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OILSEEDS focus

Protein Research Foundation • Oil & Protein Seeds Development Trust • Oilseeds Advisory Committee

Sclerotinia tolerance in sunflowers

Factors influencing soya bean yield

Canola cultivar evaluation 2020

Nutritional aspects of oilseeds

Setting the stage **for agricultural transformation**

By Gerhard Keun, CEO, Oil and Protein Seeds Development Trust and Oilseeds Advisory Committee

During a national address to all South Africans that took place on 21 April last year, president Cyril Ramaphosa highlighted the topic of transformation, particularly agricultural transformation.

According to the president, transformation within the agricultural sector is necessary as it will be of benefit in the following ways:

- It will bring about a much-needed boost for South Africa's economy, with a specific focus on the country's rural areas.
- Previously disadvantaged South Africans will be uplifted by taking up roles as inclusive partners in the food supply chain.
- It will set the stage for an improved balance in the ownership and management aspect of the food supply chain.
- It will make a valuable contribution to the creation of job opportunities, which will subsequently lead to the much-needed growth of the economy.
- There will be an improvement in food security, especially for those who reside in vulnerable communities.

The various structures in the oilseeds industry have agreed that transformation in agriculture in South Africa is imperative for the future and growth of the agricultural industry. Supporting transformation is therefore just as important for the oilseeds industry.

Improved co-ordination is needed

There are quite a number of transformation initiatives that have been launched by associations, foundations, organisations, companies, and the government in South Africa over the years. Unfortunately, none of these initiatives are as well co-ordinated as they should be, and although oilseeds form part of some of these projects, there is no specific emphasis on oilseeds such as sunflower, soya beans, groundnuts, and canola.

For several years, structures within the oilseeds industry have played a significant role in agricultural transformation by means of the provision of their respective constitutions and trust deeds. Since their inception in 1997, the Sunflower, Soybean and Soybean Food Forum, Groundnut Forum, Oilseeds Advisory Committee (OAC), and the Oil and Protein Seeds Development Trust (OPDT) have come to the agreement that transformation is vital.

Taking the lead

The challenge with co-ordinating initiatives, combined with the challenges the Grain Farmer Development Association (GFADA) experienced, gave the OAC the perfect opportunity to develop a transformation programme. Here, sunflower, soya bean, groundnuts, and canola take on the lead role.

In order to assist with the scope, focus, and envisaged outcomes of the programme, Optimal Agricultural Business Systems (OABS) was commissioned to conduct a study titled "Analysis to determine the scope of transformation projects funded in South Africa with respect to the production and processing of oilseeds". (Read more about OABS and their role in this issue of *Oilseeds Focus*.)

The oilseeds transformation programme will set the stage for improved co-ordination between existing projects, to initiate new projects, collaborate with other role-players and projects, and to improve the effectiveness and efficiency of agricultural transformation efforts in South Africa.

Addressing the challenges

Training, provision of information, technology transfer, the funding of insurance, soil correction and seed, mentorship, upliftment, and socio-economic as well as enterprise development will be at the centre of the programme.

The five pillars of the transformation guidelines of the National Agricultural Marketing Council (NAMC), namely ownership, enterprise and supplier development, skills development, management control, and socio-economic development will be addressed in the programme.

The focal point cannot simply be the commercialisation of producers alone. It needs to be much wider in order for upliftment, poverty, nutrition, and food security to be addressed.

Gerhard Keun.

For more information, contact Gerhard Keun on 011 234 3400/1 or oliesade@opot.co.za.

The latest in the **international oil market**

The supply of soft oils in 2021 is expected to remain tight, despite a recovery in palm oil production, while the rebound in vegetable oil demand is expected to influence markets going forward.

The poor performance of the Black Sea sunflower seed producers due to drought-like conditions during the growing season – causing lower yields and oil contents – will impact the market. However, supply dynamics in 2021 will keep sunflower oil prices firm.

A rebound in worldwide demand is expected as and when the global economy recovers and markets re-open post-Covid-19. The re-opening of the hospitality sector should be bullish for the vegetable oil industry and is likely to be influenced by the success of the worldwide vaccination programme. This will be a determining factor in the recovery of vegetable oil consumption.

Keeping tabs on competing oils

Russian export taxes on sunflower seed led to the largest buyer, Turkey, reducing its import duties on sunflower oil, which increased demand thereof at the expense of sunflower seed. The spread between competing soft oils, such as sunflower versus soya bean oil, will demand close attention. The new season's soya bean crop from South America should put pressure on soya bean oil prices.

Palm oil production should experience a recovery as good rain, fertilisation, and the return of foreign labour to Malaysia and Indonesia will all assist in improving production. The number of hectares in the European Union rapeseed market is expected to remain stable, despite high prices.

SA nears self-sufficiency with soya

There have been exceptionally favourable conditions for growing oilseeds crops in South Africa, with a record canola crop of 166 956 tons in the Western Cape – an increase of 76% since the previous season.

The stage is also set for an excellent soya bean crop with an increase of 14% to 806 000ha, and a yield that may well match or exceed the record 2,3t/ha of 2017. This could result in a crop of 1,8 million tons – the largest ever in South Africa.

In addition, the strong global markets for soya, driven by Chinese demand, have resulted in a Chicago Board of Trade (CBOT) increase of 42% year-on-year and a Safex increase of 32%. Prices are likely to remain firm.

Hectares planted to sunflower decreased by 5,4%, and the already suffering industry will not be content with a below-average supply of sunflower seed. In 2020/21, we saw what tight supply and demand can do to the market, such as feed millers having to scramble for alternative raw materials.

Sunflower seed prices on Safex increased 45% year-on-year, and the oil market is struggling to pass on the significant price increases to the end consumer. Year-on-year bottled sunflower oil prices increased by 16% for the end consumer, which was significantly lower than raw material costs and global movements.

Enjoy this issue of *Oilseeds Focus*.

Dr Erhard Briedenhann

Send us your contributions and suggestions to make *Oilseeds Focus* an enjoyable and valuable publication for the oilseeds industry. Contact Dr Briedenhann at erhardb@netactive.co.za for more information.

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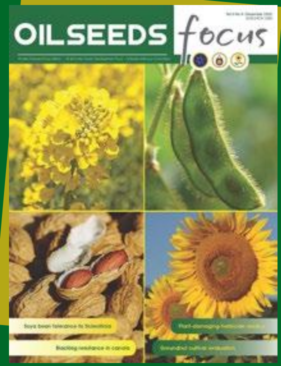

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NEWS

Global demand for sustainable soya still low

Worldwide, the demand for sustainable soya is still low, stated Joe Stone, director of the agricultural supply chain division at Cargill, in a webinar of the US Soybean Export Council (USSEC). Stone said the demand for soya from especially China is mainly based on food security. Little attention is currently paid to sustainability.

According to Stone, a clear distinction can be made between different markets. "In China, there is no value on sustainability yet; it is mainly about food security. Approximately 65% of soya from the United States (US) goes to China. On the other side is Europe. Europe has the most specific requirements, but is a much smaller market. Suppliers must be able to serve both markets." – *All About Feed*

New method boosts oil production in plant leaves

Scientists from the University of Missouri, led by Prof Jay Thelen, has found a way to 'knock out' a family of genes responsible for regulating fatty acid production in the leaves of plants rather than its seeds. Prof Thelen and his team used the gene-editing tool CRISPR-Cas-9 to turn off three small proteins in Arabidopsis that restrain oil production in the leaves. This frees up the plant to produce higher amounts of triacyglycerol in its leaves instead of in its seeds. Triacyglycerol is the main component of vegetable oil.

This method could lead to greater and cheaper production of vegetable oils from leafy plants. The possibility of dual uses for leafy crops such as soya beans could increase the protein content in its seed because of lesser production of oil in the seeds. – *International Service for the Acquisition of Agri-biotech Applications*

Insta-Pro president and CEO to retire

Insta-Pro International announced that its president and CEO, Kevin Kacere, will retire as of 30 April 2021. Kacere will continue as a senior advisor to the board of directors until 31 October 2021. Insta-Pro has initiated a national search for Kacere's successor in the US. Insta-Pro has retained Orion Search Group, a Minneapolis-based executive search firm, as its exclusive partner to conduct a national search for Insta-Pro's next leader. – *Press release, Insta-Pro*

Kevin Kacere.

European Commission authorises new GM crops

The European Commission has authorised five genetically modified (GM) crops, including three maize and two soya bean cultivars. All the GM crops have gone through a comprehensive and stringent authorisation procedure, including a favourable scientific assessment conducted by the European Food Safety Authority (EFSA). The authorisation decisions do not cover cultivation.

Member states did not reach a qualified majority either in favour or against at the standing committee and at the subsequent appeal committee. Therefore the European Commission has the legal duty to proceed with the authorisations, which are valid for ten years, and any product produced from these GMOs will be subject to the European Union's strict labelling and traceability rules.
– *European Commission*

Peanut protein alternative for fried chicken

The global fried chicken market is worth US$2,4 billion and the dish is especially popular in China. At the same time, a significant number of people in China is interested in plant-based alternatives. However, the Chinese population is 'not fully satisfied' with the plant-based offerings currently available, says Haofood CEO, Astrid Prajogo.

"Until now, plant-based meat has been based on soya bean," said Prajogo. "The taste and texture reminded them of tofu. In China, we eat tofu every day," she explained. Therefore, consumers are expecting a 'totally different experience' from plant-based meat alternatives. Haofood determined that peanut protein was best suited to the task at hand and uses proprietary methods to create modified textured peanut protein, for which it has submitted three patent applications.

"These products have superior texture and taste like chicken meat," Prajogo elaborated, "and contain omega-3, just like real chicken." – *Food Navigator*

Sclerotinia resistant genetics for non-GM crop

Cibus just hit another milestone with field trials confirming greenhouse trial results of a new canola trait that is *Sclerotinia* resistant. Peter Beetham, president and CEO at Cibus, said the rapid-rate-development system the company uses, is a family of technologies that enables it to edit genes yet keep the crops' non-GM designation.

He said the outcomes are indistinguishable from what can occur in nature, and are very similar to what occurs in a traditional breeding programme. Beetham said the initial introductions of this *Sclerotinia* resistant gene will reduce the amount of fungicide farmers need to apply.

He said the new trait is scheduled to undergo more trials this year as they work toward its registration in Canada. It is expected to take about four years until seed companies integrate this gene into their commercial canola varieties in Canada.
– *The Western Producer*

Making wheat and peanuts less allergenic

Sachin Rustgi, a member of the Crop Science Society of America, studies how we can use breeding to develop less allergenic varieties of wheat and peanuts. Rustgi and his colleagues are using plant breeding and genetic engineering to develop less allergenic varieties of these crops. Like wheat, peanuts contain various types of proteins recognised as allergens.

"Not all peanut proteins are equally allergenic," says Rustgi. Four proteins trigger an allergic reaction in more than half of peanut sensitive individuals. Rustgi and the research team are testing many varieties of wheat and peanuts to find ones that are naturally less allergenic.

In addition to traditional breeding efforts, Rustgi is using CRISPR to target protein genes. "Disrupting the gluten genes in wheat could yield wheat with significantly lower levels of gluten. A similar approach would work in peanuts." *– Crop Science Society of America*

Stop FAW in its tracks this maize season

The Department of Agriculture, Land Reform and Rural Development (DALRRD) has made a clarion call to growers of all maize and related host crops, such as sorghum and sweetcorn, as well as community members, to take precautionary control measures against fall armyworm (FAW).

With early rain experienced in different parts of the country, high infestation levels can be expected. Farmers and community members are advised to vigilantly scout for egg packs, leaf damage, and caterpillars. The moth can be caught in traps with a lure, which can also serve as an early warning of its presence.

For agrochemical control, a list of registered agrochemicals is available on the DALRRD website (*www.dalrrd.gov.za*). They can also contact the nearest local agriculture centre for technical advice. *– Press release, DALRRD*

High rainfall and plantings to boost soya harvest

South Africa remains a significant nett importer of soya bean oilcake or meal. Nevertheless, South Africa's soya bean oilcake imports have declined by 56% from the record levels of nearly one million tons in 2010, to approximately 420 000 tons in 2019. This decline in imports coincided with an increase in domestic soya bean production.

There is still uncertainty about the potential size of the yield in the current season. However, if we apply a five-year average yield of 1,82tons/ha on an area planting of 806 000 tons, South Africa's soya bean harvest could reach 1,47 million tons. This would be the second-largest harvest on record.

In such a scenario, South Africa's soya bean harvest would amount to 1,61 million tons, which would be the largest soya bean harvest on record. *– Wandile Sihlobo, Agbiz*

New canola type for potentially higher crop yield

In a new study, a team of biologists in the Faculty of Science at the University of Calgary used gene editing to modify canola's own genes, producing shorter plants with many more branches and flowers.

"We showed that gene editing actually works in canola, and simultaneously improved agronomic traits in canola by changing the plant's architecture," said study co-author, Dr Marcus Samuel.

The team targeted the gene BnD14, the receptor for a hormone called strigolactone. In their modified wild-type canola strain, the team was able to increase the number of branches to around 60 from the typical 20. They also increased the production of flowers by around 200%, within the same reproductive period and lifespan of canola grown in Canada. *– University of Calgary*

Currently, there are no registered fungicides for the prevention or mitigation of Sclerotinia head and stem rot of sunflower, neither is there complete resistance in sunflowers, although some genotypes indicate partial resistance (realagriculture.com | Photograph by Samuel Markell, NDSU)

Evaluating sunflower for yield, quality characteristics, and Sclerotinia tolerance

By MC Meiring, LA Rothmann, S Maali

Sclerotinia sclerotiorum (*S. sclerotiorum*) is a fungal plant pathogen that has the ability to infect sunflower as well as more than 500 other host plants, including weeds. *S. sclerotiorum* on sunflowers is referred to as head rot or stem rot as these are the respective plant organs affected by the pathogen. Sunflower head and stem rot is often linked to major losses, causing total or partial yield loss, as well as potentially affecting quality characteristics.

The severity of *Sclerotinia* diseases is highly dependent on the environmental factors present at the time of inoculum availability and the susceptibility of a host crop. Currently in South Africa, there are no registered fungicides for the prevention or mitigation of *Sclerotinia* head and stem rot of sunflower. In addition, no complete resistance exists in sunflowers; however, there are genotypes that indicate partial resistance (Kim & Diers, 2000; McCaghey *et al*., 2019).

A number of studies report strong interactions between host genotype and environment. The University of the Free State's (UFS) plant pathology division continues to screen for tolerance to *Sclerotinia* under various field conditions. Additionally, the Agricultural Research Council – Grain Crops conducts field trials monitoring yield and quality characteristics across production regions.

Managing *Sclerotinia* diseases through host tolerance or potential resistance may contribute to yield stability and increases, as this is the only available conventional option to our producers. Tolerance to plant diseases is the plant's response to infection through having the ability to endure disease without serious yield loss or death (Agrios, 2015). However, resistance is the plant's ability to completely or partially overcome the damaging effects caused by a pathogen (Politowski & Browning, 1978).

Sunflower field trial evaluations

Sunflower cultivars from the sunflower national cultivar trials were evaluated in field trials in both Delmas (Mpumalanga) and Clocolan (Free State) during 2019/20. Plantings were conducted sequentially from November to January, creating a range of weather conditions during the season of evaluation. Sunflowers in Delmas were inoculated with *S. sclerotiorum* in the form of milled grain mycelium at flowering (Bester, 2018).

In contrast, sunflowers in Clocolan were not artificially inoculated, but natural infection was relied upon in a field with a history of severe head rot.

Figure 1: Mean *Sclerotinia* prevalence (%) in sunflower cultivars during three different planting dates in Delmas from the 2019/20 season.

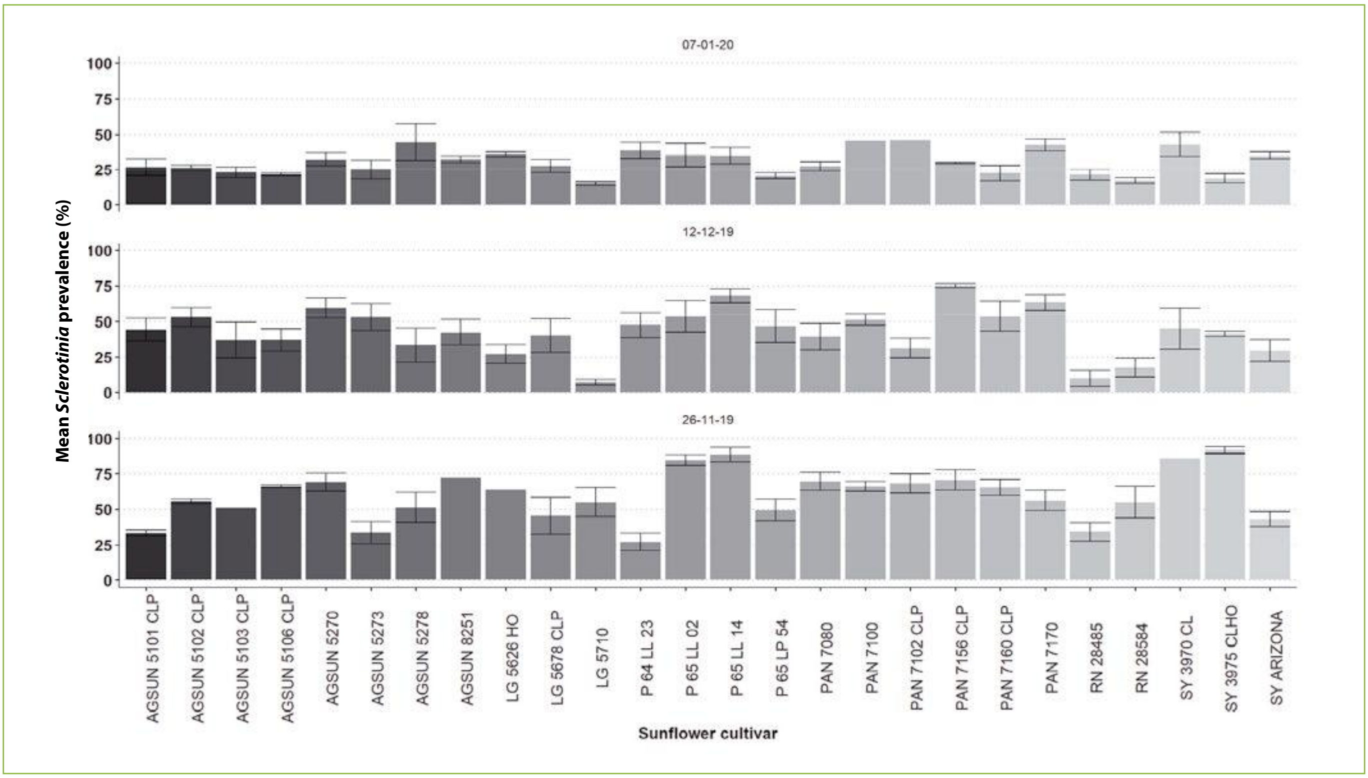
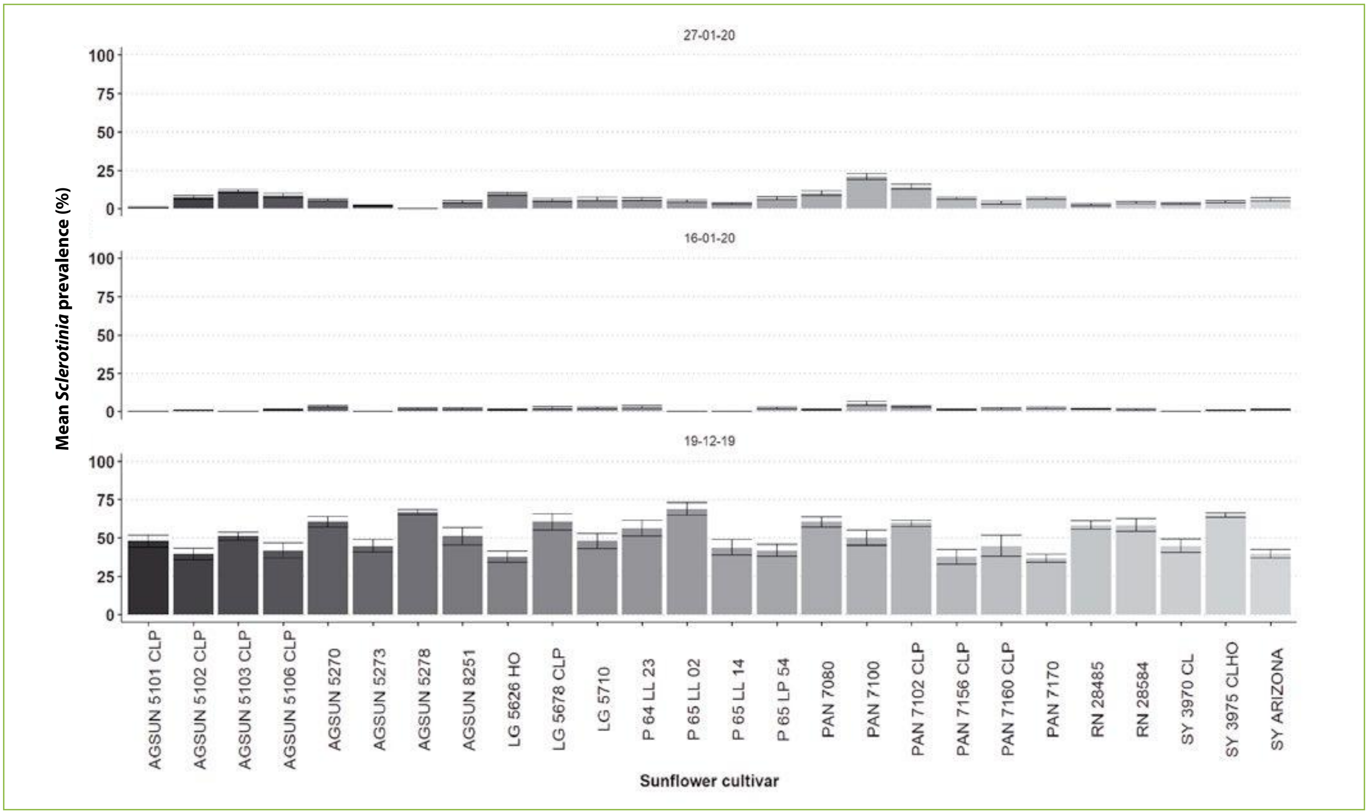


Figure 2: Mean *Sclerotinia* prevalence (%) in sunflower cultivars during three planting dates in Clocolan from the 2019/20 season.



This inoculation technique does not require injuring plants before application, therefore ensuring that no induced resistance mechanisms are triggered through wounding (Bester, 2018).

The presence or absence of *Sclerotinia* on the heads was measured at R7 and the disease prevalence was calculated. Data analyses were conducted using R (v4.0.3; R Core Team, 2020) and RStudio (v1.3.1093; RStudio Team, 2020). The bar graphs illustrate the mean *Sclerotinia* prevalence (%) observed in the different sunflower cultivars at each planting date from the 2019/20 season in Delmas (*Figure 1*) and Clocolan (*Figure 2*).

During the 2019/20 season in Delmas, the least *Sclerotinia* (~30%) was observed in the latest planting date of 7 January 2020, while those of the earlier planting dates of 26 November and 12 December 2019 were ~59 and ~42%, respectively. In Clocolan, the second and third planting dates of 16 and 27 January 2020 yielded the least *Sclerotinia*, ~3 and ~6%, contrasting with the first planting date of 19 December 2019 which yielded the highest level of *Sclerotinia* prevalence, ~50%.

There were no sunflower cultivars planted in Delmas, resulting in the absence of *Sclerotinia* infection. The sunflower cultivars showing the most tolerance to *Sclerotinia* (~10%) were LG 5710 and RN 28485, planted on 12 December 2019. In Clocolan, there were several cultivars planted on 16 January 2020 which had no *Sclerotinia* infection – AGSUN 5101 CLP, AGSUN 5103 CLP, AGSUN 5273, P 65 LL 14, P 65 LL 02, and SY 3970 CL. Only one cultivar from the 27 January 2020 planting date had no *Sclerotinia* infection – AGSUN 5278.

