland activity, though this effect may be minimal. "If you have a thyroid condition, it is advisable to minimise your intake."

Individuals with a history of calcium oxalate kidney stones might also want to avoid the excessive consumption of soya products, as tofu and other soya products contain oxalate. "However, studies suggest that soya products containing some oxalate and moderate amounts of phytates may actually benefit kidney stone patients."

It is important to note that soya contains anti-nutrients, such as trypsin inhibitors and phytates, which can inhibit the absorption of some valuable nutrients. Soaking or fermenting soya beans before cooking can reduce these compounds, making traditional soya products nutritionally superior.

Soya makes economic sense

Comparing the South African Futures Exchange (Safex) price of soya beans with the retail price of tofu, there is no question that a good effort put into product and market development could be highly rewarding. On 10 May this year, soya beans traded at around R8 750/tonne on Safex, while the retail price for a tonne of tofu ranged from R171 400 to R350 000/tonne.

However, according to the Bureau for Food and Agricultural Policy's (BFAP) 2022 *Baseline Report*, tofu and soya milk are the least popular soya-based foods in South Africa. The most popular soya-based food is soya mince, consumed by 90% of South Africans. This is followed by cooked soya beans (71%), ProNutro and FutureLife instant porridge (70%), soya-based meat alternatives (56%), and soya snack bars (54%). Only 18% of respondents consumed tofu, and 36% consumed soya milk.

When comparing the intake frequencies among low-income, middle-income and affluent households, BFAP found that various groups preferred different types of soya bean products. Low-income households most frequently consumed soya mince and cooked soya beans, while affluent and middle-class households most frequently consumed soya snack bars, instant porridge, soya-based meat alternatives, and soya milk.

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Effect of different levels of canola meal on broiler production performance

By MZ Naseem, SH Khan, and M Yousaf, Poultry Research Institute, Pakistan

The feed cost of poultry production usually ranges between 65 and 75% of total production cost (Haq and Akhtar, 2004). Therefore, nutritionists are giving more attention to exploring low-cost and good-quality ingredients for poultry rations. Vegetable proteins are the major protein source in poultry feed. Their inclusion in poultry feed is 28% and accounts for about 33,5% of total feed cost in commercial poultry (Sarwar *et al.*, 2002).

Pakistan is facing a shortage of edible oil as it is imported every year. The government decided to import canola (*Brassica napus* or *Brassica campestris*) for the extraction of oil within the country.

On account of its better oil quality than other vegetable oils, canola was cultivated in Pakistan on 122 000 acres of land resulting in the production of 73 000 tonnes of seed and 29 000 tonnes of oil from 2001 to 2002. These figures rose to 223 000 acres, 136 000 tonnes and 52 000 tonnes, respectively, from 2003 to 2004 (*Economic Survey*, 2003 to 2004).

It appears that canola will replace the major area under cultivation of rapeseed in the near future. The byproduct obtained from the processing of canola seed is canola meal, which can be used in the poultry industry. The canola meal is cheaper and used in a limited quantity in poultry feed, but its level can be increased to reduce the cost. The present project was designed to investigate the effects of different levels of canola meal on the production performance of broiler chickens during the starter and finisher phases of growth.

Experimental birds

In a study, experimental chicks were fed a broiler starter from day-old to four weeks and *ad libitum* broiler finisher rations in the fifth week. The birds had free access to feed and clean drinking water. All the chicks were vaccinated against Newcastle disease, hydro-pericardium syndrome, and infectious bursal disease.

Five isonitrogenous and isocaloric broiler starter and finisher diets in the form of crumbs and pellets were prepared (NRC, 1994). Canola meal and all other ingredients were purchased from the local market after analysing each consignment randomly at the Feed Testing Laboratory of Islamabad Mills, Islamabad. Five different levels of canola oil meal (containing crude protein 36% with 85% KOH solubility) *viz* 5, 10, 15, 20 and 25% were used in both the broiler starter and finisher diets fed to experimental groups A, B, C, D and E, respectively.

Each diet was analysed as described by the Association of Official Agricultural Chemists in 2000 for proximate composition, minerals, and aflatoxin at the Feed Testing Laboratory of Islamabad Feed Mills. All analyses and determinations were done in triplicate. The experiment lasted for 35 days in May and June 2005.

Results and discussion

During the starting and finishing periods of growth, the chickens fed a diet containing 25% canola meal gained maximum weight compared to other diets (*Table 1*). However, the difference was insignificant among the treatments. These results are supported by the findings of Lee *et al.* (1991) and Idrees (1998), who reported that canola meal can be used from 15 to 25% without any adverse effect on the growth of broiler chickens.