Varied response among cultivars

Some of the sunflower cultivars varied in their response to *S. sclerotiorum* across the different planting dates. This indicates the impact of weather conditions during each planting date and the seasonal variation on disease development.

The *Sclerotinia* disease tolerance results (in addition to the 2018/19 and 2020/21 seasons) are being incorporated into a PhD study at the University of the Free State (UFS), where the response

Figure 3: Seed yield (t/ha^{-1}) of 26 different sunflower hybrids evaluated during the 2019/20 growing season.

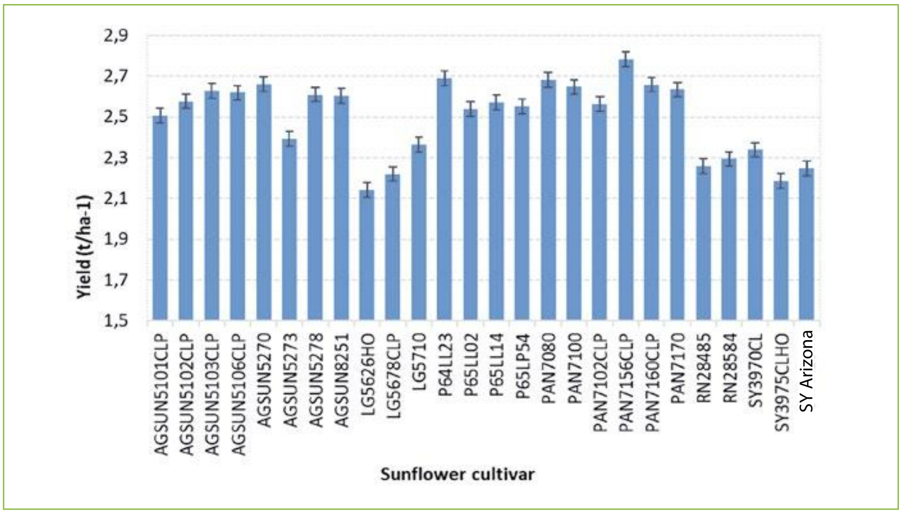


Figure 4: Oil content (% dry matter) of 26 different sunflower hybrids evaluated during the 2019/20 growing season.

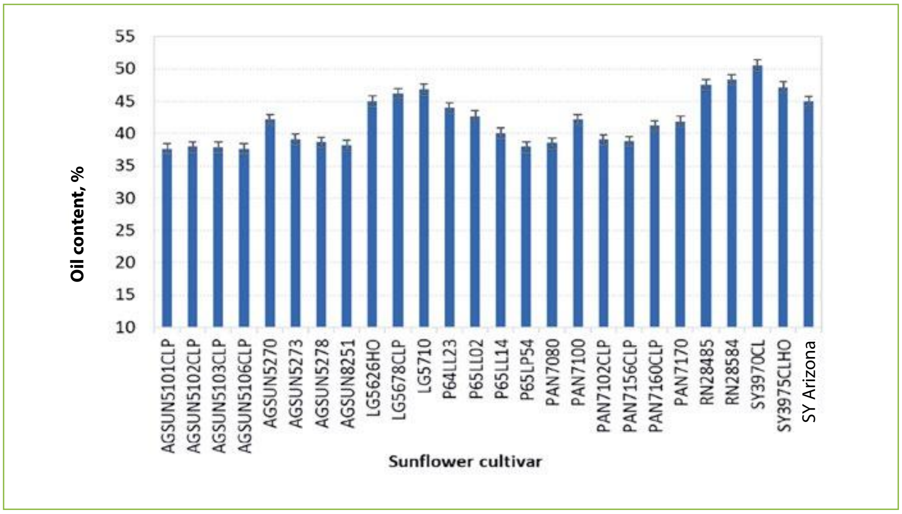
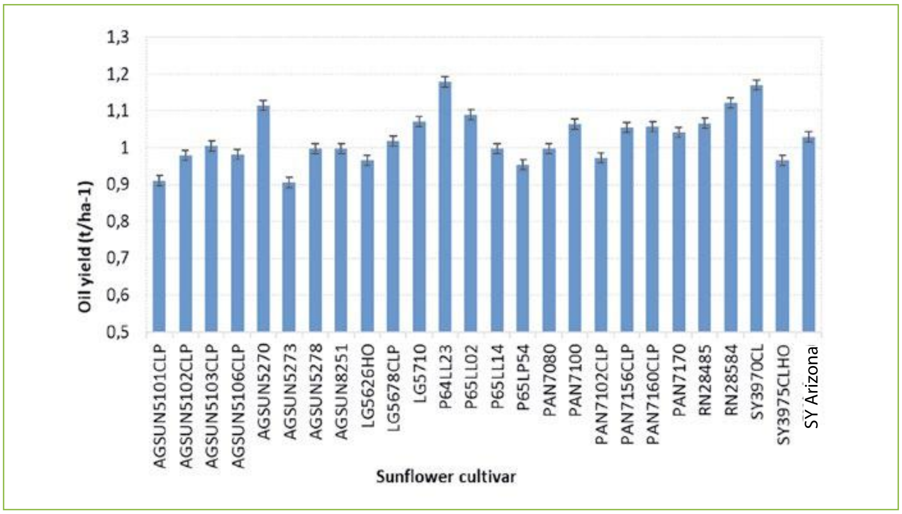


Figure 5: Oil yield (t/ha^{-1}) of 26 different sunflower hybrids evaluated during the 2019/20 growing season.



type of each cultivar at changing disease potentials will be determined. Disease potential is defined as the mean disease incidence in a planting across all cultivars at a specific locality.

Three cultivar response types can be observed:

- Tolerance to increasing disease potential.
- Intolerance to increasing disease potential.
- A linear relationship with increasing disease potential – in other words, an unstable response.

This regression methodology can be an effective and accurate tool to quantify the response of cultivars to different disease potentials and subsequently promote the selection process of cultivars for environments which may have a higher risk for *Sclerotinia* disease development. Further seasons will be added to the aforementioned studies to quantify the response of cultivars across multiple localities.

> Managing *Sclerotinia* diseases through host tolerance or potential resistance may contribute to yield stability and increases, as this is the only available conventional option to our producers.

Sclerotinia can be a yield-limiting disease and usually high disease severities are associated with lower sunflower yield. Being informed of the ability of a sunflower cultivar to tolerate *Sclerotinia*, as well as the cultivar's yield potential at different localities, are important factors to consider when choosing a sunflower cultivar. To investigate the yield and quality performance of commercially available sunflower hybrids from different seed companies, 26 sunflower hybrids were evaluated at 21 sites during the 2019/20 growing season in the North West and Free State provinces.

A randomised complete block design with three replicates was executed for each site. Seed yield was individually recorded for each site and seed samples sent to the Southern African Grain Laboratory (SAGL) for oil content analyses. Seed oil yield was calculated by multiplying oil content (% dry matter) with seed yield (t/ha^{-1}). The five best performing cultivars, in terms of average yield calculated over localities, were PAN 7156 CLP, P 64 L L23, PAN 7080, AGSUN 5270, and PAN 7160 CLP.

The overall mean yield for 2019/20 was 2,50t/ha^{-1}. Two high oleic cultivars (LG 5625 HO and SY 3975 CLOH) were entered for evaluation in 2019/20. Eleven Clearfield and Clearfield Plus cultivars were entered and one of these, PAN 7156 CLP, had the highest yield of 2,78t/ha^{-1}. It also performed the best in terms of seed yield. Eight of these cultivars – PAN 7156 CLP, PAN 7160 CLP, AGSUN 5103 CLP, AGSUN 5106 CLP, AGSUN 5102 CLP, PAN 7102 CLP, P 65 LP 54, and AGSUN 5101 CLP – had yields higher than the overall mean yield of all cultivars (*Figure 3*).

Hybrids with higher oil content

Across sunflower hybrids, the moisture-free oil content varied from 37,62% (AGSUN 5105 CLP) to 50,61% (SY 3970 CL), with an overall mean of 42,01%. The following hybrids produced higher oil content than average: SY 3970 CL, RN 28584, RN 28485, SY 3975 CLHO, LG 5710, LG 5678 CLP, SY Arizona, P 64 LL 23, P 65 LL 02, PAN 7100, P 65 LL 02, and AGSUN 5270 (*Figure 4*).

The oil yield per unit is the product of grain yield and seed oil content (t/ha^{-1}), and was calculated by multiplying oil percentage with seed yield. Significant differences were recorded among the sunflower hybrids (*Figure 5*). The oil yield for the 26 sunflower hybrids at the eleven localities during 2019/20 varied from 0,91 to 1,18t/ha^{-1} with an overall mean of 1,03t/ha^{-1}. P 64 LL 23 had the highest oil yield of 1,18t/ha^{-1}, followed by SY 3970 CL with 1,17t/ha^{-1}.

When a high-yielding sunflower cultivar is selected for the following season, it is important for producers to keep in mind that these cultivars still have the potential of being infected by *S. sclerotiorum*. However, being informed of the *Sclerotinia* disease and yield potentials of each cultivar allows producers to select cultivars which may perform best under their production conditions.

We would like to acknowledge Dr Derick van Staden of Agronomy Info Services and Koos Strydom for their commitment to the field trials, and the Department of Science and Innovation, as well as the Oil and Protein Seeds Development Trust for the research funding.

For more information or a full list of references, send an email to coetzeeLA@ufs.ac.za, mcbester6@gmail.com, or MaaliS@arc.agric.za.

Influence of core factors on soya bean yield in the North-Eastern Free State

By Jacques van Zyl, agronomist, VKB Agriculture

Every producer strives for higher yields on his or her farm. With so many uncontrollable factors that affect yield negatively, such as rainfall, high temperatures, and frost, it is critical for producers to focus on those factors they can control and manage.

This article focusses on four specific factors affecting yield, namely planting date, maturity group, plant density, and row width. In an attempt to evaluate the yield response to different planting dates, maturity groups, plant densities, and row widths, three main trials were conducted on producers' fields over three seasons (2016/17 to 2018/19) in the North-eastern Free State.

Trial description

Trials were conducted in Frankfort, Vrede, and Memel, while additional pop-up trials were done in other areas, including Reitz, and Petrus Steyn. The same maturity groups (MG 4,5, MG 5, and MG 6) were planted at different plant densities, row widths, and planting dates at each trial. Phenological development, plant height, pod clearance, the number of pods per plant, number of seeds per pod, 100-seed weight, and grain yield were measured.

This article primarily focusses on yield, phenological development, and the number of pods per plant to explain the results obtained. Planting date and maturity group are two factors that cannot be discussed separately as both have an influence on each other. The planting date cannot always be completely controlled as it is mainly dependent on rainfall. What can be controlled, however, is the maturity group a producer is going to plant on a certain planting date. A thorough understanding of soya bean growth and development is therefore essential.

Soya bean is a photoperiod-sensitive crop, which means the plant reacts to daylight length during development – more specifically, transition to flower initiation (in other words, when the plant advances from a vegetative growth stage to a reproductive growth stage). This affects the length of the plant's growth stage, which plays a big role in determining its yield potential. Each maturity group's (cultivar) photoperiod requirements differ, and they are therefore divided into different groups. This means each maturity group requires a certain day length (duration of daily darkness) to advance to the reproductive growth stage.

The role of climate factors

Daylight length changes at a constant and predictable rate throughout the year, which means a certain maturity group will start flowering at the same period each year if climate factors (temperature and rainfall) remain the same. Temperature and rainfall do have an influence on this period, but will not differ by more than a few days. The effect that planting date and maturity group have on each other is important and has a significant impact on yield.

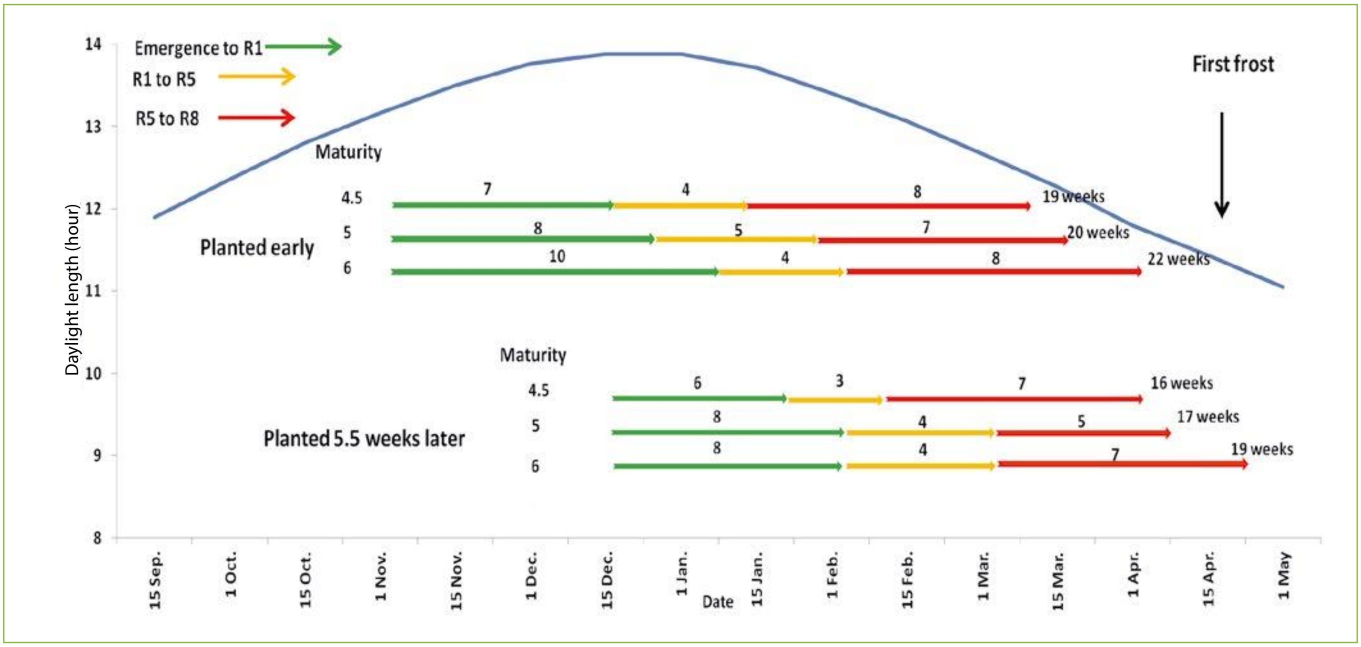
Figure 1 shows the morphological development of three different soya bean maturity groups planted at either an early or late planting date during the trials in the North-eastern Free State. The three critical growth stages (in different colours) are emergence to R1, R1 to R5, and R5 to R8 (R1 = 50% flower initiation, R5 = beginning of seed filling, R8 = physiological maturity). *Figure 1* clearly indicates how the planting date influences the growth and development of each maturity group.

Each maturity group's total growth period was shortened by three weeks due to a later planting date. This is approximately a three- to four-day reduction of the growth period for each week's delay in planting. Each growth stage is also shortened, which in effect means the vegetative growth stage, pod filling period, and seed filling period are shorter, hence a decreased yield potential. *Figure 2* clearly shows that later planting negatively impacts yield.

Effect of planting date on yield

It is also noteworthy that yield increases from maturity group 4,5 to maturity group 6 during the early planting date, while decreasing during the late planting date. When assessing each maturity

Figure 1: Representation of day length throughout the season and the effect of planting date and maturity group on the morphological development of soya beans. (Source: Robert Steynberg)



group separately, it tells an interesting story. The yield of maturity group 4,5 decreased with only 300kg/ha^{-1} from the early to late planting date, while maturity groups 5 and 6 decreased with 800 and 1 000kg/ha^{-1}, respectively.

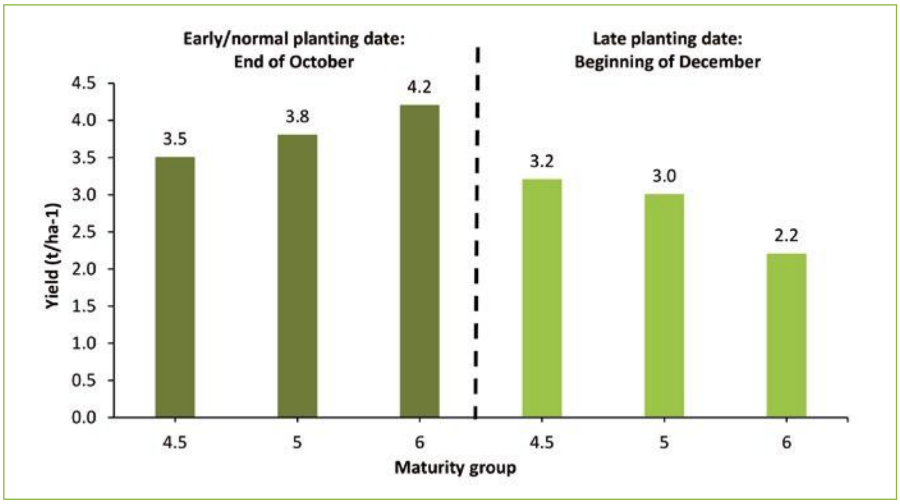
This raises the question as to why there is such a drastic contrast in yield between the two planting dates and different maturity groups. Firstly, the length of the growth period in the North-eastern Free State is mainly influenced by the first date of frost, which is usually in mid-April. This date varies each year, but because of frost, the growth period in the North-eastern Free State is limited. Secondly, rainfall decreases in late summer and autumn (March to April), which has a negative effect on plants still in the growth stage that require ample rainfall to produce a satisfactory yield.

The planting date will thus determine whether the plant's critical growth stages fall within the period of favourable conditions, which will in effect have an influence on yield. In light of this, it is clear why planting dates have such a significant effect on yield and why various maturity groups react differently to certain planting dates.

Maturity group reactions

When looking at maturity group 4,5, the difference in yield between planting dates did not differ drastically. The reason for this is simply that maturity group 4,5 could complete its growth stage for both planting dates within the specific growth period. With maturity groups 5 and 6, frost or possible drought at the end of the season had a negative effect on especially the pod filling growth stage. In other words, neither maturity groups could complete their growth period.

Figure 2: Average soya bean yield on two planting dates and with three maturity groups.



Both maturity group 5 and 6's R1 to R2 (flowering growth stages) took place during mid-February and the beginning of March, which are characterised as warm and dry periods, and negatively affected yield. It is clear from the aforementioned results that planting date plays a significant role in yield, but it cannot always be controlled. It is therefore critical to rather focus on the correct maturity group for a certain planting date.

Putting plant density to the test

Plant density is another management practice that producers still have many questions about. The soya bean plant has a large and effective compensatory ability when it comes to plant density. It can adapt its growth and development to different plant densities by means of manipulating the number of side branches, pods per plant, and seeds per pod. From the trials, pod counts were done throughout on all plant density treatments. *Figure 3* indicates how the number of pods per plant decreased as plant density increased. *Figure 4* shows that yield did not differ much between a wide range of plant densities.

Plant densities that are too low (150 000 to 200 000 plants/ha^{-1}) can have a negative effect on yield, especially when a hailstorm further decreases the plant density. It is also true that plant densities that are too high (350 000 plants/ha^{-1} and higher) affect yield negatively, especially in times of drought and high temperatures, with more plants consuming more water. Higher plant densities also lead to higher seed costs, especially when new seed is used.

According to the results from three years' trials, the optimum plant density for the North-eastern Free State ranges between 250 000 and 300 000 plants/ha^{-1}. Planting date and maturity group also play a role in the response to different plant densities, especially with late planting dates and shorter maturity groups where a slightly higher plant density (±25 000 to 40 000 more plants/ha^{-1}) has a positive effect on yield, as plants are generally smaller.

Choosing the best row width

Row width is another management practice that producers can adjust, but because most producers in the VKB area are on 0,76 and 0,91m row widths, they must decide for themselves whether or not it is worthwhile to change due to the initial cost thereof. According to the trial results, there was a significant yield increase with narrower row widths (±400 to 500kg/ha^{-1}).

In the trials, row widths of 0,30 versus 0,60m rows, and 0,38 versus 0,76m rows were evaluated. The results are shown in *Figure 5*. There are several reasons why narrower rows produce higher yields. They intercept more light earlier in the season, while the leaf canopy also forms faster and water consumption is more effective, which leads to an increased growth rate, dry matter production, and yield potential.

Narrow rows also increase the plant's ability to compete with weeds due to the overshadowing effect of a faster forming leaf canopy, which suppresses weed growth. There are certain challenges that come with narrower row width, such as diseases, and tractors and sprayers that trample plants. The perception exists that narrower row widths in soya beans can create environmental conditions that are more favourable for certain diseases such as *Sclerotinia*.

This can be overcome by planting maturity groups that produce fewer branches and have a more upright growth habit, or a maturity group

Figure 3: Average pods per plant at different plant densities.

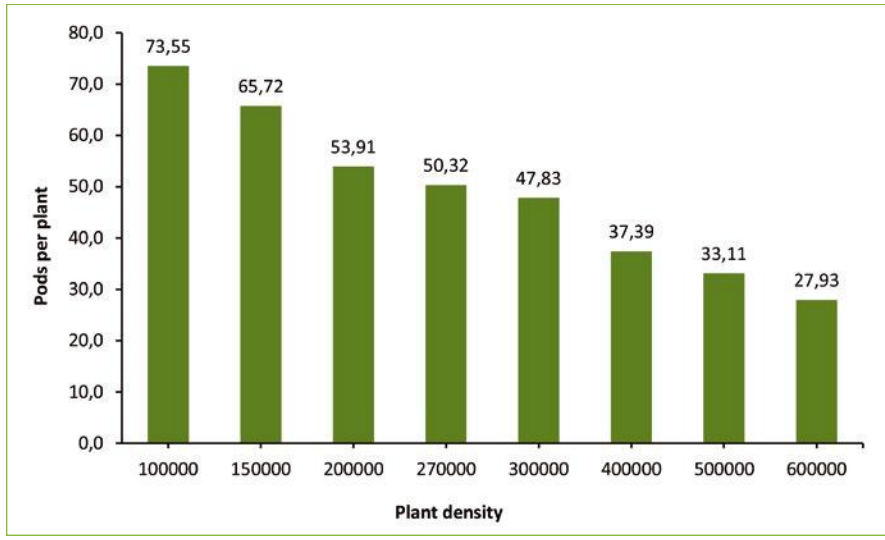
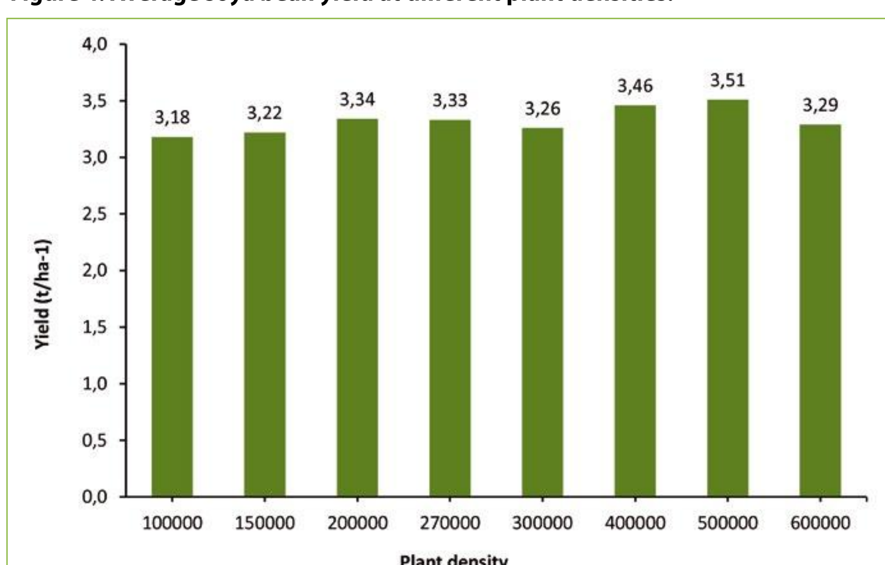


Figure 4: Average soya bean yield at different plant densities.

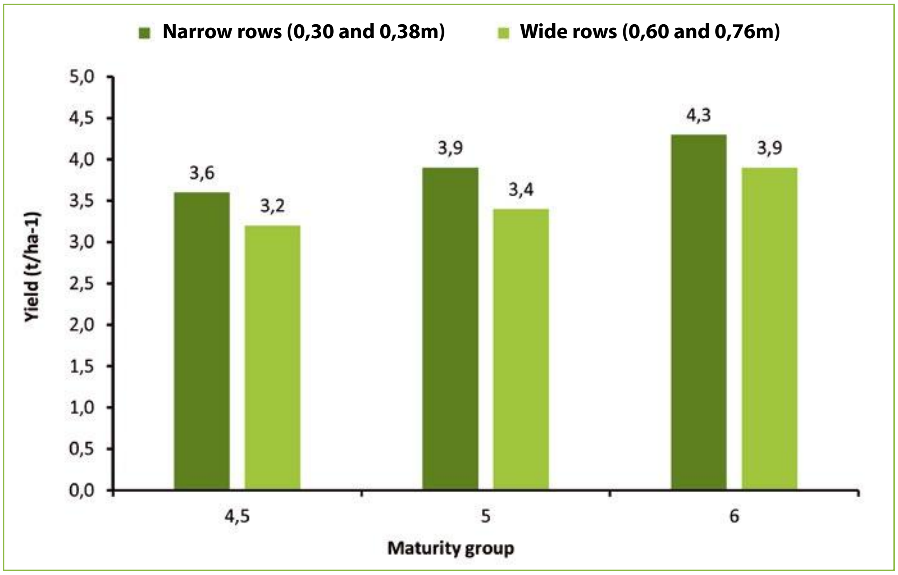


that has concluded the flowering growth stage before *Sclerotinia* becomes a problem. It depends on each producer whether he or she wants to change the row width, and if it will be worth it. However, the fact that there is a yield increase with narrower row widths is noteworthy.

In conclusion

Planting date significantly affects yield. Early planting (mid-October to mid-November) equals longer maturity groups (no longer than MG 5,5) and produces higher yields; however, shorter maturity groups still produce satisfactory yields. Late planting (mid-November to December) equals short and short to medium maturity groups (MG 4,5 to 5), which are the safest options for optimal yield. Different plant densities do not have such a large influence on yield – 250 000 to 300 000 plants/ha^{-1} are optimal. Late planting and short maturity groups can be planted at a slightly higher population (300 000 to 320 000 plants/ha^{-1}). Narrower row widths result in an increase in yield. Each farmer must decide for him- or herself whether or not to make the adjustment.

Figure 5: Average soya bean yield of narrow and wide row widths with three maturity groups.



We would like to acknowledge the Protein Research Foundation for funding this project.
For more information, contact Jacques van Zyl on 078 815 5313, 087 358 8496, or jacques.vzyl@vkb.co.za.

Lessons from Argentina: Mitigating the devastation of Amaranthus

By Sebastian Sabaté, Obispo Colombres Agroindustrial Experimental Station (EEAOC), Tucumán, Argentina

Palmer amaranth and its close native relative, *Amaranthus hybridus* (*A. hybridus*), are currently the most troublesome weeds in Argentina. *Amaranthus palmeri* (*A. palmeri*) was first detected in the country in 2010 and has been expanding since. This species produces massive amounts of seed and since it is native to the southwestern deserts in the United States (US), it can germinate rapidly (two to three days) with little rainfall.

Another biological feature that makes it the 'perfect weed' is its extended germination period during the growth season. In northwestern Argentina, it starts germinating in early October and will have five to eight cohorts until March or April. It also has an impressive growth rate, being able to double in size in approximately five to seven days. *A. hybridus* behaves in a similar way, with lower growing rates and generally fewer cohorts throughout the season.

One of the biological features that makes Palmer amaranth the 'perfect weed' is its extended germination period during the growth season. (Photograph: revistacampoenegocios.com.br)

Main aspects to take note of

Considering these traits, management of the *Amaranthus* species is based on three main aspects:

Continuous field scouting

In order to detect the presence of these species as early as possible, the systematic scouting of fields is one of the key aspects in managing these intruders. This will allow the control of 'founder' individuals early enough to prevent seed dispersion in each field. When a population of amaranth species is already present on a farm, it is also necessary to reinforce monitoring activities to ensure timely herbicide applications.

Timing is important for the use of both post-emergent and residual herbicides. In the case of post-emergence, most of the protoporphyrinogen oxidase (PPO) inhibitors (Group 14 herbicides) have a short application window, and herbicide efficiency can drop drastically when plants are more than 7 to 10cm tall. Residual herbicides are much more effective for controlling these species, but proper timing is crucial to optimise the protection period. In addition, since new cohorts will still develop, an eye needs to be kept on germinations even after residual applications.

Use of multiple residual herbicides

Considering the local experience and the valuable information available in the US, the management of amaranth populations with only one effective residual herbicide is not enough to control their expansion. Factors such as multiple resistance populations, timing of applications, and environmental conditions make it necessary to implement management strategies that include two or more effective residual herbicides with different sites of action.

In certain cases, it can be achieved by using labelled formulations or approved in-tank mixes of various active ingredients at pre-emergence of the crop. Another alternative is to use a technique called 'overlapping', which entails spraying different sequential herbicides throughout the season to prevent the natural decay of herbicide activity in the soil.

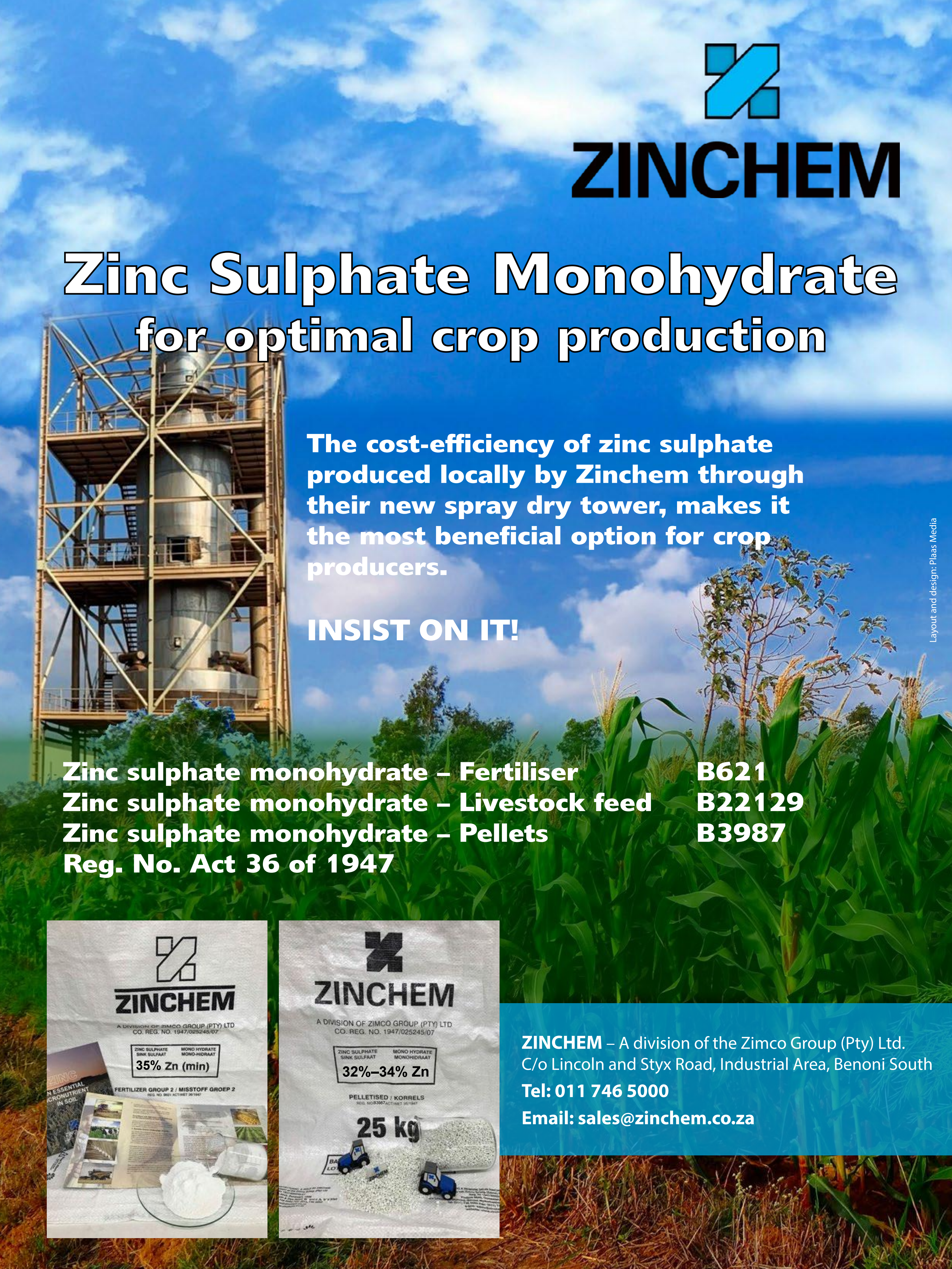
Zero tolerance for seed production

When dealing with any weedy species, we need to understand that the most threatening element is the large amount of seed each plant can produce. That is why it is necessary to eliminate any surviving weeds or 'scapes' before flowering.

According to the development stages of crops and weeds, this can be achieved by means of post-emergence herbicides, hand weeding, or harvest weed seed control tools. Growers need to consider these labours as an investment to reduce the impact of severe weed competition in the future.

Waging war against resistant weeds

It goes without saying that there is an increase in the production costs in the areas affected by resistant amaranth weeds. In Argentina, there is currently a heavy reliance on PPO pre- and post-emergence herbicides (sulfentrazone, flumioxazin, fomesafen, and lactofen). In addition, VLCFA inhibitor herbicides (Group 15) such as s-metolachlor,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Amaranthus palmeri where it was first confirmed in South Africa (April 2018) in a cotton field in the Douglas district. (Photograph: Dr Charlie Reinhardt)

acetochlor, or pyroxasulfone, and inhibitors of photosynthesis at the photosystem II (Group 5), such as metribuzin, are used in tank mixes. As the use of herbicides increased in response to these weeds, so did the selection of new resistant populations.

Back in 2012 there were two main *A. palmeri* populations in Argentina: one with resistance to glyphosate, and another with resistance to ALS inhibitors. Nevertheless, *A. hybridus* was the first resistant weed registered in Argentina in 1996, with widespread ALS inhibitor resistance at the time. Nowadays, there is evidence of resistance to PPO and growth regulators in both species in different areas.

It is important to note that in the US, Palmer amaranth has developed a resistance to seven different modes of action, leaving very few effective herbicide options for control. Therefore, different agronomic and integrated management strategies are being developed, such as cover crops, planting dates, row width, and artificial intelligence assisted spraying.

Diversifying management strategies is the best alternative, at least for the time being. Ideally, we need to consider diversification of both space and time. Diversification of space refers to the planning of different crops and herbicide schemes for the different fields on the farm, as shown in *Figure 1*. In addition, making use of crop rotation and different herbicide mixtures throughout the years for each field should be considered – this should include planning an estimated management strategy for at least three to five years.

Prevention is better than cure

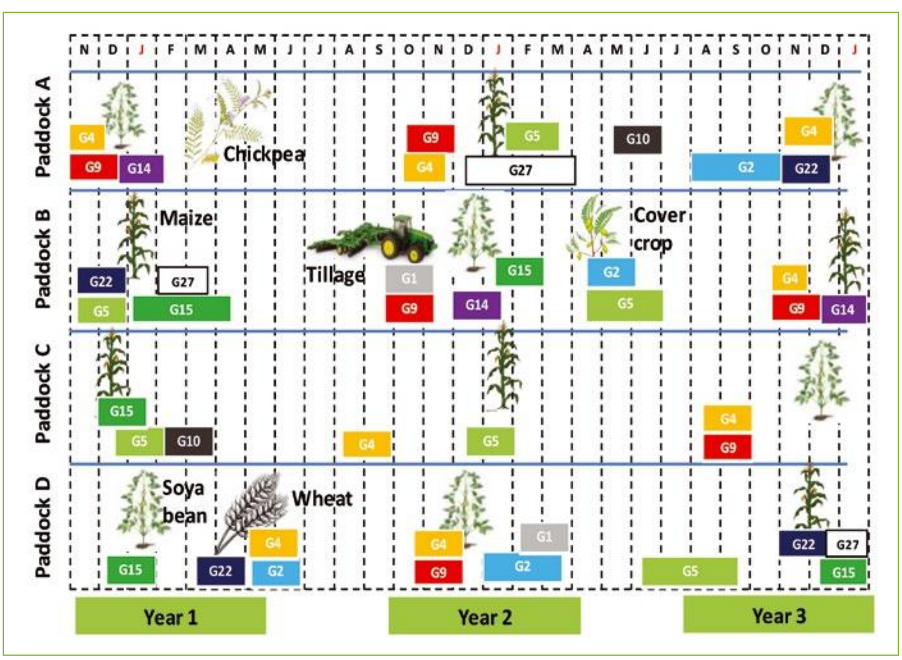
Considering the experience gained in Argentina over the past 15 years, it is recommended that this issue be addressed as soon as possible. Growers need to be aware of the risks imposed by these weeds and learn to identify them in the field early in the season. It is therefore vital to offer weed identification courses and to provide online and printed material, indicating the key aspects of species identification and scouting strategies.

The different herbicides registered in the country need to be evaluated in order to identify the best alternatives according to soil, weather, and weed biology traits. It is recommended that the establishment of regional research plots – where herbicide efficacy can be thoroughly tested – be promoted.

It is also important to study germination and growth rates, as well as the influence of planting dates and crop rotation in these variables. Beyond the growth season, winter fallow conditions and the viability of cover crops to prevent the early germination of weeds may be of interest to diversify management strategies.

It is usually difficult to foresee the impact of herbicide resistance when a single post-emergence herbicide is flawlessly controlling everything in the field. However, leaving this issue unattended can rapidly escalate into a situation where even the complex strategies that were previously described may fail. The sooner you can incorporate integrated management strategies into your production scheme, the longer you will delay herbicide resistance development and thus be able to maintain the efficacy of herbicides.

Figure 1: Schematic of crop and herbicide diversification scheme.



Different colour bars indicate the timing of herbicide application and the different groups of herbicides available (according to the Herbicide Resistance Action Committee's 2020 classification).
The specific herbicides used will depend on the active ingredients registered for the specific use in each country.
G1: Inhibition of ACCase, G2: inhibition of ALS, G4: auxin mimics herbicides, G5: inhibition of photosynthesis at PSII, G9: inhibition of EPSPs, G10: inhibition of glutamine synthetase, G14: inhibition of PPO, G15: inhibition of VLCFA synthesis, G22: PSI electron diversion, G27: inhibition of HPPD.

For more information, visit *www.eeaoc.org.ar*.

The impact of key drivers **on sunflower seed quality**

By Marion Delport, lead data scientist, Bureau for Food and Agricultural Policy

Over the past seasons, the drastic decline in sunflower seed oil content has had an adverse impact on the industry. The industry norm was typically the delivery of sunflower seed with an oil content of approximately 39% and higher; however, the oil content has dropped significantly, putting crushing margins and the overall competitiveness of the industry under pressure.

In light of this, the Bureau for Food and Agricultural Policy (BFAP) undertook a study, funded by the Oilseeds Advisory Committee (OAC) and the Oil and Protein Seeds Development Trust (OPDT), to provide a deeper understanding of the key drivers affecting sunflower seed quality, the impact of varying (lower) oil content on the industry, and potential interventions towards an upgraded state of the value chain.

Minimal average annual growth

In South Africa, yields (per hectare) and oil yield (t/ha) have been relatively stagnant over the past decade, managing to increase by an average annual growth of only 1% compared to maize yields, which have increased by an average annual growth of 2,5% over the same period. Simultaneously, the oil content (%) of the seed has decreased by an average of -0,6% annually.

The oil content of sunflower seed produced in South Africa is also significantly lower than what is produced in Argentina or the Balkan countries. Furthermore, cultivar trial data from international seed breeders shows that the same high oil content cultivar planted in South Africa yields a lower oil content than if planted under optimal conditions in Argentina (*Table 1*).

This research clearly illustrated that seed yield and oil content are complex, and that quantitative traits that are not only controlled by many genes, but are also highly influenced by environmental conditions – both additive and non-additive genetic effects – play a vital role in the inheritance of seed yield and oil content. There is

Figure 1: Sunflower seed oil concentration (%) results based on the cultivar trials for 2013 to 2019 (9% moisture level), and South African Grain Laboratories (SAGL) for 2013 to 2019 (as-is moisture levels).

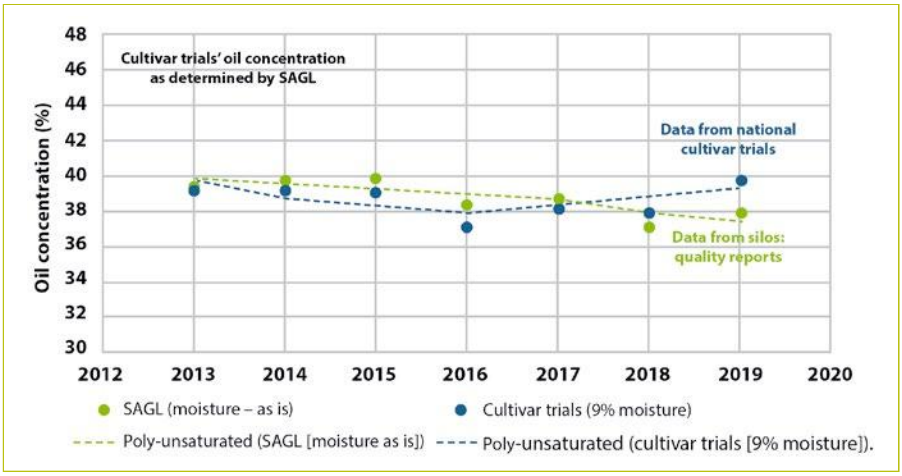


Table 1: A comparison of the performance high oil content cultivars in Argentina and South Africa. (Source: National cultivar trials in South Africa and Argentina, Corteva [2019] and ARC [2019])

Cultivar	Country	Yield (t/ha)	Oil content (%, moisture – as is)
Cultivar 1: Commercially sold in Argentina and South Africa	Argentina	2,58	52,7
	South Africa (avg 2016 to 2019)	1,77	42,3
Cultivar 2[1] in Argentina vs Cultivar 3 in South Africa	Argentina	2,51	50,4
	South Africa (avg 2016 to 2019)	1,88	40

[1]*Cultivar is of South African origin but was moved to Argentina since it could not outperform Cultivar 3, the winning Corteva cultivar in terms of yield in South Africa.*

Table 2: Factors that affect sunflower seed yield and oil content.

	Yield	Oil content
Late planting date	↓	↓
Plant population	<20 plants/ha >45 plants/ha ↓	
Temperature	↓	↓
Water stress	↓	↓

some evidence that oil content levels can be increased by introducing more high oil yielding cultivars (*Figure 1*).

Currently, producers planting sunflower have a choice of 199 different seed varieties. Of these, 113 are classified as high-oil hybrids with the potential of achieving an oil content higher than 40%. The average advertised oil content for South African cultivars is between 38 and 46%.

An analysis of advertisements from seed companies supplying the Russian, Ukrainian, Hungarian, and Argentinian markets indicated an advertised oil content in the range of 45 to 54%. Thus, the South African sunflower seed market might benefit from new imported cultivars. This must, however, first be tested to establish its potential under South African climatic and management conditions.

Sunflower production is a predominant cash crop in Argentina and the Balkan countries, while in South Africa it is a catch crop which is planted after maize. Preference is not given to the timing of production such as optimal planting date, fertiliser applications, soil analysis, or much of the required pest, weed, or disease programmes required for optimal production. *Table 2* lists the effects of some of these factors on yield and oil content.

Focussing on high yield cultivars

To encourage producers to focus more on sunflower production, the return needs to be higher than that of maize, thus requiring a higher sunflower seed selling price. However, the price cannot be increased, because, for the South African sunflower seed to remain competitive in the global market, the price of sunflower seed and oil must remain between import and export parity.

Currently, there is little motivation for producers to increase oil content (through targeted agronomic practices), therefore their primary focus is increasing yields for larger returns. One way to prevent sunflower seed oil content from decreasing further is to incentivise producers to focus on the oil content by buying higher oil content seed and planting sunflower earlier – closer to the optimal planting window.

A summary of various international and domestic quality-based pricing models highlighted two options for the sunflower industry, namely an oil content-based price premium or oil content based grading (a common practice in Argentina and the Balkan countries' pricing mechanisms), and a back-payment structure whereby the farmer gets to share in high-quality driven (high oil content) advantages at crushing level.

Consequently, the BFAP study explored the principles of an incentive system that rewards producers for adopting high oil content seed that maximises oil yield per hectare, rather than just yields per hectare. This is not a new concept and is a sunflower contracting norm in international markets.

To speed up the adoption of high oil content seed by producers, an incentive structure that stimulates uptake would be an important factor to consider, especially if there could be a perception (and theoretical expectation from a plant science and breeding perspective) of a negative correlation between yields and oil content. Therefore, at farm level, the incentive will compensate for a gross margin trade-off between producing 'high yield, lower oil content seed' and 'low yield, high oil content seed'.

Pilot study yields results

In a pilot study conducted during the 2020 season, a sunflower seed crushing facility offered a 1,5% price premium for every 1% oil content above 38%. Producers that planted Cultivar 1 (as mentioned in *Table 1*) were eligible to participate in this study.

The stakeholders described the pilot as a success because:

- Of the sunflower seed delivered, oil content was measured at 46 to 48%.
- Based on an average sunflower price of R5 887/ton, producers would have received price premiums of between R706 to R883/ton (that is 12 to 15%).
- On top of the improved price, producers that took part in the pilot reported average yields of 2t/ha.

Overall, the 1,5% premium accounts for a 0,3t/ha lower yield at the average oil content levels recorded in this study.

Oil content testing at silo level would be a key factor in implementing such an oil content-based price premium, and is currently poorly defined with no standards or thresholds of oil content levels – and not all silo depots have calibrated oil content measurement equipment.

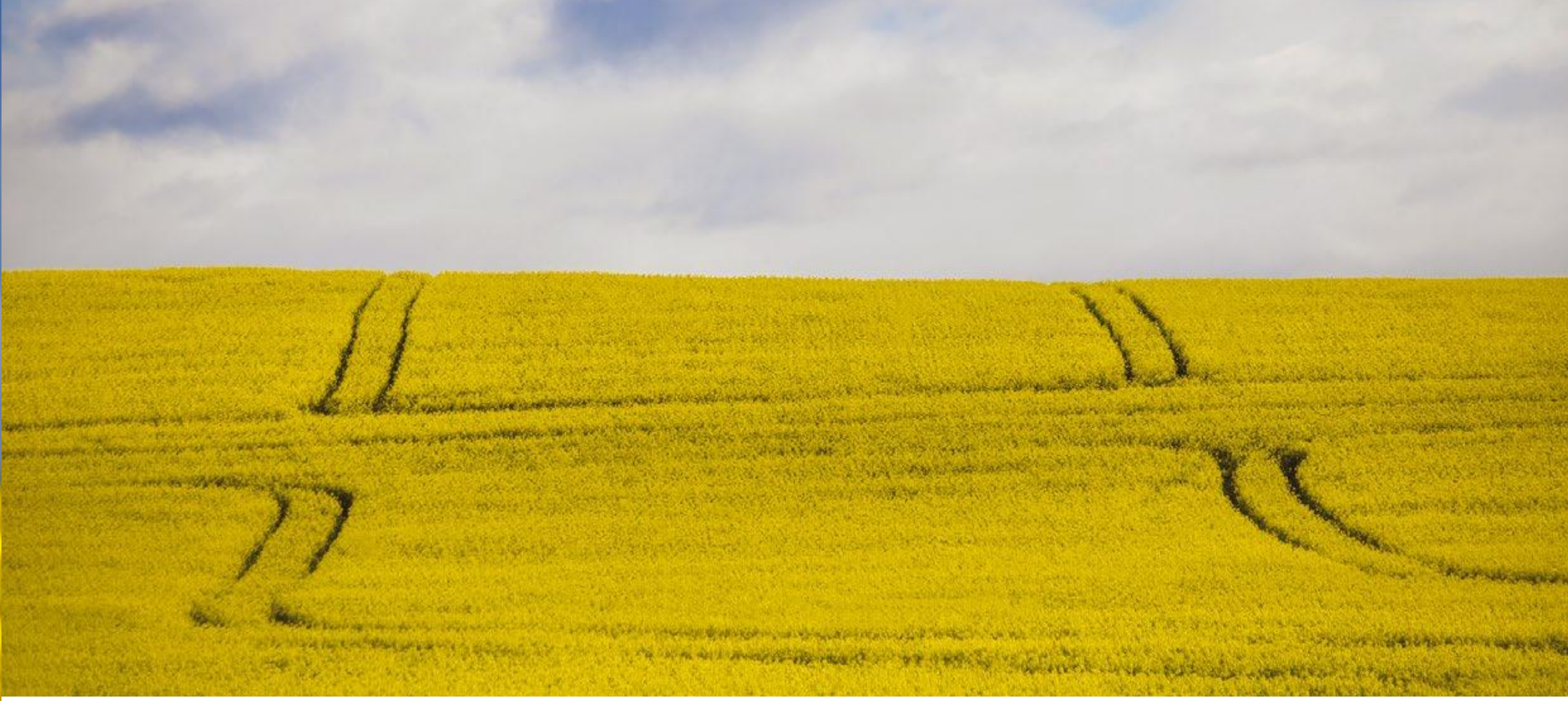
The near-infrared reflectance (NIR) testing methodology would be an analysis of choice at both silo level and crushing plants due to the speed of the test, the ease of testing, and relative accuracy. However, to make this technology available at all (or enough), silos would require significant additional investments by silo owners.