However, Arena and Penz (1990) and Franzon *et al.* (1998) reported that weight gain in broiler chickens was reduced with higher concentrations of canola meal (30 to 40%) due to the effects of a growth-inhibiting factor, i.e. glucosinolates (>30 µmol/g). In the present study, canola meal contained <30 µmol/glucosinolate due to its better processing techniques.

During the first four weeks of growth, the broiler chickens consumed less ($P < 0,01$) of the diet containing 25% canola meal than other diets (*Table 1*); however, during the finishing period of growth, the difference was not significant ($P > 0,05$) among treatments. Nassar and Arscot (1986) and Franzon *et al.* (1998) reported that broiler chickens consumed less of the diet from 0 to 21 days and from 36 to 40

Table 1: Performance of broilers fed diets containing different levels of canola meal.

Diets*	Weight gain (g)		Feed intake (g)		Feed conversion ratio	
	0 to 28 days	29 to 35 days	0 to 28 days	29 to 35 days	0 to 28 days	29 to 35 days
A	1 288,27	426,33	2 258,63[d]	913,64	1,72[c]	2,13
B	1 308,74	431,29	2 244,66[cd]	891,56	1,71[c]	2,13
C	1 310,44	441,44	2 179,39[bc]	895,16	1,68[bc]	2,01
D	1 313,86	446,44	2 168,31[b]	894,92	1,67[b]	1,99
E	1 314,57	475,43	2 086,19[a]	878,43	1,59[a]	1,91

**A: 5% canola meal (CM); B: 10% CM; C: 15% CM; D: 20% CM; E: 25% CM. Means with different letters within a column differ significantly ($P \leq 0,01$)*

days when a higher level (up to 40%) of canola meal was used in the diets.

However, no reduction in feed intake was observed when canola meal was used up to 15% (Leeson *et al.*, 1987). The exact reason for the decrease in feed intake is not known but it may be due to its high fibre content.

Feed conversion ratio

Broiler chickens fed a diet containing 25% canola meal showed better ($P < 0,01$) feed conversion ratio (FCR) values compared to other diets during the starting phase of growth (*Table 1*). However, the difference was non-significant ($P > 0,05$) among the diets during the finishing phase. The broilers fed a diet with 5% canola meal had the lowest ($P < 0,01$) FCR compared to other diets during the starting phase of growth (*Table 1*). However, this difference was non-significant ($P > 0,05$) during the fifth week of the trial.

Franzon *et al*. (1998) reported that layer chickens fed a diet containing canola meal had better FCR values with increasing canola meal levels (20 to 40%) in diets. It might be due to better protein quality (increased availability of proteins due to the 85% KOH solubility) of the canola meal that was superior to other vegetable meals.

Dressing percentage

The dressing percentage and relative weights of the liver in chickens of five groups are presented in *Table 2*. Better dressing percentage and relative weight of the liver were found in chickens fed a diet supplemented with 25% canola meal compared to those fed diets containing 5, 10, 15 and 20% canola meal (*Table 2*); however, the differences were non-significant ($P > 0,05$). These findings are supported by those of Kinal and Kroliczck (1983), who reported that dressing percentage was better at a higher level of canola meal (30%) in a broiler diet due to its higher digestibility value than rapeseed meal.

Mortality rates

Total chicken mortality during the starter phase was 1, 3, 4, 5 and 6%, while during the finisher phase, it was 0, 1, 2, 2 and 3% for diets A, B, C, D and E, respectively. Comparatively higher mortality was observed in a chicken-fed diet with 25% canola meal compared to other diets. This was consistent with the observations of Campbell and Slominski (1999) with 25% canola meal. Mortalities were recorded due to ascites because of rapid growth, high feed efficiency and large pectoral muscle mass, all requiring high oxygen levels.

The modern chicken has a small lung volume: bodyweight ratio, causing an inability of the respiratory system to respond to the broilers' elevated oxygen needs, which can lead to hypoxia and respiratory acidosis (Kiiskimen, 1985). Acidosis affects cellular membrane integrity reduces free radical elimination and transude leakage of blood vessels that leads to accumulation in the abdominal cavity; hence ascites develops (Proudfoot and Hulan, 1987).

Economic aspect

Finally, the economics of the high-level (25%) canola meal diet was more encouraging, as it generated more profit than that of low-level canola meal diets. The results revealed in Pakistani Rupees (Rs) that the total return on sale per bird was Rs76,29, 76,38, 76,78, 77 and 78,62 at a total expenditure of Rs61,39, 60,99, 60,19, 60,12 and 59,29 for groups A, B, C, D and E, respectively. The net income per bird was Rs14,90, 15,39, 16,59, 16,88 and 19,33 for groups A, B, C, D and E, respectively.