Carte blanche for producers

Overall, it comes down to the producers' willingness to adopt new high oil content seed and predominant cash crop production practices (such as earlier planting dates), as well as favourable environmental and climatic factors.

This is to improve their ability to produce seed that exceeds the threshold of 38%, preferably in excess of a 41% oil content, as well as the wherewithal of processors to pay premiums that will sustainably stimulate high levels of high oil yielding seed production, while competing with crude oil imports.

For more information, email Marion Delport at mailadmin@bfap.co.za.



Canola cultivar evaluation: Western and Southern Cape 2020

By PJA Lombard, L Smorenburg, and J Strauss

During the 2020 season, a total of 14 canola cultivars were tested in the cultivar evaluation programme. Among these were four conventional, four CI (Clearfield, imazamox tolerant), and five of the TT group (triazine tolerant) cultivars. A combination-type cultivar (Hyola 580CT) that is tolerant to both CI and triazine, was included in the trials for a second year.

As a result of the challenges faced in 2020, no new cultivars could be tested; however, all were hybrids.

Climate

Rainfall on the Langgewens Research Farm in the Swartland was 12mm less than the long-term average. The temperatures, along with the rainfall, in all probability created the ideal circumstances for vegetative development up until July. Maximum temperatures from May to June were 1,3 to 2,4°C higher than the long-term average. Canola plants are extremely susceptible to high temperatures, especially during the process of flowering up until the completion of seed filling. During this time, the maximum (1,1°C) and minimum temperatures (1,4°C) were lower than the long-term average.

However, the average rainfall for the growing season was 92mm more than the long-term average of 244mm. The average temperature in August was 1,6°C (maximum) and 1,4°C (minimum) lower than the long-term average. Both the maximum and minimum temperatures were lower during October, which meant that temperatures in the Overberg were favourable for seed filling. The confluence of climate conditions in 2020 resulted in a high seed yield.

Results

Yield results for the various areas are summarised in *Table 1*. Data from the CI and TT cultivars is indicated separately from the conventional cultivars. The new combination-type cultivar, Hyola 580CT, is included in the TT group.

In the Swartland, the average yield per trial varied from 3 324kg/ha^{-1} (first planting at Langgewens) to 2 269kg/ha^{-1} at Hopefield. The CI cultivars 44Y90 (4 072kg/ha^{-1}) and 43Y92 (3 570kg/ha^{-1}) delivered the highest yield for the first and second sowing, respectively, at Langgewens. The two conventional cultivars Diamond (3 367kg/ha^{-1}) and Quartz (3 318 kg/ha^{-1}) had the highest average yield in the Swartland.

Table 1: Swartland and Southern Cape seed yield for 2020 (kg/ha^{-1}).

Cultivars 2020	Langgewens 1	Langgewens 2	Hopefield	Tygerhoek 1	Tygerhoek 2	Riversdale	Napier	Average
Planting date	11 May (rain 25 May)	2 June	18 May (rain 25 May)	7 May	22 May	20 May	9 June	
	kg/ha^{-1}	kg/ha^{-1}	kg/ha^{-1}	kg/ha^{-1}	kg/ha^{-1}	kg/ha^{-1}	kg/ha^{-1}	kg/ha^{-1}
Hyola 50	2 826^{d}	3 430^{abcd}	2 343^{abcd}	3 111^{defgh}	3 575^{def}	3 819^{def}	3 142^{defg}	3 166de
Diamond	3 579^{ab}	3 513^{abc}	3 009^{ab}	3 427^{cdef}	3 891^{abcde}	4 202^{bcd}	3 380^{bcdef}	3 572^{bc}
Tango	2 712^{d}	2 874^{e}	2 035^{bcde}	3 030^{efgh}	3 316^{ef}	3 729^{def}	2 881^{fg}	2 940^{ef}
Quarts	3 668^{a}	3 203^{abcde}	3 084^{a}	3 613^{bcd}	4 291^{ab}	4 649^{ab}	3 275^{cdef}	3 683^{ab}
Conventional avg	**3 196**	**3 255**	**2 618**	**3 295**	**3 768**	**4 100**	**3 170**	**3 340**
43Y92	3 934^{a}	3 570^{a}	2 650^{abc}	3 489^{cde}	3 595^{cdef}	4 626^{ab}	3 783^{bc}	3 664^{ab}
45Y93	3 756^{a}	3 513^{ab}	2 111^{bcde}	4 062^{ab}	4 396^{a}	4 710^{a}	4 542^{a}	3 870^{a}
45Y91	3 773^{a}	3 335^{abcde}	2 777^{ab}	4 159^{a}	3 955^{abcd}	4 459^{ab}	3 968^{ab}	3 775^{ab}
44Y90	4 072^{a}	3 550^{ab}	2 681^{ab}	3 754^{abc}	4 181^{abc}	4 414^{abc}	3 973^{ab}	3 804^{ab}
Cl average	**3 884**	**3 492**	**2 555**	**3 866**	**4 032**	**4 552**	**4 067**	**3 778**
Alpha TT	3 497^{abc}	3 015^{bcde}	2 078^{bcde}	3 541^{bcde}	3 496^{def}	3 957^{cde}	3 525^{bcde}	3 301^{cd}
Hyola 555 TT	2 789^{d}	2 938de	1 686de	2 588^{h}	3 149^{f}	3 409^{f}	2 848^{fg}	2 772^{f}
Hyola 559 TT	2 832^{d}	3 129^{abcde}	2 366^{abcd}	3 043^{efgh}	3 675^{bcdef}	3 514^{ef}	2 640^{g}	3 028^{def}
Hyola 350	2 956^{cd}	3 327^{abcde}	1 487^{e}	2 857^{gh}	3 112^{f}	3 718^{ef}	2 978^{efg}	2 919^{ef}
Hyola 650	3 079^{bcd}	2 977^{cde}	1 634de	3 135^{defg}	3 217^{f}	3 838^{def}	3 601^{bcd}	3 069de
Hyola 580CT	3 069^{bcd}	2 928de	1 826^{cde}	2 927^{fgh}	3 263^{f}	3 592^{ef}	3 264^{cdef}	2 981^{ef}
TT average	**3 037**	**3 052**	**1 846**	**3 015**	**3 319**	**3 671**	**3 143**	**3 012**
Trial average	**3 324**	**3 236**	**2 269**	**3 338**	**3 651**	**4 045**	**3 414**	**3 325**

**Cultivars marked with the same letter do not differ significantly.*

Table 2: Traits of the cultivars tested from 2018 to 2020. (Data obtained from the *Australian Blackleg Management Guide Fact Sheet, 2014 to 2020*).

Cultivar	Type	Company	Year of first test	Growth period: Days until flowering, 2019/20	Days until flowering, Langgewens, 2018/19	Yield (% of trial average), Swartland, 2019/20	Yield (% of trial average), Rûens, 2019/20	Blackleg index	Blackleg index + Jockey^{j} / Saltro^{s}/ Ilevo^{i}	Blackleg resistant group #
Hyola 50	Conv	K2 Seed	2009	Late	Late	99	93	r^{2016}	r$^{2016(j)}$	AD
CB Tango	Conv	Agricol	2013	Early*	Early*	93	93	ms^{2014}	mr$^{2014\ (j)}$	B
Diamond	Conv	Agricol	2015	Early	Early	119	108	mr^{2020}	r$^{2020\ (jsi)}$	ABF
Quartz	Conv	Agricol	2018	Semi-early	Semi-early	117	115	r^{2020}	r$^{2019\ (j)}$	ABD
44Y90	CL	Pioneer	2016	Medium	Semi-early	110	112	r^{2020}	r$^{2020\ (jsi)}$	B
45Y91	CL	Pioneer	2016	Late	Late	106	106	r-mr^{2020}	r$^{2020\ (jsi)}$	B
43Y92	CL	Pioneer	2017	Semi-early	Semi-early	115	110	r^{2020}	r$^{2020\ (i)}$	B
45Y93	CL	Pioneer	2019	Late^{2019}	Late^{2019}	102	110	r^{2020}	r$^{2020\ (si)}$	BC
Hyola 555 TT	TT	K2 Seed	2011	Semi-early	Semi-early	84	85	mr^{2014}	r$^{2014\ (j)}$	D
Hyola 559 TT	TT	Barenbrug	2014	Semi-early	Medium	93	86	r^{2020}	r$^{2020\ (s)}$	ABD
Hyola 650 TT	TT	Barenbrug	2017	Medium	Medium	86	93	r^{2017}	-	ABD
Alpha TT	TT	Agricol	2017	Semi-early	Semi-early	99	99	ms-mr^{2018}	r$^{2018\ (j)}$	BF
Hyola 350 TT	TT	K2 Seed	2018	Early	Early	92	90	r^{2020}	r$^{2020\ (jsi)}$	ABDF
Hyola 580 CT	Cl & TT	Barenbrug	2019	Semi-early^{2019}	Medium^{2019}	85	89	r^{2020}	r$^{2020\ (jsi)}$	BC

r = resistant; mr = mildly resistant; ms = mildly susceptible; s = susceptible. ** Slow to germinate (adjusted dates).* *Seed treatment: Jockey = j, Saltro = s and Ilevo = i.*

The TT cultivar Alpha (2 863kg/ha^{-1}) had the highest average yield in the Swartland, followed by Hyola 559 TT (2 776kg/ha^{-1}). The average yield of the TT cultivars was 13% (26% in 2019) and 22% (9% in 2019) less in 2020, compared to the conventional and CI cultivars. The yield of the CI cultivars was on average 9% more than the yield of the conventional group of cultivars.

In the Rûens, the average yield varied between 4 045kg/ha^{-1} at Riversdale, and 3 015kg/ha^{-1} at Tygerhoek Research Farm during the first planting date. The yield of the first planting was negatively influenced by irregular germination. Average yield was 3 704kg/ha^{-1} compared with 1 678kg/ha^{-1} in 2019.

Due to the lengthy growing season, the CI cultivar that had a longer growing season, delivered the highest yield in the trials. The average yield of 45Y93 was 4 549kg/ha^{-1}. The cultivar with the second highest yield in 2020 was also a CI cultivar, namely 44Y90.

The conventional cultivar Quartz (4 072kg/ha^{-1}) delivered the highest average yield in the conventional group, as well as in the Southern Cape, as was the case in 2019.

It was followed by Diamond (3 824kg/ha^{-1}), which had the highest yield in 2017. In the TT group, Alpha TT (3 659kg/ha^{-1}) had the highest yield, followed by Hyola 650TT (3 552kg/ha^{-1}) in second place, and the combination cultivar Hyola 580CT (3 373kg/ha^{-1}) in third. The average yield of TT cultivars was 8 and 23% lower than the conventional and CI cultivars, respectively. In 2019, variation in the Southern Cape was 20 and 12%, while conventional cultivars had a 20% difference.

The traits of the cultivars are summarised in *Table 2*. Take note that various agents have been added to the blackleg index. The average seed yield of two seasons gives a better indication of the expected yield of a cultivar than a single season, as was the case in 2020, which had a record season in commercial terms.

In conclusion

The climate of the 2020 season had a positive effect on production. Due to the cooler weather in August and September, the growing season lasted longer than usual. In contrast, though, the 2019 season was unusually dry with record high temperatures measured in September, which greatly affected yield. In 2020, the yield at corresponding localities was 67 and 133% more in the Swartland and Southern Cape, respectively. The 2019 and 2020 seasons highlight the severe impact that climate change can have on production in the Western Cape.

For more information, send an email to PJA Lombard at pietl@elsenburg.com.

Breeding rights of sunflower **in the spotlight**

By Ursula Human

Increased investment in the agricultural and seed industry in South Africa has triggered some debate on intellectual property rights. This is according to a webinar recently hosted by the Institute of Social and Economic Research (ISER) at Rhodes University.

The webinar focussed on plant breeders' rights (PBRs) in the South African sunflower seed industry. The research on sunflower PBRs by Dr Binganidzo Muchara and Dr Charity Nhemachena of the Unisa Graduate School of Business Leadership was discussed. Their study included an analysis of the evolving landscape of sunflower PBRs in South Africa.

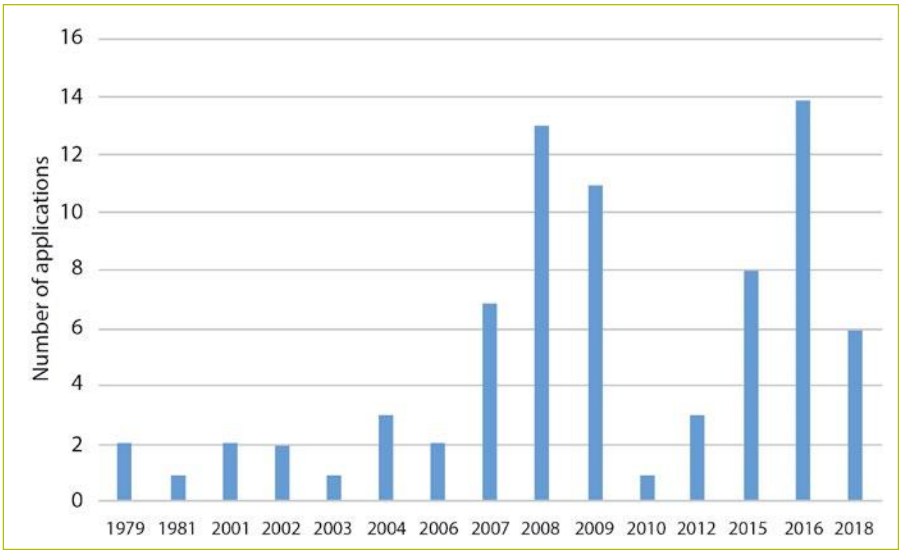
Influence of PBRs on investments

According to Dr Muchara, PBRs are crucial because if these rights are not well protected, no value can be derived from the investment in breeding. If there is no value to this arduous process, investments in breeding might be deterred, which could have a knock-on effect on the entire value chain.

Dr Muchara noted that if investors do not derive benefits from sunflower breeding, the dwindling investment could impact the productivity of the industry. For example, there will be no advancement if the industry keeps on using old varieties. With no increase in yields, the industry runs the risk of not being able to sustainably meet local demand.

Sunflower is a key commodity in South Africa and is the third-largest primary crop after maize and wheat. It can be used in several products and, locally, is the main source of vegetable oils. Sunflower can be used in the production of biodiesel and oilcake for animal feed, while the seeds serve as ingredients in products such as granola bars, margarine, and multi-seed bread.

Figure 1: Annual applications for sunflower varietal improvements by plant breeders between 1979 and 2019. (Source: Authors' compilations with data obtained from the *South African Plant Variety Journal*)

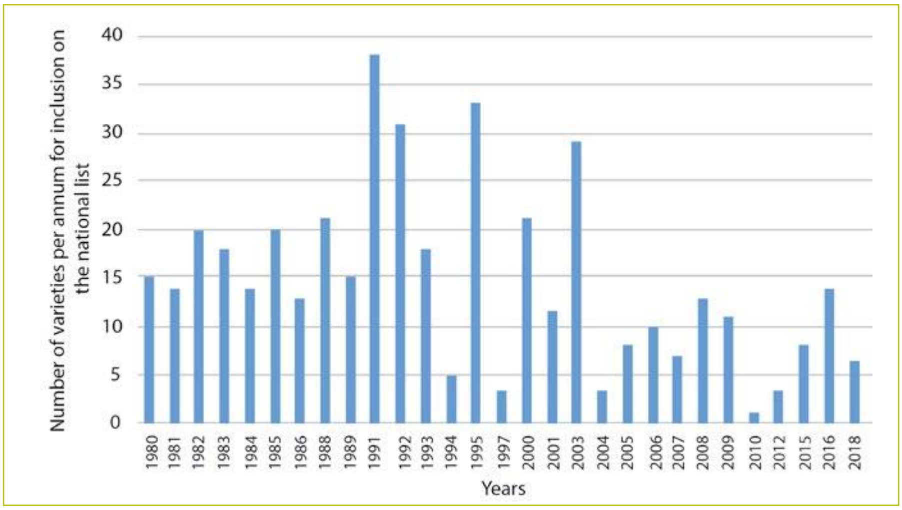


Overview of the history of PBRs

According to Dr Nhemachena, several laws have been formulated to protect intellectual property rights, both at national and international level. She shared a brief history of PBRs from around the world and said the protection of plant breeders' intellectual property rights was recognised from as far back as the 19th century.

However, it was only in 1961 that the International Union for Protection of New

Figure 2: Annual applications for the inclusion of sunflower varieties on the national variety list between 1979 and 2019. (Source: Authors' compilations with data obtained from the *South African Plant Variety Journal*)



Varieties of Plants (UPOV) was established to co-ordinate plant variety protection laws, as well as standards for protection across all member countries. South Africa has been a member of the union since 1977 and was the tenth country to join. UPOV provides standardised laws for PBRs, as well as the procedures used for testing new varieties. This assists breeders in obtaining financial rewards for their efforts, which are both time-consuming and expensive.

Breeding rights of new varieties

There is a continuous demand for high-quality, disease-resistant plants with higher yields. In South Africa, a new variety can only be granted breeding rights once it has been listed in the *South African Plant Variety Journal*.

Once the plant has been listed, breeders are awarded PBRs for a specific period. Rights for plants are granted for 20 to 25 years in South Africa, depending on the type of crop; breeding rights for sunflower are granted for only 20 years, said Dr Nhemachena. She explained that during the first five to eight years (the period during which the breeder enjoys sole rights), the breeder has the right to multiply and market propagation material of the specific variety.

During the next 15 years, the rights holder is required to issue licences to others who want to use the material, with the breeder collecting royalties from the licence holders. After 20 years, the new sunflower variety will become openly available to anyone who might need it.

Private sector vs public sector

A database was created for the study using the *South African Plant Variety Journal*, to determine the extent of PBRs granted in South Africa. Data on sunflower varieties in the country was collected from this list between 1979 and 2019.

The research done by Dr Nhemachena indicated that the local private sector constituted the largest share of sunflower breeding rights, accounting for 77% of applications for varietal inclusion on the national variety list. The researchers further found that the second highest percentage of applicants were collaborations between local and foreign companies, making up 19% of all applications.

Partnerships are formed with local companies when they apply for foreign sunflower varieties to be included on the national variety list. The leading companies of such partnerships include Syngenta United States (US), Syngenta France, Pioneer Hi-Bred International in the US, Dow Agrosciences Argentina, and Bioseed US.

Those in the public sector, such as the Agricultural Research Council (ARC), however, play a minor role in the development of sunflower varieties, representing only 1% of the share.

Eco-friendly energy sources

According to Dr Nhemachena, the future is bright for sunflowers as a biofuel crop in South Africa. This can be seen in the ARC's research on exploring the use of crop breeding to produce advanced biofuel. Various crops in the country are identified as having potential as bio- and renewable diesel. This includes oilseed crops such as sunflowers, soya beans, and canola.

Oilseeds are widely recommended for eco-friendly, renewable energy sources, meaning a more efficient variety registration process in the least amount of time. The ARC has been exploiting selected cultivars of sunflowers for production of renewable diesel, which is known to meet the requirements for use in a diesel engine.

The study concluded that it is necessary to establish a process for registering new sunflower varieties that can be concluded sooner. It is also necessary to improve public registration so as not to rely on the private sector alone.

Table 1: Applicants for inclusion on the national variety list.

Applicant	Number of applications	Percentage of applications
Pannar Seed®	102	23,8
Pioneer Hi-Bred International	51	11
Saffola	42	9,8
ARC	10	2,3

To access the full research report or to watch the webinar, simply scan the QR codes.

PBR Journal QR *PBR Video QR*

For any additional information, contact Dr Charity Nhemachena on nhemachenacharity@gmail.com.

Drought-tolerant sunflower gene
the first of its kind

By Martin Mariani Ventura, global seed and trait manager, Verdeca

In 2003, Bioceres initiated a research collaboration with the National Scientific and Technical Research Council (also known as CONICET), Argentina's main research organisation, and the National University of the Littoral (also known as UNL), a Santa Fe-based university where an essential plant molecular biology research lab is based. There, a group led by Dr Raquel Chan and Dr Daniel González discovered the drought-tolerant effect of a sunflower gene named Hahb-4.

Based on the group's discovery and additional know-how, Bioceres funded a project specifically for the development of a new Hahb-4 gene expressing *Arabidopsis thaliana* plants with different promoter elements, to test molecular constructs that would later be used in crops of interest.

Early attempts to develop drought-tolerant crops using biotechnology

Figure 1: HB4® technology timeline.

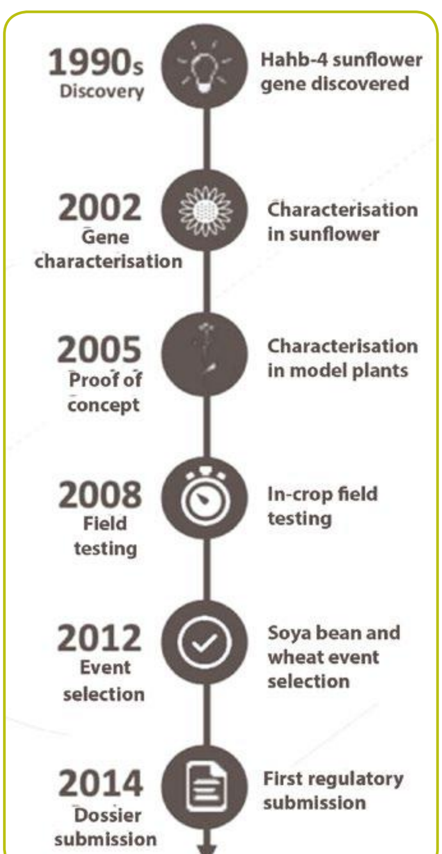


Figure 2: How does HB4® work?

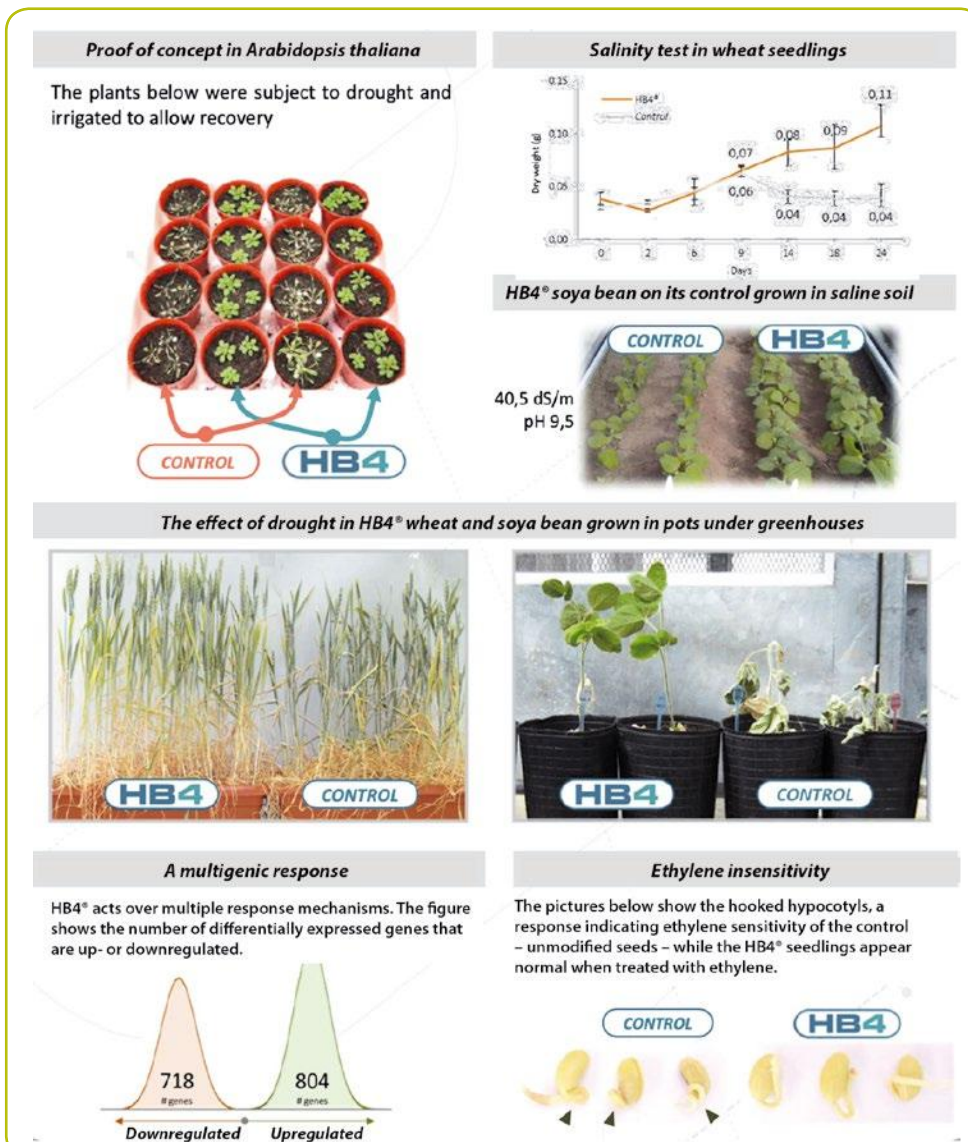
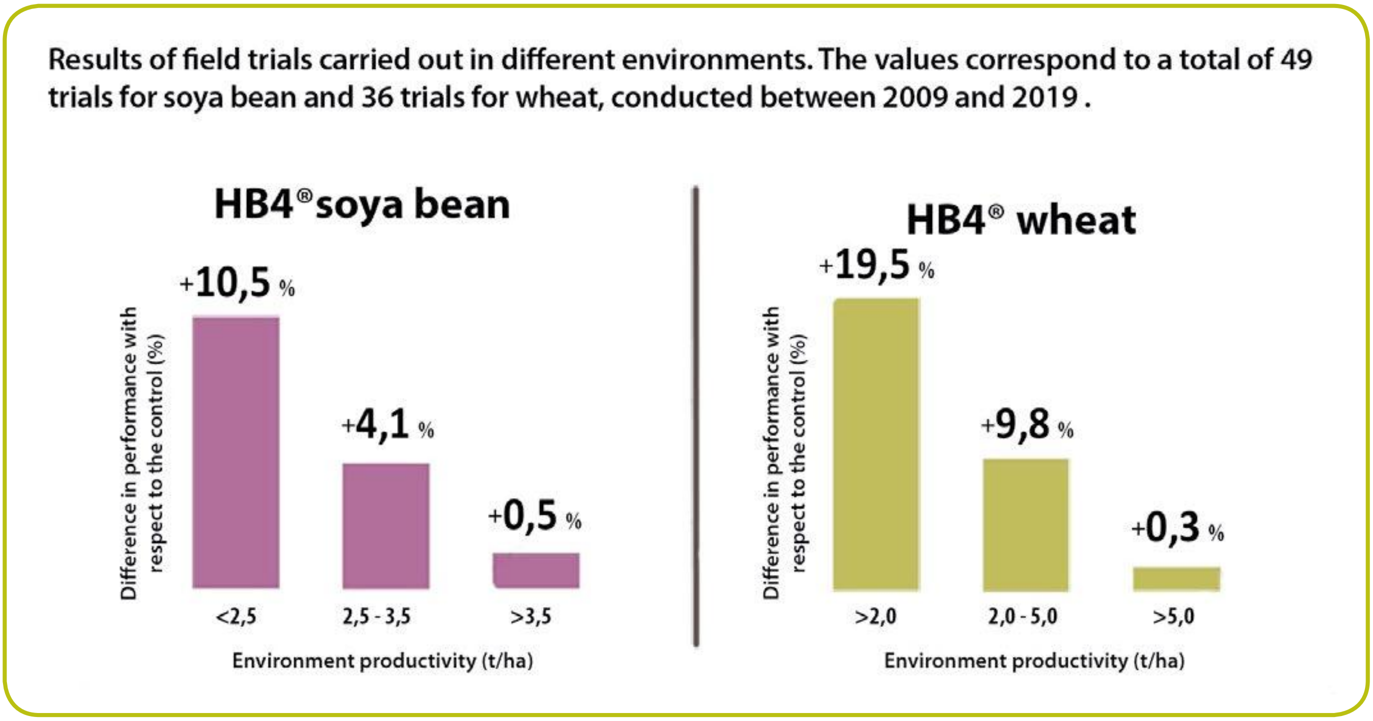


Figure 3: HB4® technology performance.



were focussed on single-function genes. In many instances, genes from desert thriving plants were used to induce higher synthesis of osmolytes or enzymes involved in scavenging reactive oxygen species. These modifications often produced plants that could survive with less water, but yields were also less even in optimal growing conditions.

The only two commercial drought-tolerant technologies available today are based on this approach. Monsanto utilised a bacterial chaperone for its DroughtGard® maize, and PT Perkebunan Nusantara XI's NXI-4T sugar cane uses a bacterial enzyme that catalyses the production of an osmoprotectant.

A different strategy involves genes responsible for signalling cascades and gene expression regulation.

Where biotech fails, HB4® succeeds

The consensus today is that regulatory genes are likely to provide valuable tools to increase yields under a variety of challenging growing conditions. The Hahb-4 gene is a transcription factor that modulates the expression of several hundred genes and provides drought tolerance, making the HB4® technology unique as there are no similar commercial products available today.

Furthermore, the response driven by the Hahb-4 gene is not related to early stomatal closure, an unsuccessful target during biotech's early attempts to develop drought tolerance.

A particularly efficient version of the Hahb-4 gene was identified to provide enhanced efficacy. An additional distinctive element of the technology is the absence of yield drag in high yield conditions. This is in part due to the inducible nature of the promoter elements and the very low expression levels of the modified Hahb-4 gene, even under severe environmental stress.

Ethylene physiology plays an important role in the decreased yields of crops grown under abiotic stress conditions. HB4® not only decreases ethylene synthesis, but also causes plants to be more insensitive to its effects.

Crop transformations started once greenhouse efficacy with optimised genetic constructs in model plants was completed. Seed from multiple events were multiplied to allow for the first field trials in 2008 and 2009 for wheat and soya bean, respectively. Lead events were selected after several seasons of positive results in field tests.

Final event selections were carried out in 2012 for wheat, and in 2013 for soya bean based on multiple performance and molecular data. Such data was used to complete an intellectual property (IP) portfolio for the technology comprising three patent families. In parallel, the available information has been published in several recognised scientific journals

Verifiable resilience

The modified sunflower Hahb-4 gene augments the plant's adaptability to the environment, thereby enabling a greater grain yield. Field performance data from multiple seasons shows that HB4® technology can improve yields in soya bean to wheat systems by between 10 and 20%, even in unfavourable years when yields are generally low.

Consequently, the same data shows no yield penalty due to the technology in good years, when yields are greater. The combination of these two features makes HB4® technology the first of its kind.

For more information, send an email to contact Martin Mariani Ventura at martin.mariani@verdeca.com.ar.

Ensuring food security with the help of genetics

By Jacques Bredell, seed specialist, InteliSeed

Genetics is the study of the genes of an organism and deals with the inheritance of characters. Farmers face many challenges with food production, and we need to assist them with the best products available.

A broader view of genetics

One of the ways to mitigate challenges is the use of specific crop varieties selected for their desired traits (genes). In the past, this was done through traditional breeding/selecting. However, our knowledge of what the different types of genes are and their function within living organisms, has greatly increased.

Through the use of improved scientific methods, technologies, and breeding programmes, we have started to develop processes to catalogue each gene and its functions. This allows us to speed up the selecting and breeding process. Genetics and gene selection has always been a part of our food and farming history since we first decided to put down roots and establish a community.

The true value in breeding has to do with the ability of such selections to have resistance and tolerance to the various diseases, pests, and climate challenges, such as droughts or extremely cold temperatures. These traits are especially important to our farmers as they will allow them to do faster crop rotation, decrease the use of harsh chemicals, and most importantly, they will be able to cultivate varieties outside their normal environment or growth cycle.

This will allow for year-round production of crops, as well as being able to bring the production of essential crops closer to areas where there is irregular supply of nutritional foods, therefore contributing to food security for the future.

For more information, send an email to info@inteliseed.co.za or visit *www.inteliseed.co.za*.

Early-season nitrogen fertiliser management of soya bean: Feeding for yield

By Stephano Haarhoff, Yara Africa Fertilizer, and Pieter Swanepoel, AgriSciences Faculty, Stellenbosch University

Fertilising soya bean has been a challenging component of sustainable soya bean production across farming systems in South Africa. Much research has been conducted over the decades exploring soya bean yield response to applied fertilisers, but many questions remain.

The decision-making process regarding soya bean nutrition for producers is further complicated by inconsistent growth conditions early in the growing season. For example, soil conditions at the time of planting or crop establishment, can limit soil microbial activity and thus potentially hinder nitrogen fixation and early vegetative growth. This can be more prevalent across the hot and dry western production regions such as the Free State and North West, while high loads of crop residues alongside cooler conditions in the eastern production regions may lead to a shortage in nitrogen supply before nodulation is completed.

Understanding soya bean fertiliser dynamics is therefore critical to promote maximum yields by enabling plants to fully utilise available resources, such as sunlight and soil water.

Early-season nitrogen fertiliser

Soya bean utilises nitrogen originating from two nitrogen sources, i.e. biological nitrogen fixation originating from the relationship between soil-living bacteria, rhizobia (*Bradyrhizobium japonicum*), and soya bean; and inorganic nitrogen available from the soil. This symbiotic relationship between soya bean and the bacteria involves the release of ammonia to the plant by the bacteria in exchange for organic compounds provided by the soya bean plant.

The bacteria live in small growths on the roots called nodules *(Photograph 1*). It is within these nodules that nitrogen, which was otherwise unavailable for use by the plant, is transformed to a plant-available nitrogen form. This process is called nitrogen fixation. Indeed, this relationship promotes nitrogen enrichment of the soil, and increases plant growth and development while it reduces the need for inorganic nitrogen from soil or fertilisers.

Drivers of nitrogen fixation

It is generally believed that 50 to 60% of soya bean nitrogen demand is addressed by bacterial fixation. However, these values are highly variable among farms and are therefore challenging to incorporate into soya bean fertiliser programmes. Nitrogen fixation is primarily driven by climate conditions, soil tillage practice, soil water status, and temperature and inoculation strategy. Interestingly, soya bean will generally not be a host to naturalised soil rhizobia as is the case with other warm-season legumes such as cowpea and mung bean.

Before nodules are formed (ten to 14 days after emergence), soya bean nitrogen demands must be met by the soil inorganic nitrogen pool and seed reserves. If low soil nitrogen levels are present, poor nitrogen uptake may lead to restricted growth and development, ultimately resulting in yield penalties. An application of up to 40kg of N/ha^{-1} at the V1 development stage, may increase aboveground leafy growth and yield in the more arid production regions of South Africa (Botha *et al*., 1997).

This positive effect is attributed to the easily accessible source of nitrogen for plant uptake before effective nodulation has taken place. In higher yielding regions, such as KwaZulu-Natal and Mpumalanga, an early-season nitrogen fertiliser application (25 to 40kg of N/ha^{-1}) can be done to address nitrogen needs due to the shorter growing season and more favourable growth conditions. Nitrogen fixation alone may be insufficient during accelerated early season growth.

Potential trade-offs

Several potential trade-offs associated with an early-season nitrogen fertiliser application exist. Firstly, high soil inorganic nitrogen levels may prevent or limit nodules from forming, ultimately restricting nitrogen fixation and supply later in the growing season when conditions are favourable for crop growth.

In addition, urea-based nitrogen applications may hasten crop residue breakdown if broadcasted, which is a crucial consideration when soya bean forms part of no-till or conservation agricultural systems. The loss of soil cover could lead to higher soil temperatures, as well as increased soil water losses by evaporation and runoff during high rainfall events. This effect may be more prevalent in the subsequent maize or soya bean rotation sequence as residue levels are low following soya bean.

Also, in farming systems where soil water is the most limiting factor for crop production, low soil water levels following planting may restrict nitrogen uptake, omitting the benefits offered by early season nitrogen-fertiliser applications.

Nitrogen fertiliser source

Nitrogen fertiliser source is another consideration when choosing the appropriate fertiliser strategy for soya bean. Local research showed that nitrate sources were better utilised by soya bean compared with urea or ammonia sources. In the soya bean production systems of the United States, an increased soya bean yield was found in cases where nitrate-N levels were below 50kg/ha^{-1} in the top 90cm or below 90kg/ha^{-1} in the top 60cm of the soil profile.

The symbiotic relationship between soya bean and rhizobia for optimal nitrogen supply following optimal nodulation.

Shallow soya bean roots are vital for nitrogen, phosphorus, and potassium uptake under no-tillage practices.

High crop residue loads under no-tillage may inhibit the required nitrogen supply to soya bean plants early in the growing season.

Soil layers restricting soya bean root growth should be addressed to avoid yield losses.

Limiting high nitrate levels in the immediate soil region surrounding nodules is extremely challenging, as deeper placement (>10cm) is only achievable prior to planting during seedbed preparation in conventional tillage systems.

Future outlook and considerations

Several agronomic management factors should be considered when deciding on the optimal nitrogen fertiliser strategy. A systems approach should be followed where all contributing factors such as the previous crop, tillage system, soil fertility status, and crop residue, are considered to achieve sustainable soya bean yields:

Soil fertility status: Depletion of soil nutrients (phosphorus, potassium, and micronutrients) due to long-term monoculture or inadequate fertiliser strategies, restrict soya bean yields in the short term. Across maize-soya bean or maize-maize-soya bean crop rotation sequences, large amounts of nutrients are removed annually from fields and should be replaced by the application of fertiliser, cattle manure, and/or chicken litter. Soil layers deeper in the profile are easily depleted by long-term maize monoculture, especially under no-tillage characterised by no soil disturbance.

Stratification of these nutrients in the upper 15cm of the soil profile has been identified in soya bean production systems and may be problematic if insufficient root development takes place (*Photograph 2*). Soil pH status should not inhibit the availability of nutrients (especially micronutrients molybdenum and iron) or microbial activity, and should be addressed by the timeliness application of lime. Gypsum can also be considered to ameliorate certain soil chemical problems.

Crop residue levels: Maize residues dominate maize-soya bean cropping systems and are primarily utilised as livestock feed during the winter months or left on the surface if no livestock is present in the farming system (*Photograph 3*). Due to the high C:N ratio of maize residues, the amount of nitrogen present in these residues is insufficient to meet the needs for rapid decomposition by soil microbes. As a result, microbes compete with developing soya bean plants for available soil nitrogen.

Where high loads of crop residues are present, alongside optimal growth conditions, the insufficient nitrogen supply should be addressed by band placement or broadcasting of a starter nitrogen fertiliser at planting. This approach may be vital where conventional systems are converted to no-till systems to promote economically sustainable yields.

Soil tillage: Soya beans are highly sensitive to compacted soil layers (*Photograph 4*). Soil layers restricting soya bean root growth due to compaction, should be addressed accordingly. A once-off tillage action may be needed where the soil-water-plant interactions are severely limited, which ultimately affects the symbiotic relationship between soya bean and nitrogen supply via nitrogen fixation or fertiliser applications.

Soil compaction can be either a biological problem caused by a lack of actively growing plant roots throughout the soil profile, or the use of farm machinery and uncontrolled traffic on soils. The sustainable use of alternative crop rotation sequences by incorporating cover crops into these maize-soya bean dominated systems, can potentially serve as a tool to combat these concerns over the long term. However, more research is required to demonstrate the effects of cover crop roots on soil physical quality and compaction in South African production systems.

Tools to address nitrogen needs

Although early-season nitrogen fertiliser can be utilised as a tool to address soya bean nitrogen requirements early in the growing season, there is a need to explore whether nitrogen fertiliser can reduce nitrogen limitations without compromising the biological fixation capacity of soya bean plants.

Quantifying these effects across a wide range of soil types and climate regimes, may reveal additional tools for farmers to further improve their soya bean productivity using current resources. Inconsistent rainfall patterns and high daily temperatures highlight the need for such approaches.

For additional information, references, or discussion, send an email to Dr Stephano Haarhoff at stephano.haarhoff@yara.com or Dr Pieter Swanepoel at pieterswanepoel@sun.ac.za.

Understanding Group A herbicides and maximising grass control in canola

Grass control in cereal crops is very important, and this specifically is one of the advantages of planting canola as a rotation crop. Effective grass control, especially ryegrass (*Lolium* spp.) should start with a pre-plant application, but a follow-up foliar application with a selective grass herbicide is usually a necessity.

These foliar applications of Group A herbicides, with clethodim being the most well known, will be the last opportunity to manage escaped grass weeds and to stop new seeding for that specific season. This application in canola is therefore probably the most important application other than a fungicide spray for *Sclerotinia* spp. later in the season.

For Group A herbicides to work effectively, they need to land on target, be taken up by the plant and translocated to the growing point of the plant where cell division occurs. These herbicides disrupt an enzyme pathway at the growing point that stops the production of cell division (new leaves). This can be tested by pulling out the main leaf 10-14 days after application to see if the herbicide has translocated and worked effectively.

However, there are several factors that can be adjusted to increase the efficacy of these Group A herbicides.

Weed size and state

It is known that Group A herbicides have a poor phloem mobility. Due to this weak translocation, the less the distance the herbicide needs to move to the growing point, the quicker and more effective it will be. The longer it takes to reach the growing point, the more time there will be for the weed to metabolise the herbicide and therefore a smaller amount will reach the site of action.

The most important factor in ensuring effective control is therefore to spray Group A herbicides on smaller weeds. Efficacy declines drastically once weeds start to tiller. Therefore, always treat smaller weeds and do not delay applications to wait for any further weed germinations. The state of the weed with relation to any type of stress, will further decrease the translocation to the growing point. By spraying during moisture stress, waterlogging, and particularly after frost, will significantly decrease efficacy.

Water quality and uptake

It is well known and proven that dissolved cations (Na^+, $Ca2^+$, Mg^{2+}) in spray water antagonise clethodim. It has also been shown that ammonium sulphate adjuvants will bind these cations and improve uptake that will increase efficacy. PM McMullin, a Canadian researcher, also proved that above-mentioned salt antagonism can only be totally overcome by applying ammonium sulphate in combination with an oil adjuvant concentrate.

There is a tendency in South Africa to only apply one adjuvant with herbicides. This will be a mistake with clethodim. A registered crop oil concentrate is therefore also necessary with clethodim to ensure that droplets stay on target and do not bounce off, increasing spreading and uptake at the end.

Coverage

The implications of poor coverage are underestimated, especially with Group A herbicides. Higher water volume (at least 150ℓ/ha) will increase coverage on the leaf and can even assist in getting droplets into the sheath, closer to the growing point where the site of action is. Medium to medium-coarse droplets with higher carry volumes will also assist in providing higher efficacy. More on-target droplets mean more effective weed control.

Group A mixes

A common strategy that has been growing over the past two years is to apply two different Group A herbicides together. An example of such mixes are clethodim plus haloxyfop. The advantage of having haloxyfop as a mixing partner is that the phloem mobility of haloxyfop is higher than that of clethodim. The quicker it moves to the site of action, the less chance there will be for metabolic breakdown. This may result in haloxyfop reaching the growing point easier and therefore increasing control.

Make sure to spray a registered product with the above-mentioned mixtures to ensure excellent control and no damage to the canola crop.

Factors for maximum efficacy

To maximise the efficacy of Group A herbicides, especially clethodim, the following factors must be understood:

- Remember that cation antagonism is a reality and that spray grade ammonium sulphate needs to be used in combination with a registered oil adjuvant.
- Weed size matters, especially in ryegrass, and spraying before tillering is crucial in ensuring that the herbicide reaches the site of action (growing point).
- With poor environmental conditions (wind, humidity, or temperature) throughout the season, water volume is one of the only factors that can be controlled to ensure more effective coverage on the target.
- Lastly, use a registered herbicide that includes more than one Group A herbicide to increase the chances of efficacy and reduce the selection pressure for new resistant biotypes.

For more information, contact
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It's time to think **outside the (feed) tank**

By Riyashna Rampersadh (Pr.Sci.Nat. 116453), associate product manager: monogastric nutrition, Kemin sub-Saharan Africa

In recent years, there has been a key focus on the use of various fats and oils in poultry diets. This move stems from the increased costs related to raw materials and vegetable oils. Energy sources provide several advantages to a diet and its benefits to the poultry industry have been well documented. Oxidation of fats/oils is an ongoing process; it is an irreversible process where free radicals are formed when fats/oils remain exposed to certain external factors.

Oxidation can have several unfavourable results, such as lowered nutritional value of the ingredient, feed refusal that leads to lowered feed intake, creation of off-flavoured compounds, rancidity, reduction of shelf life, and oxidative stress. The negative impact on the energy and nutritional values of fats/oils can be costly.

The effects brought about by free radical chain reactions during the oxidation process can, however, be slowed down with the use of a combination of radical scavenger molecules, metal chelators, and an inert carrier.

A selection of antioxidant solutions

Several synthetic antioxidant solutions are utilised in the South African feed industry, such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), propyl gallate, and ethoxyquin. The natural antioxidant solutions available in the global feed industry include α-Tocopherols, oregano, nutmeg, rosemary, thyme, sage, basil, pepper, cinnamon, and cloves.

The combination of one or more of these antioxidants has proven to offer better protection compared to stand-alone ingredients. It is for this reason that scientists worldwide have formulated a range of both dry and liquid products that can be used in the animal feed production sector.

Oxidation can be measured by primary (peroxides, dienes, and so on), secondary (carbonyls, aldehydes, trienes), and tertiary products. Primary oxidation can be measured by a peroxide value (PV). It is used as an indicator of the primary oxidative state of a product and is defined as the amount of peroxide oxygen in mEq per kilogram of product.

During secondary oxidation, PV levels decrease due to peroxides being utilised in the production of aldehydes and ketones. Thiobarbituric acid/malondialdehyde (TBA) value is measured in milligram per kilogram and is used as an indicator of secondary oxidation.