Economic data indicated that a high level of canola meal (25%) was more feasible and economical to obtain maximum profitability from broiler production. Low prices of canola meal and better feed efficiency with increasing levels of canola meal are two major factors which resulted in decreased cost of production.

The findings of this experiment suggested that canola meal (with 85% KOH solubility) can be incorporated up to 25% in broiler starter and finisher diets without any adverse effect on production parameters. For optimising the profits from the feeding of canola meal, it may be used at a higher level in the diets of commercial broiler chicks.

Table 2: Percentage dressed carcass weights and relative weights of livers of broiler chickens fed canola meals.

Parameters	Diets*				
	A	B	C	D	E
Dressing percentage	58,15	58,47	59,44	59,78	62,11
Relative weights of liver	18,60	18,86	21,05	21,85	22,15

**A: 5% canola meal (CM); B: 10% CM; C: 15% CM; D: 20% CM; E: 25% CM.*

This article has been shortened for publication in *Oilseeds Focus*. For the complete article and references, visit *www.pvj.com.pk/pdf-files/26_3/page%20129-134.pdf*.

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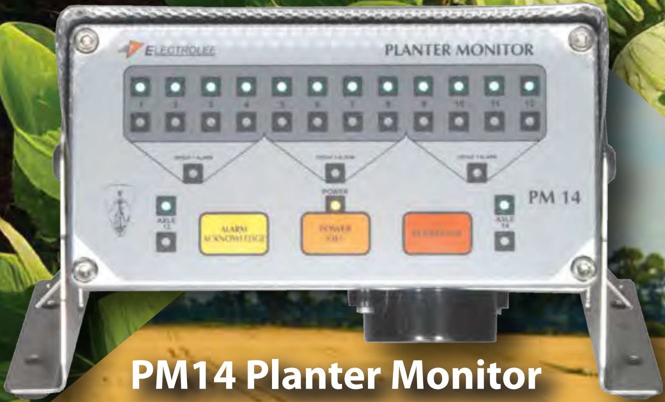

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Just and equitable compensation for land

By Hans-Jurie Moolman, Moolman & Pienaar Incorporated

Section 25(2) of the *Constitution of the Republic of South Africa, 1996 (Act 108 of 1996)* (the *Constitution*) provides that property may only be expropriated for a public purpose or in the public interest, when it is done in accordance with a generally applicable law. It is subject to compensation, the amount of which and the time and manner of payment of which have either been agreed to by those affected, or decided or approved by a court.

The new *Expropriation Bill (B23-2020)*, which is currently considered by the national legislature, has elicited major public debates. It is controversial for two primary reasons: expropriation as an internationally recognised method that gives government the power to acquire private property and use it for a public purpose; parallel to this, and even more prominent, is the fact that government can use it by way of the proposed legislation, to expropriate property without compensation.

A lot of politics is driving this issue, but there is no doubt that the provisions relating to just and equitable compensation, where it relates to expropriation, have their origins in the history of the country. Not only were people deprived of their property rights because of their race – they were also deprived of their right to just and equitable compensation.

Compensation after 1994

Legislation introduced after 1994 afforded people who were deprived of their right to property without compensation, or who received a lesser amount as compensation, the right to institute claims before 31 December 1998 in respect of their historical losses and where the state was/is obligated to settle these claims by:

- Obtaining the land from the current owners and returning it to the claimants.
- Compensating the claimants monetarily.
- Making alternative state land available.

The legislation is known as the *Restitution of Land Rights Act, 1994 (Act 22 of 1994)* (the *Restitution Act*) and gives effect to Section 25(7) of the *Constitution*, which entails that a person or community dispossessed of property after 19 June 1913 as a result of racial discrimination, is entitled to either restitution of that property or to equitable redress.

Section 2 of the *Restitution Act* states that claimants are not entitled to any of the aforesaid compensation if the claimant in question did indeed receive just and equitable compensation at the time of the dispossession. The same section explicitly upholds Section 25(3) of the *Constitution* as the prescribed criterion for what is considered just and equitable.

Just and equitable

In practice, the criterion stipulated in Section 25(3) will be used for calculating compensation in cases where land cannot be returned or where claimants were indeed compensated, but the amount was not appropriate.

The method used to calculate compensation was discussed in detail in the Constitutional Court case of *Florence vs The Republic of South Africa 2014(6) SA 456 (CC)*. In this case, the applicant could not acquire a title deed for property for which payments had been made over a 14-year period. The then *Group Areas Act, 1950 (Act 41 of 1950)* prohibited them from taking ownership of the property, and they subsequently filed a claim.