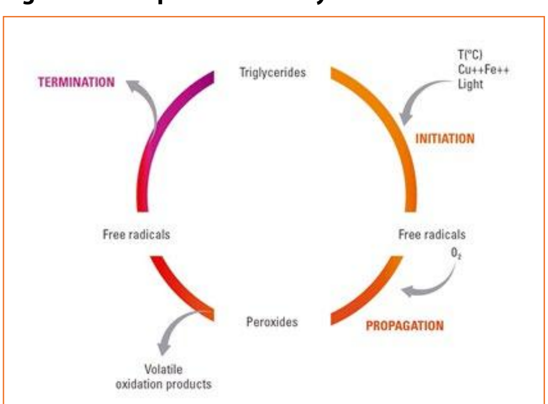
Tertiary oxidation results in a decline in TBA values as the products are transformed into free fatty acids. A p-anisidine value (AV) is an additional indicator of secondary oxidation. Total antioxidant (Totox) is calculated as 2PV + AV and is used as an additional convenient measure of oxidation.

The different phases of oxidation

There are three distinct phases of oxidation, namely initiation, propagation, and termination. Initiation is the step whereby radical species are created from exposure to oxygen, moisture, light, storage time, temperature, and the presence of metal ion compounds such as copper and zinc.

Propagation is the continuous step during which the free radicals of the initiation phase react to form additional free radicals, resulting in peroxide formation. Termination results in free radicals reacting with one another to form a stable molecule, thus ending the lipid oxidation cycle (*Figure 1*).

Figure 1: The lipid oxidation cycle.



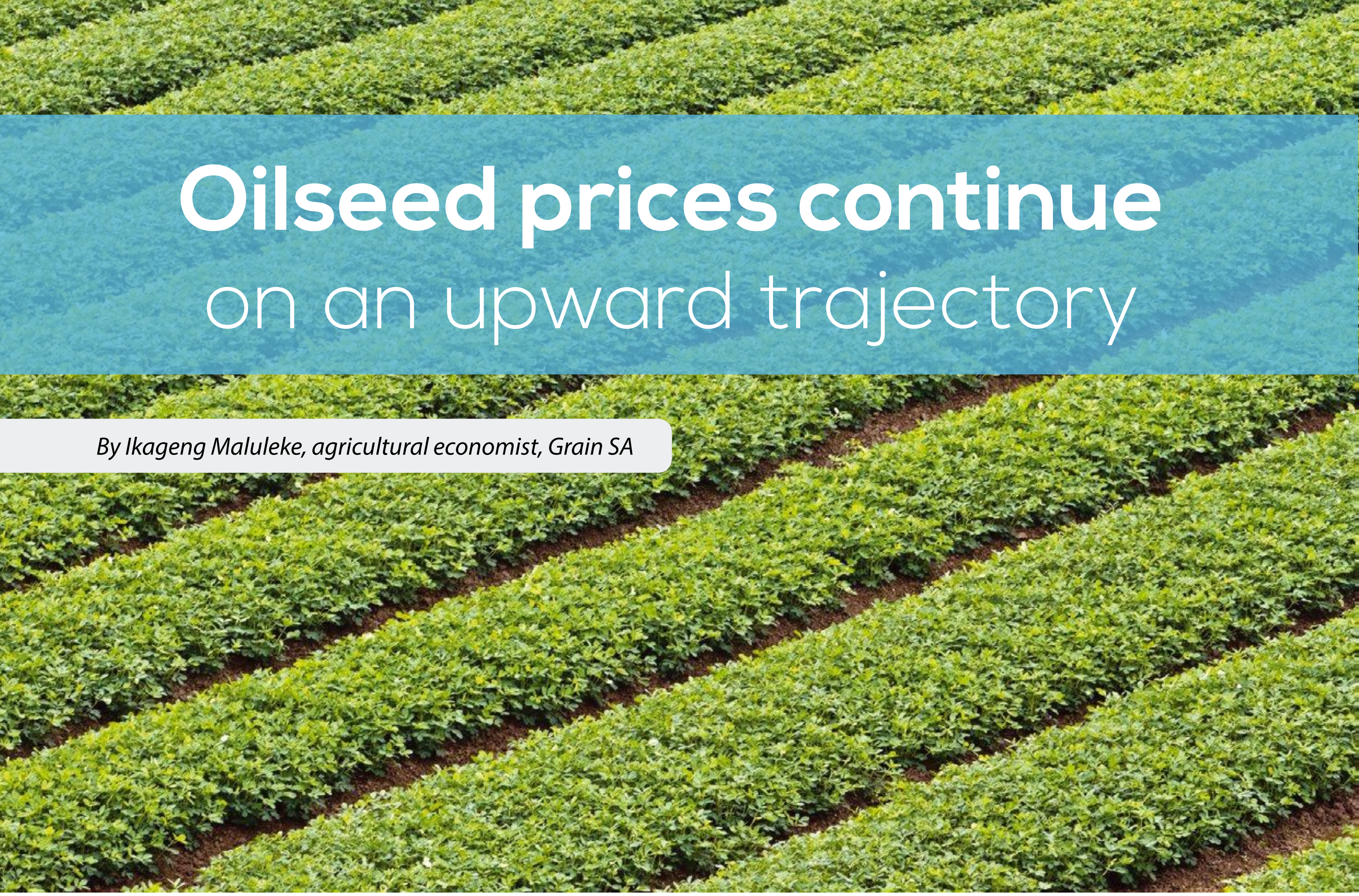
Steps to guarantee a positive outcome

Product storage can result in either a delay or acceleratation of the oxidation process. Storage of products in a cool, dry, and dark area is advised. Stock control rules (first in, first out) should always be applied to ensure that stock does not remain on the floor for a long period of time.

Cross-contamination between old and new products should be avoided as far as possible. A combination antioxidant is advised based on the type of operation. The type of oil produced or utilised is an important factor to consider. Some fats/oils are more prone to oxidation than others, by virtue of their content of unsaturated versus saturated fats. The addition of an antioxidant into the production process as soon as possible offers improved protection against the effects of oxidation.

An initial audit of the entire production process is necessary to detect the areas of concern. Thereafter, treatment and continuous monitoring of treated feed ingredients and final feed is paramount to ensure the success of an antioxidant. This should form part of a facility's quality assurance programme and displays commitment to feed safety.

For more information, contact Riyashna Rampersadh on riyashna.rampersadh@kemin.com.



Oilseed prices continue on an upward trajectory

By Ikageng Maluleke, agricultural economist, Grain SA

Global oilseeds production for 2020/21 is currently estimated at 595 million tons, which is more than 600 000 tons higher than the January estimate. This is due to slightly higher sunflower and soya bean production, among others, offsetting small declines in groundnut production.

Forecasts by the USDA

According to the United States Department of Agriculture (USDA), global supply and demand forecasts for soya bean include higher exports at 169,7 million tons and lower ending stocks at 83,4 million tons. The higher exports are expected from the United States (US) and Russia, while Argentina is expected to import considerably. The US and Brazil will therefore have lower carryover stocks at the end of the season, which would offset Argentina's higher stocks.

In the US, market incentives since late 2020 have been in favour of planting soya bean over maize. The soya bean to maize ratio for new crop futures has been above 2,5 for some time, compared with a break-even ratio of 2,3. This potentially sets up a very volatile scenario for 2020/21.

Even with production at projected levels, the current size of the demand base for soya beans implies that it will be difficult for ending stocks to increase substantially in 2020/21. For stocks to be replenished to more normal levels, either prices will have to rise further to reduce the size of the demand base, or good weather will be needed first in South America this winter, and then in the US in the summer of 2021.

Global sunflower production

Sunflower seed production is expected to decrease by about 4,75 million tons in 2020/21 to 50,1 million tons compared with the previous season, although hectares planted are

Table 1: Global oilseeds supply and demand. (Source: USDA)

	2018/19	2019/20 estimate	2020/21 projections (Jan)	2020/21 projections (Feb)*
	Million tons			
Production	600,03	576,29	594,48	595,09
Total supply	717,12	708,69	705,27	705,45
Trade	170,94	190,15	192,65	193,87
Consumption	488,98	506,15	512,28	512,99
Ending Stocks	132,40	110,36	96,50	95,64

**Data as at 10 February 2021.*

expected to increase marginally from 26,34 to 26,84 million ha. Production is expected to decrease for all major producers namely Argentina, Russia, the Ukraine, European Union (EU), and Turkey, with lower domestic consumption in all these countries.

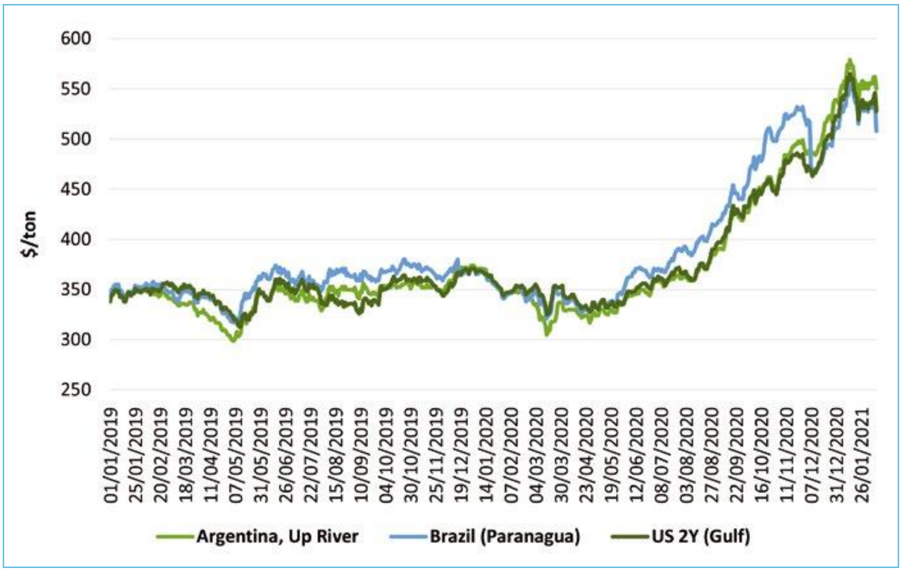
The production of meal and oil is only expected to increase marginally compared with the previous season. As part of measures to reduce food prices, Russia issued a decree to restrict exports of sunflower and other crops for the first half of 2021. This will have an impact on trade flows.

Groundnut market looks firm

The international groundnut market is also looking firm, with Brazil out of old crop and Argentina with very little inventory available until harvest time. Chinese interest in US groundnuts continues to grow and only time will tell if it will be realised. Local consumption in the US continued to soar, as families spent more time at home. It seems that peanut butter and peanut snacks have been flying off grocery store shelves.

Changes in the US groundnut market are expected due to rising cotton and maize prices, giving the groundnut market a firm undertone. These prices offer competitive alternatives, which might lead to a decrease in hectares planted. Hence producers will require better incentives to plant groundnuts this year.

Figure 1: International sunflower seed prices. (Source: IGC)



The EU has announced a 25% tariff on US groundnuts and other products. The tariff went into effect on 10 November 2020, as authorised by the World Trade Organization (WTO), but the market is still digesting the news and determining its potential impact. According to US sources, the direct tariff is another example of the EU taking steps to limit the ability of US groundnuts and agriculture to compete fairly in this key market.

After two seasons of consecutive declines in hectares planted towards groundnuts, producers in Argentina have returned hectares to groundnuts, with projections at 350 000ha, which could yield about 1,35 million tons. Export taxes for groundnuts and groundnut products were reduced in March 2020 as part of a decree to increase their profitability relative to soya beans and grains.

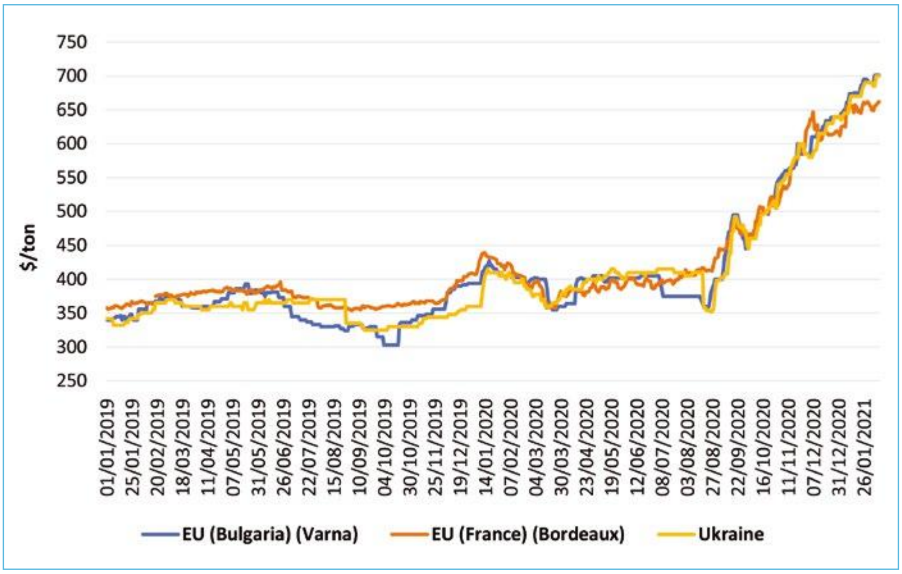
Global price movements

The price rally over the past few months in the grain and oilseeds markets defied projections for lowered global agricultural trade and consumption trends as a result of the Covid-19 pandemic. Stronger markets for vegetable oils, coupled with gains in equities and crude oil, added to the positive tone at times.

A rebound in exports and a continuation of export demand growth has led to a more optimistic price scenario for soya beans. Price gains were also underpinned by outlooks for much tighter US supplies, owing to good domestic demand and a record-breaking export campaign, led by China. US stocks are placed at a seven-year low.

Likewise, the Argentine market also recorded a net gain of 15% on declining production prospects, while there were also labour issues at ports, slowing down the loading. Soya beans in Brazil remain tight, with increased imports supplementing limited domestic

Figure 2: International sunflower seed prices. (Source: IGC)

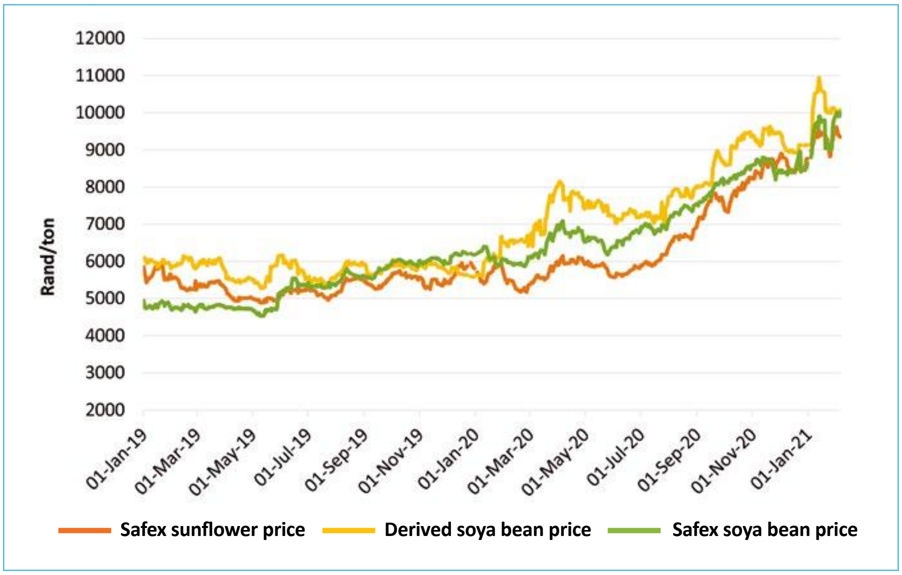


supplies since late 2020. Although much-needed rain alleviated some concerns earlier this year, total rainfall remains far below historical levels in many growing regions. This has created support for current price levels and prices are expected to remain strong.

Expectations are that prices may decline once the Brazil harvest commences. While this will ease any short-term supply issues, supply and demand factors still point to prices remaining well above the depressed levels observed prior to August 2020.

With weaker production estimates for sunflower seed and derivatives, international prices continued to track higher, mainly due to a marked reduction in sunflower product availabilities following poor Black Sea crops.

Figure 3: Historical Safex oilseeds prices. (Source: Grain SA)



Implications for the feed sector

The increase in oilseeds prices, especially those used in the feed sector, is bound to have a significant impact on an already depressed sector, which was starting to pick up after the first wave of Covid-19 and subsequent lockdowns.

Global production of livestock and poultry in the first quarter of the year is forecasted higher based on available preliminary data. Nonetheless, it is anticipated that production growth for the second half of the year will be slowed due to higher expected feed costs, which are likely to hamper production growth.

Domestic perspective

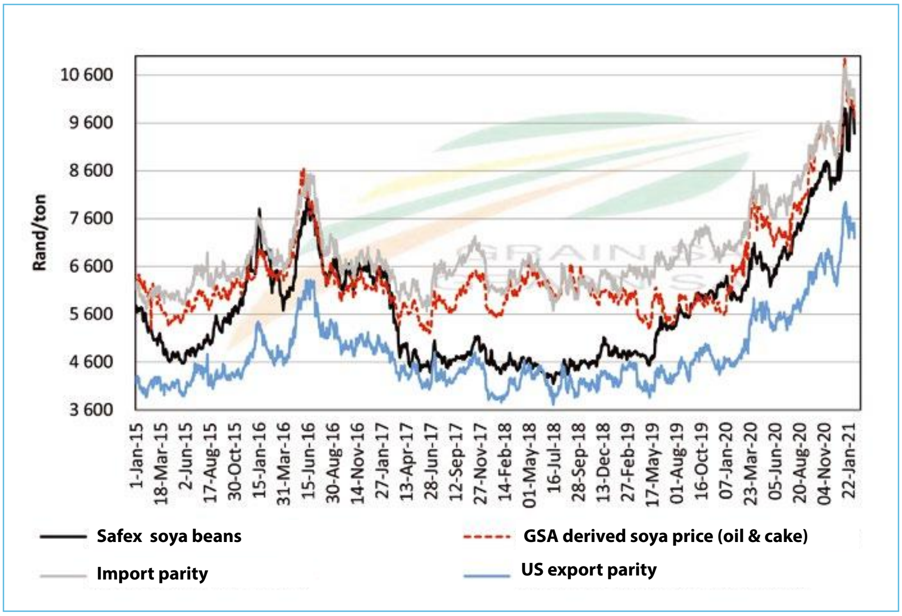
Against the backdrop of rising global oilseeds prices over the past few months, South African oilseeds prices have been tracking these prices higher, with local prices at an all-time high since 2016. Between January 2020 and January 2021, sunflower prices increased by 62% and soya bean prices by 53%.

According to the Crop Estimates Committee (CEC), the preliminary production area estimate for sunflower seed for 2021 is 473 300ha. This is 5,4% lower than the 500 300ha planted the previous season, and can help to support prices further. It is estimated that 806 000ha have been planted to soya beans, which represent an increase of 14,33% compared with the 705 000ha planted last season. This makes it the highest area planted to soya beans in South African history.

Essentially, record yields could lead to a dip in prices, but expectations are that international prices will be supportive in the short to medium term, given the global supply situation. This can affect the feed sector negatively, especially the poultry sector, if its prices do not increase on the same trajectory. The poultry industry is already in distress, with feed costs being one of its major concerns.

Notwithstanding minor changes in global production on a month-to-month basis, oilseed supplies are still considered adequate and trade flows remain strong. However, this is met by the reality of increased vulnerability in most disadvantaged economies, perpetuated by the Covid-19 pandemic. Purchasing power is constantly diminishing and increasing international oilseeds prices will create a burden for low-income countries that depend on imports.

Figure 4: Prices of derived soya bean delivered in Randfontein. (Source: Grain SA)



For more information, email the author at ikageng@grainsa.co.za.

United front tackles **soya bean value chain challenges**

By Gerhard Keun, chief executive officer, Protein Research Foundation

The soya bean industry has made excellent progress over the past few years. Local production doubled and processing of local soya beans increased substantially, leading to an improvement of the trade balance with significantly fewer imports of oilcake into South Africa. This was a great improvement for everyone in the soya bean value chain.

During a meeting at the Sunflower and Soybean Forum (SSF) in 2018, it was reported that the industry was facing a situation where a substantial supply of soya beans is available, yet oilcake is still being imported. The Protein Research Foundation (PRF) identified this as an opportunity to facilitate a soya bean value chain discussion.

Various stakeholders join forces

On 6 December 2018, a first meeting was called between stakeholders, which included representatives of the South African Oil Processors' Association (SAOPA), Animal Feed Manufacturers' Association (Afma), South African Cereals and Oilseeds Trade Association (Sacota), Grain SA, the Protein Research Foundation (PRF), the Oilseeds Advisory Committee/Oil and Protein Seeds Development Trust (OAC/OPDT), the South African Cultivar and Technology Agency (Sacta), the Department of Trade and Industry (dti), and the Department of Agriculture, Forestry and Fisheries (DAFF).

The meeting was held in order for stakeholders to address certain industry bottlenecks, as well as discuss strategies regarding the industry's future. The soya bean industry was recognised as the cornerstone of various other industries and, as such, it is vital to secure the growth thereof. Five categories were discussed, namely supply and demand balance, pricing transparency, quality, infrastructure, and imports and exports (*Table 1*).

Table 1: Categories discussed during the first soya bean value chain stakeholder meeting.

Supply and demand	
Processing capacity	Processing capacity was confirmed at 2,1 million tons (a level of 80% utilisation would result in 1,68 million tons crushing capacity. Full-fat capacity is at 450 000 and 360 000 tons at 80% utilisation).
Local infrastructure	
• **Electricity supply** • **Water supply**	Load-shedding and constraints relating to access to water create substantial downtime. This directly results in wastage and losses, which affect crushing margins.
• **Transport/logistics**	Improved infrastructure in terms of logistics is needed. If South Africa wants to achieve total replacement of imported oilcake, transport to the coastal regions (such as the Western Cape) needs to be addressed.
Quality	
South African soya beans and soya bean oilcake quality must be confirmed and combined with reliable and consistent supply.	A South African industry norm regarding oilcake quality needs to be developed and published in order to manage and co-ordinate the quality of oilcake in the country. The industry also needs to launch an investigation into and set the benchmark on best practices, in alignment with international standards and quality handling.
Pricing and transparency	
	Developing an oilcake futures contract to be listed on the South African Futures Exchange (Safex).
Imports and exports	
During years of oversupply, it is important to be able to export.	DAFF is in the process of applying for market access to China.

On 11 November 2019, role-players in the soya bean value chain met again to report back on progress made with the actions identified in 2018, as well as to identify and discuss new strategies. Attendance of the value chain discussion was also extended to representatives of the South African Poultry Association (Sapa), Agbiz Grain, the South African Grain Laboratories NPC (SAGL), South African Pork Producers' Organisation (Sappo), and the World Bank.

On 27 August last year, role-players in the soya bean value chain met again to report back on progress relating to the actions identified in 2018 and 2019, as well as to identify and discuss new strategies. It was also resolved that in future, meetings will be organised on a quarterly basis in order to speed up and increase progress.

Table 2: New strategies identified by role-players in the soya bean value chain.

Farm-level economics	
In major producing countries, producers are delivering soya beans with a significantly higher moisture content (up to 17%), which can potentially reduce harvest losses.	• Identify four or five silo complexes that are close to crushing plants to undertake a cost-benefit exercise of delivering soya beans with a higher moisture content. • Green beans are an extremely isolated problem, but the international experience is that harvesting at higher moisture levels could increase the quantity of green beans, which is a problem and will need to be addressed in the study.
Soya bean content and quality	
Consistency and not quality of soya beans are the biggest issue. This is due to management issues such as green beans, moisture content, time of harvesting, etc.	• Explore the possibility of compensating producers of soya beans with a higher protein content. • Inconsistent results for the same quality tests at various laboratories must be addressed. Suggest a reference laboratory such as the SAGL and do continuous competency tests on soya bean and soya bean meal for quality.
Information from processors and storage operators who receive stock directly from farms will add great value to the data which the SAGL already has.	• The SAGL should supply results timeously and should not provide historical data only at the end of the season. • Members of Agbiz Grain will be asked about the possibility of providing samples per silo per week.
Local infrastructure	
Expansion of soya bean production to the western production regions will be influenced by transport differentials to be implemented during 2021 by the JSE.	
Rail infrastructure will have to be used in order to unlock the potential for soya bean oilcake in the Western Cape.	
The JSE's intention to scrap broker codes when trading on Safex requires attention.	• Scrapping of broker codes when trading on Safex will be discussed before attending the JSE marketing meeting. • Scrapping of broker codes might be a risk to smaller crops such as soya bean and sunflower and should perhaps be implemented for maize as a first step.
Supply and demand	
The expansion of local soya bean processing capacity, which depends on future scenarios of feed use, needs to be discussed.	Several master plans are currently being developed or have been completed. The various initiatives between the livestock, grains, and oilseeds industries must be co-ordinated to ensure alignment.

Table 3: Initial as well as new strategies discussed during an additional meeting between soya bean value chain role-players.

Farm-level economics	
Delivering soya beans at a higher moisture level to reduce harvest losses.	• Identify four or five silo complexes that are situated near crushing plants to undertake a cost-benefit exercise of delivering soya beans with a higher moisture content. • The issue of green beans will be handled as part of the project.
Financing of producers	• A report will be compiled regarding the availability of finance for producers.
Soya bean content and quality	
To initiate a soya bean, full-fat soya bean, and soya bean meal quality study.	The project proposal, to determine the key drivers of the quality of soya bean products (full fat, expeller, and solvent extraction meal) for feed use in South Africa, submitted by the Bureau for Food and Agricultural Policy (BFAP), was approved.
Intervention regarding sourcing nutrient information on direct deliveries from processors and storage operators.	
Inconsistent results for the same quality test at various laboratories are being addressed.	The project proposal, to establish a proficiency testing scheme for soya beans and soya bean meal, submitted by the SAGL, was approved.
Markets and integrated value chains	
The impact of import duties on soya beans and soya bean meal.	The project proposal, to analyse the impact of import duties on soya beans and soya bean meal on the integrated soya and livestock value chain, submitted by BFAP, was approved.
Transport/logistics	
A discussion regarding an alternative transport differential system with the University of the Free State.	The transport issues are to be attended to by an ad-hoc work group comprising representatives of Grain SA, Sacota, Agbiz Grain, the dti, and DAFF.
To find a solution for cost-effective delivery to the Western Cape.	
To attend to the possibility of rail infrastructure.	

The efforts of the soya bean value chain group will contribute not only to co-ordinating actions in the soya bean industry and/or to promote the industry, but also to create an entire value chain plan in order to create additional value for end consumers.

For any information, send an email to Gerhard Keun at gkeun@proteinresearch.net.

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A28140/OF

Efficient internal grain control systems: The key to clean audits at NWK

NWK is committed to the transparency of its silo quantities and operations, and welcomes the regular audits performed by the JSE, as well as the South African Grain Information Service (Sagis).

"It is alleged that agricultural companies sell grain which they do not yet have in stock, manipulate prices, and create artificial shortages. It is also alleged that the JSE and Sagis do not undertake regular audits to verify that the silo certificates issued correspond with actual quantities," said Nico Pieterse, senior manager of grain at NWK.

This follows a recent discovery by the JSE that another agricultural company had transgressed the reporting rules of silo quantities. Some grain producers subsequently accused the JSE of negligence and alleged in media reports that it occurs at other agricultural companies too, and that this practice has a negative impact on grain prices.

Internal audits at NWK silos are conducted twice a year, and external auditor, PwC, also conducts an annual audit. In 2020, the JSE performed no fewer than six audits at NWK's silos at Delareyville, Ottosdal, Koster, Vermaas, Bodenstein, and Coligny. Furthermore, the independent consultant, Chris Sturgess, undertook two additional audits at NWK's silos and those of its competitors, by order of the JSE. At the time of writing, Sagis was conducting a physical audit at NWK, which takes place once every two years.

Rigorous practices remain the norm

NWK also supplies the JSE and Sagis with monthly reports on quantities that are subject to an audit. "NWK's internal control systems are of such a nature that you cannot sell grain if you don't have it. Grain quantities are monitored daily by silo managers, who report these numbers to regional managers, after which they are verified by NWK's stock and financial divisions.

"Audits do not stop at silos. Mills also have to disclose the quantities they purchase. The entire value chain is subject to audits, and there are constant cross references which will point out any discrepancies on silo certificates," Pieterse explained.

"Integrity has always been one of the values on which NWK bases its business model. South Africa's oldest agricultural company will never transgress when issuing silo certificates," Theo Rabe, CEO of NWK, concluded.

For more information, contact Johan Bezuidenhout on 018 633 1368, jbezuidenhout@nwk.co.za, or visit *www.nwk.co.za*.

Photograph: Olia Nayda

Impact of peanut consumption in the LEAP Study: Feasibility, growth, and nutrition

By Mary Feeney, George du Toit, Graham Roberts, Peter H Sayre, Kaitie Lawson, Henry T Bahnson, Michelle L Sever, Suzana Radulovic, Marshall Plaut, and Gideon Lack

The Learning Early About Peanut Allergy (LEAP) study intervention disagrees with the current World Health Organization (WHO) advice, which recommends that infants should be exclusively breastfed for the first six months of life.

Similar to the dietary practices in the United States (US) and Australia, the mean age of introduction of peanut-containing foods in the United Kingdom (UK) is 36 months and only around 8 to 10% of infants eat peanut before age one year. Many professional allergy societies now recommend the LEAP study intervention of early peanut introduction in infancy, followed by ongoing regular consumption until age 60 months for the prevention of peanut allergy in high-risk infants. This advice may in time be extended to encompass all children, regardless of the risk of peanut allergy.

Although regular consumption of peanut from an early age appears to be an effective strategy for the prevention of peanut allergy in high-risk infants as well as in infants recruited from a general population, there could be unexpected consequences for growth and nutrition. Anecdotally, no adverse health consequences have been associated with this practice in countries such as Israel, where peanut is regularly consumed by infants and young children.

Epidemiological studies describe the beneficial health effects of regular nut consumption in children and adolescents, including a lower body mass index (BMI), a higher healthy eating index, and higher intakes of micronutrients. Furthermore, there is a long tradition of using peanut as the mainstay of nutritional fortification programmes in developing countries and even in the US as part of the Special Supplement Nutrition Program for Women, Infants, and Children.

Despite these dietary practices, intervention studies involving regular consumption of peanut or similar energy dense foods in early childhood are lacking in the literature. The LEAP intervention recommended an intake of 6g peanut protein per week on the basis of the upper quartile of intake observed in infants in Israel (7,1g peanut protein per month).

Aim and design of the study

This study represents a planned secondary analysis from the LEAP trial, a randomised, open-label, controlled trial comparing two strategies to prevent peanut allergy: consumption or avoidance of peanut in high-risk infants.

The objectives of this study were to evaluate the feasibility of the introduction of peanut in infancy and the effects of regular ongoing consumption on the growth, nutrition, and diet of infants with atopy enrolled onto a randomised controlled trial. Using data from the LEAP study, we compared infants randomised to consumption or avoidance of peanut during the first five years of life.

Infants aged four months to fewer than eleven months with severe eczema and/or egg allergy were randomly assigned to consume or avoid peanut until age 60 months. Participants randomised to peanut consumption (except those who were diagnosed with peanut allergy) were advised to eat at least 6g peanut protein per week distributed over three or more meals per week, until age 60 months.

Because of a choking risk, it was also recommended that whole peanuts be avoided during early childhood. Participants randomised to avoidance (and participants who were diagnosed with peanut allergy) were given detailed dietary advice on how to avoid exposure to peanut during study participation.

Peanut consumption was monitored using a validated food frequency questionnaire (FFQ) at intervals. For subgroup analyses, peanut consumers were divided into quartiles on the basis of average peanut consumption throughout the study as measured by the FFQ.

Measurements

Anthropometric measurements were taken in duplicate and the mean value recorded by trained staff at each study visit. Measurements were transformed into z scores using the WHO Child Growth Standards. Nutritional intake monitoring a three-day food diary was completed before or shortly after each study visit.

Foods and drinks were analysed to produce average daily energy, macronutrient, and micronutrient intakes. Portion weights were assigned on the basis of information from manufacturers or food packaging, and/or estimated from standard food portion sizes, all scaled down for age on the basis of details recorded in the food diary and portion size resources. Nutrient intakes were compared with UK dietary reference values (DRVs) by age and sex.

Types of foods consumed over the duration of the study were compared between avoidance and consumption groups. All foods were mapped to 61 food groups on the basis of those reported elsewhere. In addition, we separated peanut-containing foods and specialist allergen-free products (e.g. wheat/gluten-free cereals).

Anthropometry and skinfold measurements were compared using general linear models adjusted for treatment assignment and sex. Percentage of total energy (%TE) intake was compared using equivariance t tests. Micronutrient intakes, total protein intake, percentage of total protein intake, and average daily consumption of different types of foods were compared using Wilcoxon tests.

Details of the study

The median age of participants at screening was 7,8 months. The median duration of study participation was 4,4 years.

In the consumption group, average peanut intake exceeded the recommended study intake within the first month post-randomisation, was sustained during the first six months of the intervention, and on average increased throughout the study. Median peanut intake in the avoidance group remained at 0g throughout the study.

The main sources of peanut changed over time with peanut butter becoming the main source as participants got older. Other sources, including peanut-containing breakfast cereals and confectionary, were minor sources of peanut protein. Crushed or ground whole peanuts were eaten by some participants from age twelve months.

Infant feeding

There were no differences in breastfeeding characteristics between treatment groups before or after randomisation. The introduction of peanut did not result in a significantly shorter duration of breastfeeding in the peanut consumption group, even when adjusted for maternal highest level of education, gestational age at birth, and ethnicity.

At the time of randomisation, 290 participants had introduced infant formula in the consumption group and 287 in the avoidance group. Solid foods were introduced at a mean age of five months in both groups. There were no differences in the age at which the following food allergens were introduced pre-randomisation: dairy foods (excludes infant formula), egg, wheat, fish, soya, and tree nuts.

Growth and nutritional intakes

There were no differences in weight, height, BMI, or other anthropometric measurements (waist circumference, as well as subscapular and triceps skinfold thickness) between the consumption and avoidance groups at any time during the study. Even when comparing the highest quartile of peanut consumers with peanut avoiders, there were no differences in anthropometric measures. There were no differences in anthropometric measurements when compared with WHO Child Growth Standards either.

Energy and macronutrient intakes

There were no differences in total energy intakes between randomised groups at any point and for the highest quartile of peanut consumers compared with peanut avoiders.

The %TE from carbohydrate was higher in the avoidance group compared with the consumption group at all post-randomisation points. Conversely, the %TE from fat was higher in the consumption group compared with the avoidance group at all post-randomisation points.

When macronutrient subgroups were compared, %TE from starch was significantly higher at 21 and 30 months, and %TE from sugars was significantly higher at 30 and 60 months in the avoidance group. There were no differences between randomised groups in %TE from saturated or polyunsaturated fatty acids at any point. Intakes of monounsaturated fatty

Manganese

Glyphosate + Mn source	Soybean yield (t/ha)
Glyphosate	3,83
Glyphosate + MnCO3	5,04
Glyphosate + MnSO4	4,71
Glyphosate + Mn EDTA chelated	4,84
Glyphosate + Mn Amino acid chelated	4,51

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Recommended usage

PRODUCT	DOSAGE / HA	APPLICATIONS
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Importance of manganese for Round Up ready crops

Glyphosate is responsible for chelating elements in soil, rendering them unavailable for plant absorption. Consequently, plant physiological processes such as chlorophyll formation and photosynthesis are negatively influenced. Round Up ready crops require 50% more manganese to be as physiologically active as their non-Round Up ready or conventional crops. Glyphosate induced Mn deficiencies are also responsible for deteriorating the natural immune system of plants[1].

[1] Huber, D. M., 2007. What About Glyphosate-Induced Manganese Deficiency?. Fluid, pp. 20-22.

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Photograph: Corleto

acids were significantly higher in the consumption group at 60 months.

Vitamins and minerals

As peanut-containing foods often have added sodium, we assessed this intake between peanut avoiders and consumers. Sodium intake was elevated for all participants; this intake was not significantly different between randomised groups or in the highest peanut consumers compared with peanut avoiders. Calcium, iron, zinc, and vitamin D intakes were compared as intakes of these micronutrients are often compromised in children with food allergies.

There were no differences in intakes for calcium (except at twelve months), iron, or zinc. There were no differences between groups in intakes of vitamin D, however, intake decreased over time.

Foods consumed

To see whether the consumption of peanut, a source of vegetable protein, led to a reduced intake of protein from other sources in order to maintain overall protein homeostasis, we compared the sources of protein in the avoidance and consumption groups.

There were no differences between randomised groups in protein intake from different sources at any post-randomisation point. However, when we compared the highest quartile of peanut consumers with the avoiders, we found significantly higher intakes of vegetable protein and lower intakes of animal protein at 21, 30, and 60 months.

Results

The LEAP study successfully introduced peanut to the diet of infants randomised to peanut consumption. The recommended intake was achieved in the first month of the study and maintained throughout, confirming the ease with which peanut can be introduced to the infant diet.

Despite eating different peanut-containing foods, even whole peanuts from the age of twelve months, no episodes of participant choking or aspiration were reported. However, clinicians should still emphasise that whole peanuts and chunks of peanut butter are a choking hazard in young children and should not be consumed before age five years.

The timing of introduction of other allergenic foods was equivalent between groups before randomisation. A high proportion of LEAP infants were breastfeeding at the time of introducing peanut and, reassuringly, peanut consumption did not affect the duration of breastfeeding. Although the study intervention does not comply with WHO guidelines on exclusive breastfeeding, it did not negatively impact breastfeeding itself.

Peanut consumption did not lead to differences in weight, height, BMI, or other anthropometric measurements - even among the highest quartile of peanut consumers.

Macronutrient intakes in both groups were in line with UK recommendations apart from carbohydrate, which fell close to the recommended intake. When compared with US dietary reference intakes, both groups met acceptable macronutrient distribution ranges for protein, fat, and carbohydrate at all study visits. Sodium intakes were above UK-recommended maximum intakes in both groups, but below US-recommended maximum intakes.

Nutritional priorities of maintenance of energy and protein homeostasis are achieved in different ways in peanut consumers compared with avoiders. Peanut consumption led to a higher fat intake and a lower carbohydrate intake compared with avoidance, while energy balance was maintained in both groups.

These differences in fat and carbohydrate intakes were accentuated in the highest quartile of peanut consumers, while protein intake stayed constant across quartiles of peanut consumption and in the avoidance group. We believe this shows evidence of protein regulation occurring in children from an early age.

The addition of peanut-containing foods did not affect %TE intake from protein because intake from other sources (animal protein sources) was decreased to maintain protein homeostasis; energy balance was maintained by adjusting non-protein energy intakes (fat and carbohydrate).

For some infants, the introduction of allergenic foods between age four and six months may be important for allergy prevention. Our results show that in high-risk infants, early consumption of peanut from age four months is safe and effective for allergy prevention.

Conclusion

This is the first randomised trial to introduce peanut in infancy and demonstrates that the intervention is easily achieved and has no adverse dietary sequelae. In addition to a reduction in peanut allergy at age 60 months, peanut consumption did not negatively impact growth in childhood, even at the highest quartile of consumption. These findings are reassuring in the context of new consensus communications to feed peanut early to high-risk, atopic infants.

This article has been abbreviated for publication in *Oilseeds Focus*.
To read the full article, visit *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5056823/.*

Quality testing on grain and oilseeds: a vital link in the value chain

By Wiana Louw, general manager, Southern African Grain Laboratory NPC

Informed business, economic, and social decisions in the food and feed value chain can only be made when the required information regarding the quality of the commodities being used as raw materials, as well as that of the final products, are available. Quality can only be assessed when accurate measurements are available, which also ensure food safety and, finally, support trade.

The cost of measurements constitutes a significant part of the grain and oilseed industry's budgets. However, these costs are offset by the economic impact of crucial decisions made based on measurement results. To confidently provide accurate, reliable, and comparable measurement results, testing laboratories can implement a range of methods.

Compliance with quality standards such as ISO/IEC 17025 provides an excellent platform, as this international standard was designed to provide testing laboratories with a set of guidelines to develop their own quality system, covering the range of parameters included in their scope of testing offered to customers.

For compliance, call in the pros

Evaluating a laboratory's compliance with its own quality system, based on the requirements set out in the standards, is done by national accreditation bodies established for this purpose. The South African National Accreditation System (SANAS) provides this service to laboratories in South Africa as well as other regions.

SANAS conducts surveillance audits at regular intervals to confirm compliance. New and improved methods are frequently needed due to changes in local and international regulatory requirements, improved techniques, and laboratory instrumentation. During these assessments, new methods and technical signatories are also evaluated to be added to the scope of accreditation.

The Southern African Grain Laboratory NPC (SAGL) is accredited by SANAS and has complied with this international standard since 1999. The SAGL uses measurement standards or reference materials as prescribed in the standard to confirm technical competence and to ensure international comparability. This demonstrates continued method performance through participation in relevant proficiency testing schemes, and the use of appropriate quality control materials.

Reliable data the secret to success

Measurements to determine the quality of grain and oilseed commodities over seasons and different production regions provide a useful database to establish trends. The quality parameters included in the annual surveys conducted at the SAGL are determined by industry role-players, taking into consideration the breeding, production, storage, processing, and final application for use.

Results of these surveys can, for example, be used when recommendations need to be made regarding changes to regulations, such as those for grading. They can also be used when value chain studies – with the purpose of implementing improvements – are conducted.

The grain and oilseed industry uses reliable, quality data on agricultural commodities when marketing these products locally, but even more importantly, to potential customers in the rest of the world.

Customers submit samples to the laboratory to support their internal quality control processes, and since not all samples can be submitted to an external laboratory for testing, they also make use of calibration samples prepared at the SAGL. These samples are used to evaluate the accuracy of their equipment and the competency of their employees. They also participate in the proficiency schemes offered by the SAGL as an independent evaluation and confirmation of compliance.

Continuous improvement

Globally, greater emphasis is being placed on food security and safety, with growing population numbers putting pressure on natural resources to provide enough safe food and feed. As a result, the spotlight also moved to reliable testing results as an integral part of improved production, management, and early warning systems.

An important goal of the SAGL – as with any testing laboratory – is to continuously improve the quality of the testing while increasing the sample throughput with the implementation of new technology, training of laboratory staff, and improved quality systems.

To better fulfil its role in the value chain, the SAGL also conducts investigative and research studies to find solutions or suggest alternatives to current processes.

To access quality data on soya beans, sunflower, grain sorghum, wheat, and maize, visit *www.sagl.co.za* or phone 012 807 4019.

Nutritional aspects of **oilseeds**

By B McKevith, British Nutrition Foundation

Oilseeds are energy dense foods. Although they contain protein and carbohydrate, most of the food energy they provide is as fat. Oilseeds vary widely in their fatty acid composition, but tend to be rich in monounsaturated fatty acid (MUFA) or polyunsaturated fatty acid (PUFA). Some seed oils contain significant amounts of the essential fatty acid (EFA) ALNA, an n-3 fatty acid, and linoleic acid (LA), an n-6 fatty acid. From these two, the body can make all the fatty acids it needs.

Generally, whole oilseeds are a source of fibre, phosphorus, iron, and magnesium. Many oilseeds are also a source of vitamin E, niacin, and folate. Whole oilseeds also contain phytoestrogens, a group of substances including lignans and isoflavones. Phytoestrogens may provide a protective effect against coronary heart disease as they have been shown to have a lowering effect on blood cholesterol. Additionally, some phytoestrogens may have antioxidant properties (Goldberg, 2003).

Vegetable oils do not contain the same levels of macronutrients, vitamins, and minerals as whole oilseeds. In fact, apart from fat itself, vitamin E is the only nutrient present in appreciable amounts. Vegetable oils do, however, contain a range of phytochemicals.

Whole oilseeds

Relatively small amounts of whole oilseeds are eaten in Britain. The average weekly intake of nuts and seeds, including that of non-consumers, was 17g for men and 12g for women (Henderson *et al.*, 2002). Nuts and seeds did, however, contribute a small proportion of the total PUFA intake, providing 3% of cis n-3 PUFA intake in men and 2% of cis n-3 in women, and 2% of cis n-6 intake in both men and women (Henderson *et al.*, 2003a).

Oilseed meals

Oilseed meals are important in animal nutrition as they are used in feed compounds. Oilseed meals are high in protein, with most being over 40% (Young, 1982). They also contain about 10% carbohydrate and some fat (the amount of which is dependent on the efficiency of oil extraction, but values range from ~1 to 6% depending on the oilseed and method used for extraction) (Young, 1982).

Vegetable oil and spreads

Margarines and cooking fats are the major foods produced from vegetable oils. Historical data shows that household consumption of total fats and oils has decreased from 245g/person/week in 1942 to 186g/person/week in 2000. Household consumption of lard, margarine, and butter has decreased over time, with concomitant increases in vegetable oils, low-fat spreads and reduced-fat spreads (DEFRA & National Statistics, 2001).

Margarines and cooking fats are used in a variety of foods. Vegetable oils provide a number of specific functions, including batter aeration, emulsifying properties, flavour provision and improvement in keeping properties (Macrae *et al.*, 1993). Vegetable oils are also used for frying. Hydrogenated vegetable oils may, however, contain trans fatty acids.

Contribution of oilseeds to diets

From oilseeds a range of oils and spreads are produced. These products are used as an ingredient in or to cook other foods. It is therefore difficult to estimate the total intake of oilseeds and foods containing vegetable oils or fats produced from oilseeds.

Fat spreads are an important source of vitamin E, being the main contributor of adult vitamin E intake among British adults and the second most important source among British children and young people. Excluding butter, they contribute

14% of total vitamin E intake in adults (Henderson *et al.,* 2003b), 17% in boys and 16% in girls (Gregory *et al*., 2000).

Fat spreads also contribute a significant proportion of vitamin D, with margarines and low-fat spreads contributing to 16% of intake in adults (Henderson *et al*., 2003b), 19% in boys and 19% in girls (Gregory *et al*., 2000). Fat spreads contribute to total vitamin A intake, but to a smaller extent.

Fat and health

Fat is an essential nutrient with a number of important functions. It carries fat-soluble vitamins and supplies EFAs, which are important structural elements of cell membranes and are essential for the formation of new tissues (Nettle, 1993). They are particularly important for the development of the brain, nervous system, and retina (BNF, 1999).

Body fat is an energy store and has been recognised as an endocrine gland, producing signalling molecules which play an important role in preventing the accumulation of body fat in tissues, other than the usual fat stores (Nugent, 2004b). The total amount of fat in the diet and the amount of the different fatty acids in the diet can influence health.

Fat and heart health

Generally, high intakes of saturated fatty acids and trans fatty acids have been associated with raised blood cholesterol levels, one of the risk factors associated with cardiovascular disease (CVD). In comparison, MUFA decreases the 'bad' LDL-cholesterol (LDL-C). While PUFA also decreases LDL-C, intakes of n-6 PUFA above 10% energy may have adverse effects on 'good' high density lipoprotein cholesterol (HDL-C) (Clarke *et al.*, 1997).

Although n-3 fatty acids have little or no effect on total blood cholesterol levels, a substantial amount of work has focussed on their ability to reduce blood triacylglycerol levels. This, together with evidence that long-chain n-3 fatty acids reduce the risk of having a fatal heart attack, indicates an important role for long-chain n-3 fatty acids in maintaining heart health.

PUFA has also shown to influence insulin sensitivity, a key factor in the development of metabolic syndrome, abnormal blood lipids, insulin resistance, and high blood pressure. But to date, there is little support for a role in healthy people. There is also interest in the potential of fatty acids to influence endothelial function.

The majority of the work on heart health and n-3 fatty acids has focussed on long-chain n-3 fatty acids found in fish oils, rather than the shorter chain fatty acids found in oilseeds and their oils. In dietary studies, ALNA-rich oils do not appear to reproduce fish-oil-like effects on CVD risk factors (Sanderson *et al.*, 2002). Nonetheless, a World Health Organization (WHO)/Food and Agriculture Organization of the United States (FAO) report on diet and chronic disease listed ALNA as a probable factor decreasing the risk of CVD (WHO/FAO, 2003).