The court found, inter alia, that the plaintiff is entitled to compensation calculated on the basis of the loss suffered at the time of the dispossession. The court also found that the plaintiff was entitled to compensation calculated based on the difference between compensation paid at the time of the dispossession and the market value of the property.

As a result, market value was equated in the judgment and in the Land Claims Court, to just and equitable compensation in terms of Section 25(3) of the *Constitution*.

Given the aforesaid and against the background of current political debates on the subject, it should be interesting to see whether just and equitable compensation will be consistently applied when determining the monetary value of and compensation for the injustices of the past, and the manner in which the state will proceed to acquire private land in a bid to ensure the success and finalisation of its land reform programme.

It will be significant to see if just and equitable compensation as intended by the *Constitution* will have two different applications, determined by context or other factors. If so, what factors will be used in order to, constitutionally and legally, justify these different applications?

Of course, this will have to be evaluated by also taking into consideration the fact that the courts have been applying and interpreting the *Constitution*, and especially Section 25(3), for almost 30 years, and that some 70 000 out of approximately 76 000 restitution claims during that period were resolved on a just and equitable basis where there was very little deviation from market-related compensation to land owners affected by land claims.

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Suspension without pay as an alternative to dismissal

By Tiaan Botes, legal advisor, LWO Employers Organisation

The *Labour Relations Act, 1995 (Act 66 of 1995)* (the *LRA*) stipulates that all employees must be treated fairly, as unfair suspension may constitute an unfair labour practice in terms of section 186(2)(b) of the *LRA*.

Punitive suspension is a sanction that can be imposed on an employee – in this regard, the employee is temporarily suspended without pay. It is a form of disciplinary action that addresses serious misconduct or other serious offenses contravening the company's policies or code of conduct. It is vital to note that the goal of punitive suspension is to offer employees the opportunity to remedy their actions and change their behaviour.

Permissible disciplinary sanction

The Labour Court found that suspension without pay is a permissible disciplinary sanction when the circumstances warrant it. Furthermore, the court found that although Section 19 of the *Basic Conditions of Employment Act, 1997 (Act 75 of 1997)* (the *BCEA*) prohibits the employer from making deductions from an employee's remuneration, it does not prevent the employer from imposing the sanction of suspension without pay. This provision was a pertinent point in the case of *Koka vs Director-General: Provincial Admin North West Government (1997) BLLR 874 (LC)*.

As can be noted from the case, the application of punitive suspension depends on the circumstances of each case; moreover, employers must observe the principle of fairness when considering this disciplinary measure.

If suspension is applied as a disciplinary sanction, all standard requirements relating to substantive and procedural fairness need to apply. Since suspension is typically utilised as an alternative to dismissal, it would be advisable to follow the guideline contained in Appendix 8 of the *LRA*, *The Code of Good Practice: Dismissal,* when deciding to suspend an employee.

Possible reasons for this action

There are several reasons the employer may choose punitive suspension rather than the immediate dismissal of the employee. One of the key reasons is to give the employee the opportunity to improve his or her behaviour as well as a second chance to continue his or her activities. This is a more constructive option, especially if the employee has a long service history or if the nature of the offence does not justify immediate dismissal.

Furthermore, punitive suspension may be a useful alternative in cases where the evidence supporting immediate dismissal is lacking but the employee's actions remain cause for concern.

Assess before acting

It is important to bear in mind that punitive suspension is not always the most appropriate solution. In some cases, punitive suspension may not be sufficient to address the seriousness of the offense or the damage to the business' interests. There should be a balance between the interests of the employee and the business, as well as the impact of the employee's actions on the work environment and the employer-employee relationship.

In a country like South Africa with its rich history of labour legislation and where the protection of the rights of employees is a priority, punitive suspension plays a key role in maintaining fairness and discipline in the workplace. If applied correctly, it can be a valuable tool for dealing with labour relations issues.

However, it may only be imposed if both parties have agreed to it. The employee can withhold consent if the suspension is deemed unreasonable.

The LWO Employers Organisation assists employers to comply with labour law, and to use it to their advantage to protect their business. As a registered employers' organisation with the Department of Employment and Labour, the LWO has the right to represent members at the Commission for Conciliation, Mediation and Arbitration (CCMA). Take note that this article is not legal advice – consult one of our legal advisors about any specific legal problem or matter. For more information, send an email to Tiaan Botes at tiaan@lwo.co.za, or info@lwo.co.za or visit *www.lwo.co.za*.

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