In addition, soya protein has been associated with decreased cholesterol levels (Anderson *et al*., 1995), and in a three-month randomised study the isoflavone genistein was found to decrease blood pressure in subjects with mild hypertension (Rivas *et al*., 2002). However, it is unlikely that soya oil will have these effects as these components are removed during processing.

Fat and cancer

Some studies have indicated that there may be an association between fat intake and the risk of certain types of cancer, for example:

- Franceschi (1999) compared the diets of people with colorectal cancer to hospital controls. A high intake of saturated fatty acids seemed to be associated with an increased risk of colorectal cancer, while high intake of PUFA (chiefly olive and seed oils) showed a marginal inverse association with colorectal cancer risk.
- Another Italian case-control study found a reduced risk of ovarian cancer with a high intake of olive oil and for a group of specific seed oils (i.e. sunflower, peanut, and soya) (Bosetti *et al*., 2002).
- In the Norfolk component of the European Prospective Investigation into Cancer and Nutrition (EPIC) study, a relationship was found between saturated fatty consumption and breast cancer (Bingham *et al*., 2003).

Although these studies may suggest a role for fatty acids in cancer, findings from such case-control studies are weak and need to be verified by randomised controlled trials.

Fat and obesity

Fat is a concentrated source of energy, providing twice as much energy per gram as protein or carbohydrate. It has been suggested that it may be easier to consume an excess of energy when eating a high-fat diet, as fat-rich foods have a poor satiating power compared with protein and carbohydrate-rich foods.

If energy intake and expenditure are unbalanced, then the excess energy is stored in the body as fat, potentially leading to an individual becoming overweight or obese. Although the replacement of saturated fatty acids with carbohydrates has been the standard advice for weight loss, high carbohydrate diets have been shown to increase plasma triacylglycerol and decrease beneficial HDL-C levels. There is considerable debate about the most effective balance between carbohydrate and fatty acid profile.

Other roles of fat in health

Diabetes

Because of the reported effects of n-3 fatty acids on blood insulin levels, there has been some interest in the potential of n-3 fatty acids to influence type 2 diabetes and associated risks (Lovejoy, 1999). Work in animal models has shown that long-chain n-3 fatty acids improve insulin sensitivity compared with n-6 PUFA (Storlein *et al.*, 1991), although work in obese patients with impaired glucose tolerance given fish oil supplements for two weeks did not affect fasting concentrations of glucose and insulin, nor induced glycaemia and insulin response (Fasching *et al.*, 1991).

Inflammatory conditions

EFAs are used in the body to produce eicosanoids, which participate in inflammatory and immune responses. As n-3 fatty acid derived eicosanoids are generally less potent than those derived from n-6, it has been suggested that decreasing the dietary n-6/n-3 ratio may be beneficial in a number of conditions that involve abnormal immune responses, such as asthma, Crohn's disease, psoriasis, and rheumatoid arthritis. The evidence of a benefit of n-3 fatty acids in most of these conditions remains conflicting and/or weak (Prescott & Calder, 2004).

However, a review on the nutritional management of rheumatoid arthritis concluded that long-chain n-3 PUFA consistently demonstrated an improvement in symptoms and allowed a reduction in the use of non-steroidal anti-inflammatory drugs (Rennie *et al.*, 2003).

Cognitive function

Work in France studying the relationship between the fatty acid composition of erythrocyte membranes and cognitive decline in free-living volunteers found that a higher proportion of total n-3 fatty acids was associated with a lower risk of cognitive decline (Heude *et al.,* 2003). Several studies have found an association between dietary fat and fatty acids, and cognitive function and risk of dementia, with a reduced risk of cognitive decline or dementia associated with intakes of n-3 PUFA, particularly the long-chain n-3 PUFA associated with fish consumption (Kalmijn 2000; Morris *et al.*, 2003; Kalmijn *et al.*, 2004). However, these observations do not equate to causality and need to be verified in clinical trials.

Future developments

It seems people could benefit from increasing their consumption of n-3 PUFA, particularly those which are long-chained. Oil-rich fish is an excellent source of long-chain n-3 fatty acids, but alternative ways of increasing n-3 fatty acids are needed for several reasons. Firstly, many people do not eat fish. Secondly, as the majority of fish stocks are now being fully exploited, the recommendation to increase consumption of fish needs to be balanced against sustainability concerns (WHO/FAO Expert Consultation, 2003). Food manufacturers could use more n-3 rich PUFA in pre-prepared food products, as well as developing products which include n-3 rich oilseeds such as linseed and soya to help consumers increase their n-3 PUFA intake.

Plant biotechnology could also be used to produce plants with long-chain n-3 PUFA. The LIPGENE project is investigating this possibility by using transgenic technology to reproduce in oilseeds, the exact metabolic pathway responsible for the production of long-chain n-3 PUFA, thereby increasing the levels of n-3 PUFA in vegetable oil (Nugent, 2004a).

Another possibility is to manipulate the fatty acid composition of animal products by feeding livestock ALNA-rich oils or adding ALNA-rich seeds to feed. For example, Weil *et al.* (2002) reduced the n-6/n-3 ratio by 54% in butter, 60% in meat and 86% in eggs. Increasing PUFA levels may change flavour because of their greater susceptibility to oxidative breakdown and the generation of abnormal volatile compounds during cooking. In some but not all studies, the meat produced from pigs fed whole linseed had abnormal odours and flavours at a concentration of 3mg ALNA/100mg in muscle and fat tissue fatty acids (Wood *et al.*, 1999).

However, it has been demonstrated that consumption of products with increased n-3 contents can increase the n-3 content of plasma in humans, leading to a decrease in the n-6/n-3 (Weill *et al.*, 2002). The success of such a strategy will depend on the acceptability of the final products, the costs to industry, the willingness of the consumer to pay a premium price, and the presence of a strong scientific rationale.

Conclusion

Oilseeds and the products made from them have a role in a healthy, balanced diet even though they are energy dense and contain a high proportion of fat. They are particularly important sources of vitamins D and E, as well as contributing to vitamin A intake.

Oilseeds and their products are also rich sources of PUFA. While there seems to be important roles in health for PUFA, particularly in replacing saturated fatty acids in the diet, it may be particularly important to increase the n-3 family of PUFA rather than those belonging to the n-6 family.

The long-chain n-3 PUFAs are found in oily fish, but other ways of increasing intakes are needed. Innovative techniques may be needed, such as increasing the levels of n-3 PUFA in vegetable oil using transgenic technology, as well as increasing the n-3 PUFA content of animal products and highlighting to consumers good sources of n-3 PUFA.

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Making a tangible difference in rural communities with soya

By Izak Hofmeyr

For more than ten years, the Eden Social Development Foundation (ESDF) has been addressing malnutrition and protein deficiency in impoverished rural communities in Southern Africa, especially in the Bergville and surrounding areas of KwaZulu-Natal. Looking beyond short-term feeding solutions, the foundation subscribes to a long-term sustainable approach by empowering locals to take control of their own nutritional needs.

One of the key aspects of this process is access to appropriate food-processing knowledge and technologies. This approach, says ESDF manager, Henry Davies, is based on three steps: providing the knowledge and associated training within communities to expand familiarity of the health benefits of soya, planting and harvesting of soya, and utilising it to produce affordable food products in individual homes.

Community upliftment

With this in mind, the ESDF depends on identifying and training community leaders to proceed with training within their immediate areas. "In addition, we identify 'soya-preneurs' and assist them with establishing micro-enterprises by providing sustainable food-processing equipment, to manufacture and distribute soya food products within the communities where the soya awareness programmes have been established," said Henry.

"The last crucial objective is assisting small-scale farmers with the planting of soya as a rotation crop, along with maize and other food crops. The focus therefore stretches from household gardens and kitchens, to small-scale farmers and micro-enterprises."

Henry, a millwright by trade, arrived in Bergville in 1987 to produce full-fat soya using a high-shear dry extrusion process. He soon observed the potential of soya in the upliftment of deep rural communities in the area.

"I was involved in mission work with the Mobile Evangelical Trust, which brought me in contact with these communities. I realised there was a great need for job creation, as well as a well-balanced diet. What struck me was the contrast between the opposite banks of the Tugela River.

"On the one bank were the well-tended, lush soya and maize fields of the local commercial producers, while on the other residents were struggling to make ends meet through subsistence agriculture. I started thinking of ways to lend a helping hand to these communities."

A mobile threshing machine built by Henry Davies in co-operation with the Soybean Innovation Lab (www.innovationlab.illinois.edu) for harvesting maize, soya, and sugar beans.

Small beginnings

Because soya was his passion, it goes without saying that his plans revolved around this crop. He identified one farmer, the late Simon Mbele, and started by assisting him with planting soya. "We planted 10ha that year and the soya crop looked great. But, when harvest time arrived, we ran into trouble. The commercial farmer next door, Miela Steyn, was willing to help harvest with his equipment, but the bridge across the Tugela was too narrow to get the harvester across.

"The upshot was that we had to harvest those 10ha by hand and transport it to a bean thresher. The next year we planted 50ha and encountered the same problem.

"Although I realised that empowering small-scale farmers was crucial, this part of the project came to a grinding halt, albeit momentarily." Meanwhile, Henry became involved with the Southern African Soy Food Association to start marketing soya as a food source in the country.

His goal was to train residents in rural areas to plant their own soya, and to use the crops in their own households and communities to produce delicious, high-quality soya food. "I obtained equipment to make soya milk. The one system, called VitaGoat, works without electricity and the other, SoyCow, operates with electricity. With the assistance of the World Initiative for Soy in Human Health (WISHH), we established a training centre with the SoyCow system.

Development through training

"We started training people to make products such as tofu and yoghurt from soya milk. I realised, however, that I had to take the technology and knowledge to the people. I mounted a VitaGoat on a trailer and started going out into the communities to show them what could be done with soya." During this time, the Oilseeds Advisory Committee (OAC) and the Oil and Protein Seeds Development Trust (OPDT) offered him financial assistance and have been his sole sponsors since 2012.

"Along with the training on how to make food from soya, I shifted my focus to assisting subsistence farmers with planting it. I met with Grain SA's Graeme Engelbrecht and soon realised Grain SA was doing sterling work with farmer development. It allowed me to focus exclusively on community development by empowering people in the production and use of soya products."

Henry realised, however, that the equipment needed was simply too expensive. He wanted to reach the people directly with equipment that was affordable. "I returned to the communities with a soya awareness programme with the support of the OAC and OPDT and taught the women how to plant the crop in their back gardens.

"After harvesting, I returned with my rudimentary equipment, which included a small gas stove, a pot, and a hand grinder, to teach them how to make soya milk. With the soya milk we made yoghurt, and with the by-product of the yoghurt, okara, we made soya chips and nuts."

Early on, Henry contacted community facilitators in various areas around Ladysmith who conducted, among others, HIV/Aids awareness programmes, and business training. They organised the communities into groups, which made it much easier for him to access many people simultaneously.

"We focussed on eight groups in three areas. I also trained one community co-ordinator and eight facilitators to conduct the soya training. We put together a soya box comprising a gas stove, a pot, a small hand grinder, and the necessary utensils and raw materials to equip every facilitator for the training.

A gradual change, thanks to Covid-19

After several years of involvement, Henry realised that the practice of gardening had, to a large extent, disappeared from rural community culture. He suspects that this is an unfortunate side-effect of the grant system. Another sad reality was that the community facilitators did not use the soya products in their own homes.

"However, Covid-19 has markedly changed this situation. During lockdown, the facilitators realised they could stretch their rand by making soya products for household use. Gardening is still a challenge, but I have noticed a gradual change in this regard – thanks to Covid-19. Isn't that ironic?"

Henry Davies in action during a training session on the use of okara in biscuits to prolong shelf life.

The objective for this year, he added, is to approach the community facilitators with the idea of upscaling the quantities of soya products. "One group has already started making 20 litres of yoghurt at a time. We have managed to secure funding, so we are going to get a freezer and an electric grinder for them to start a small business.

"The 2021/22 period has also afforded the facilitators the opportunity to start their own 'soya in food' businesses. We will conclude the training as I believe most people in the communities where we were active now understand soya. Facilitators now have the opportunity to start their own businesses."

Making a difference

Henry said he is often asked why he is involved in this project. He says the answer lies in relativity. "If you are used to a lot, what we do might seem miniscule and

Making soya milk

Clean two cups of raw soya beans by removing any soil or small stones. Soak it in eight cups of water overnight. Rinse the soya beans. Add another eight cups of water, grind the beans, and bring to the boil. Filter press the grounded beans. You now have soya milk and okara. Add sugar to the soya milk for lactose to stimulate better culture growth, as well as a pinch of salt for flavour.

Cool to 40°C (Henry uses his own body temperature to estimate the approximate heat by pressing one finger against his forehead and putting another in the milk. When the milk is a bit warmer than his forehead, the temperature is acceptable for culture growth.)

For soya yoghurt, add culture to the milk, wrap the pot in a cloth, and leave until the next day. For flavour, you can use dairy-based cold-drink concentrate or vanilla essence and mix it with the yoghurt. Add sugar to taste. The idea is to use ingredients that can easily be found at the local spaza shop.

The ESDF's youngest participating soya producer, Mafanelo Mbhele.

The ESDF's most senior participating soya producer, Enoch Dlalisa.

A household soya garden – the result of one of the ESDF's training sessions on how to plant soya.

insignificant. But if you have very little, being empowered to create something extra is a big deal. Even a thousand rand a year extra in their pockets is money they would otherwise not have had, and this makes a tremendous difference in their lives. That is what it is all about."

While Henry was focussing on the community awareness programme, several black crop farmers approached him for help planting soya. The OAC and OPDT opted to fund this initiative and the local structures of the Department of Agriculture (DoA) became involved as well. The farmer development programme comprises three facets. The ESDF, with funding from the OAC and OPDT, provides the soya seed, inoculant, pre-emerge herbicide, and foliar feed. The foundation has also undertaken the marketing of the soya beans.

The farmer provides the land and fertiliser and is responsible for management. He or she needs to provide additional herbicides and pesticides if necessary. The DoA provides the tractors, implements, and diesel for planting and harvesting. Although there are individual small-scale farmers who plant between 5 to 10ha on their own, most of them are organised into groups. This seems to be the preferred approach of the DoA.

Going from strength to strength

"I personally have a soft spot for the individual small-scale farmers who have limited resources, but still try their level best. There are some who are becoming increasingly successful and I am convinced they will in future be fully fledged commercial farmers. Those are the ones I really try to help. I am happy that the farmer development programme in the Bergville area is progressing, thanks to the three facets of the programme that each play their part."

The next step in bringing the community and farmer development programmes together is to target the wives of these farmers in the processing of soya beans, as well as the making of 'soya in food' products. Henry is currently in the process of developing a mobile threshing machine that can either be installed in proximity for use by the various groups or be used by an independent operator as a separate business.

A training session held to demonstrate the effective use of soya yoghurt.

Hectares successfully planted for the 2020/21 season:

- **Bergville:** 290ha planted by the ESDF, farmers' groups, and the DoA; 51ha planted by small-scale farmers. Total: 341ha.
- **Newcastle:** 255ha planted by the ESDF, farmers' groups, and the DoA. Total: 255ha.
- **Estcourt:** 90ha planted by the ESDF, farmers' groups, and the DoA. Total: 90ha.
- **Free State:** 75ha planted by farmers. Total: 75ha.

Total: 761ha.

"The prototype for this machine was originally developed in Ghana, with the aid of various international development organisations. We are in the process of adjusting that prototype to suit our particular conditions."

For more information, send an email to Henry Davies at office@edenfoundation.org.za or visit *www.edenfoundation.org.za*.

The scope of transformation projects **in South Africa**

By Dr Hamman Oosthuizen, OABS Development

Transformation in agriculture in South Africa is an imperative aspect of the future and growth of the agricultural industry. Numerous initiatives have been and still are being launched in this regard. However, it seems that these transformation initiatives are often disjointed and not co-ordinated. Furthermore, a multitude of role-players at both provincial and national level are at the helm of these initiatives.

Among the institutions that fund these projects are banks, agribusinesses, producer organisations, trust funds, private companies, and the South African government. The contributions of these institutions come in the form of financial assistance, supply of farming equipment, financing of input costs and farming equipment, advice on soil correction and fertiliser application, and access to processing facilities.

An integral part of these projects, which is also complex, is the management of the funds made available for transformation initiatives.

Rihan Saayman of OABS interviews oilseeds farmers in the Western Cape.

Solomon Masango in one of his soya bean fields in the Belfast district of Mpumalanga. Next to him is Ryan Newborn of OABS.

OABS takes the lead

The Oilseeds Advisory Committee set out to gain a better understanding of the transformation projects being funded within the oilseeds production and processing sector, including commodities such as soya beans, sunflower, canola, and groundnuts. To achieve this, the committee appointed Optimal Agricultural Business Systems (OABS) to execute the study. Taking the lead in the OABS project team are Drs Daan Louw and Hamman Oosthuizen.

The first phase of the study encompassed the identification and grouping of role-players involved in the production and processing of oilseeds. Groups surveyed included government institutions (six), industry organisations (ten), producers' and commodity organisations (six), farmer development agencies (two), agribusinesses and implementing agents (23), financiers (five), and offtakers and processors (13). *Figure 1* illustrates the various groups and identified role-players.

The objectives of the study are as follows:

- To determine the number of transformation projects in South Africa per oilseed type and geographical region.
- To uncover the structure of the projects and give an opinion on their success.
- To verify the main role-players involved in the transformation initiatives and, where possible, quantify the financial contribution made.
- To highlight where projects have failed and offer explanations for this.
- To make recommendations regarding the funding of future oilseed transformation projects that can make an impact, including those with processing potential.
- To list the challenges that must be overcome in order to maximise the success of oilseed transformation projects.

Understanding the background

The OABS team conducted interviews with these role-players in order to familiarise themselves with the background and focus of each project, the services offered, footprint, selection criteria, number of clients, and the extent/value of projects

Figure 1: Stakeholders involved in transformation projects in the oilseeds industry.

Government institutions

- Eastern Cape Department of Rural Development and Agrarian Reform
- Free State Department of Agriculture
- KwaZulu-Natal Department of Agriculture and Rural Development
- Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs
- North West Department of Agriculture and Rural Development
- Western Cape Department of Agriculture

Industry organisations

- Oil and Protein Seeds Development Trust
- Oilseeds Advisory Committee
- South African Sunflower Seeds and Soybean Forum
- South African Groundnut Forum
- South African Cultivar and Technology Agency
- Sorghum Trust
- South African Cereals and Oilseeds Trade Association
- South African National Seed Organisation
- South African Oil Processors Association
- Winter Cereal Trust

Producer and commodity organisations

- Agri SA
- Grain SA
- Hortgro
- National African Farmers' Union
- South African Grain Farmers' Association
- TLU SA

Agribusinesses and implementing agents

- AFGRI – Lemang Agricultural Services
- Agricol
- Bayer (Monsanto, Dekalb)
- Centane/Mbashe Agricultural Initiative (Wiphold)
- Corteva (Dow, Du Pont, Pioneer)
- Farmsol
- Farmwise Grains
- For Farmers
- GWK – Agriqua Holdings
- Kaap Agri
- Link Seeds
- Lucid Support Services
- NWK
- Omnia
- OVK
- Sasol Agricultural Trust
- Sensako
- Senwes
- Silostrat
- SSK
- Syngenta
- TWK Agri
- VKB – Agricultural Development

Farmer development agencies

- Grain Farmer Development Association
- Eden Social Development Foundation

Financiers

- Absa
- Capital Harvest
- First National Bank
- Nedbank
- Standard Bank

Offtakers/processors

- ABInbev
- Africa SunOil Refineries
- Central Edible Oils
- Cofco Agri
- Epko Oil Seed Crushing
- Louis Dreyfus Company
- Majesty Oil Mills
- Philafrica Foods
- RussellStone Group
- Sime Darby Hudson & Knight
- VKB (Free State Oil)
- Willowton Oil & Cake Mills
- Wilmar Continental Edible Oils

funded. In total, the OABS team conducted 65 interviews and documented the information obtained.

Several companies and projects, however, opted not to share detailed information (project numbers and/or hectares) or simply did not respond to the survey request from the study team.

The second phase of the study, in which farmers involved in the various projects were interviewed, was concluded early this year. These interviews will shed some light on farmers' perception and experience of the different projects/programmes.

Fifty farms across the country were targeted for interviews. Twenty of these interviews were conducted during December last year and the remaining ones in January this year. The results of these surveys, together with those of phase one, will hopefully give a clearer picture of the status of transformation in the oilseeds industry, current projects/programmes, as well as the effectiveness and efficiency thereof.

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The subdivision of agricultural land: What to consider

By Shirande Schmidt, VDT Attorneys

The subdivision of agricultural land is not as simple as one might think. If you want to sell a portion of your farm, lease a portion of it over a long period or even bequeath your farm to your children, the provisions of the *Subdivision of Agricultural Land Act, 1970 (Act 70 of 1970)* (the Act) might apply.

It is therefore imperative that all owners of agricultural land take note of the Act's provisions, as well as the consequences of non-adherence.

Importance of the Act

The primary purpose of the Act is to prevent the subdivision of agricultural land into small uneconomic pieces that will hinder agriculture in future.

An article published in *Landbouweekblad* in 2019 stated that according to Statistics South Africa, more than 500 000 agricultural households were lost in the old homelands from 2011 to 2016 due to these households being relocated to agricultural land of around 0,5ha. These households previously used their land for agricultural purposes. However, due to the size of the new properties, farming had become unproductive, unfeasible, and consequently impossible.

This demonstrates the importance of the Act, as agricultural land with a high value and yield should be protected and not subdivided into uneconomic portions. Therefore, before any subdivision of agricultural land can take place in any of the ways mentioned, the minister of agriculture (the minister) must give written consent. (Instances where the minister's consent is not required are outlined in Section 2 of the Act.)

The process of subdivision

Subdivision can be long and cumbersome, and the process will differ based on the landowner's intention. The starting point in any case will be to approach a surveyor to draft a subdivision diagram. This diagram must be submitted to the minister, together with the application, whereafter the minister will consider various aspects before coming to a decision.

As this is a bureaucratic and lengthy process, consulting an expert to ensure your application is processed in a timely manner is advisable.

Selling a portion of your farm

In the case of the sale of a portion of your farm, it is imperative that you obtain the consent of the minister before you enter into the contract. Section 3(e) specifically states that no portion of agricultural land, whether surveyed or not, and whether there is any building thereon or not, shall be sold or advertised for sale without the written consent of the minister.

This means that you may not take any preliminary steps, such as advertising the portion to be subdivided, or signing an agreement relating to the sale of the portion, before obtaining the necessary consent. You also cannot enter into a sale agreement with a suspensive condition that states that you must first obtain the consent of the minister before the agreement comes into force. If any such preliminary steps are taken, the agreement will be regarded as null and void.

Leasing a portion of your farm

Should a farmer wish to alienate the right to use a portion of his farm by leasing such portion to another person, the minister's consent will also be required, should this be regarded as a long-term lease. The Act states that no right to such a portion of the land shall be sold or granted for a period of more than ten years, for the natural life of any person, or to the same person for periods aggregating more than ten years.

This provision clearly prevents a lease that is concluded for ten years or more, including a lease that is concluded for five years and thereafter renewed for another five years, or a lease for the natural lifetime of a person, without the minister's written consent.

Bequeathing your farm

It is important to note that no person may own an undivided share in agricultural land. Therefore, should you bequeath your farm to, for example, two of your children in your will, each will be entitled to an undivided share. This is prohibited unless you have the necessary consent from the minister. Consequently, upon your death, there will be unnecessary delays and consequences in administering your estate.

Alternative options would be to rather bequeath your farm to a company of which your children are directors and shareholders, or to a testamentary trust of which your children will be the beneficiaries. In this manner your children could still obtain the benefits of the farm, but through alternative measures.

Should none of the options mentioned be followed, the only alternative would be to sell the farm and divide the profit between your children.

Conclusion

In light of the aforementioned, owners of agricultural land should be aware of the provisions that apply to the subdivision of such land, as non-adherence may result in unnecessary and undesirable consequences.

For more information, contact Shirande Schmidt on 012 452 1300 or shirandes@vdt.co.za.


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