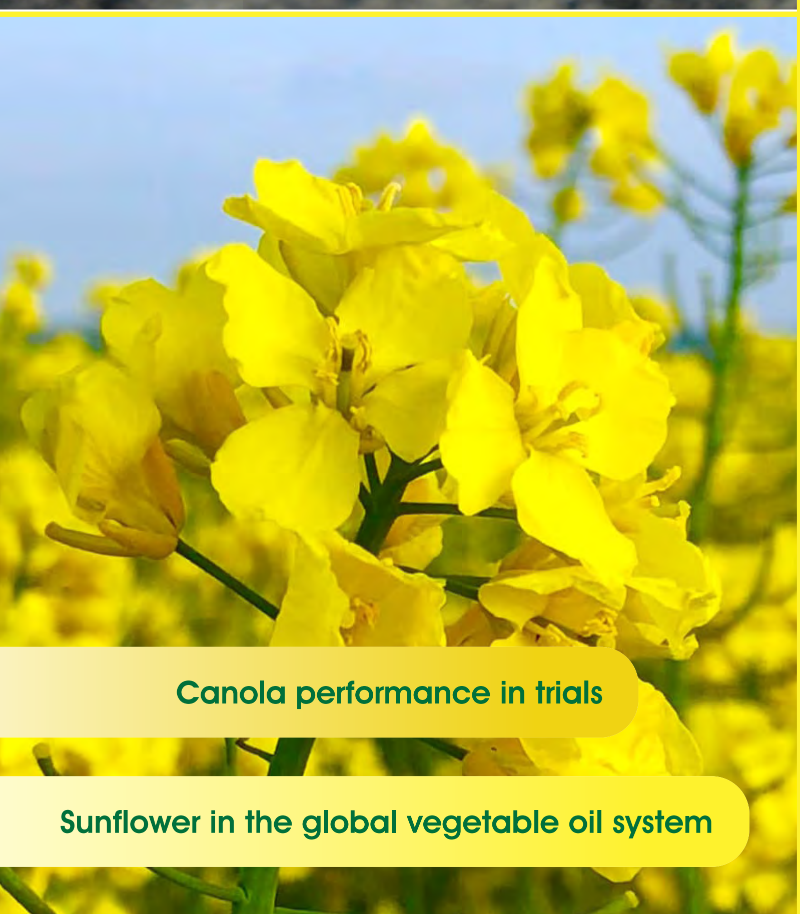
Vol 7 No 3 • September 2021
ISSN 2410-1206

OILSEEDS focus

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



Canola performance in trials

Sunflower in the global vegetable oil system

Drought tolerant crop improvement

Soya-derived products for human consumption

Adding oilseeds to the mix:
Is it the protein needed to boost transformation?

By Dr Pieter Taljaard, CEO: Grain SA

What a success story we have all experienced over the past two decades: the awakening of the local soya bean industry. Since the turn of the millennium, we saw an approximate sixfold increase in the area planted and a sevenfold increase in production. This past season was a record year, both in terms of area planted and the production of soya. Although this growth comes from a very low base, it still seems like the industry was talking about a production goal of one million tons of soya beans just the other day.

Soya beans have contributed significantly to the local agricultural sector and the balance of payments by replacing the lion's share of imported oilcake. The entire value chain benefited from producers who were willing to learn and improve their production skills and capacities, supported by various industry role-players. Likewise, producers benefited from crushing plants erected in strategic locations, creating the direct demand/offset for local soya beans. It was therefore a considerable gain for the entire economy.

In terms of the other summer oilseeds, progress with groundnuts has to a large extent been hampered by seed challenges, whereas sunflowers struggled to break through the yield ceiling. Looking at canola, prospects to further grow the local industry and even boost potential export markets, can create significant demand pull in the medium term. This is a phenomenon that not only us at Grain SA, but all value chain role-players should be very positive and excited about.

Collaborating for growth

At farm level, in addition to price diversification from a commodity marketing perspective (energy vs protein markets), producers are increasingly experiencing the crop rotational benefits between grass crops and oilseeds. Very often it's the grasses that benefit most from improved soil health and depressed disease pressure.

Currently, it is crystal clear from looking at the Agriculture and Agro-Processing Master Plan (AAMP) as well as the Poultry Industry Master Plan, that growth and transformation are taking centre stage. One can also argue that growth is a prerequisite for transformation. What I am trying to point out, is that every industry faces the same challenges and responsibilities.

Since the turn of the millennium, we saw an approximate sixfold increase in area planted and a sevenfold increase in production.

There are three basic ways to increase profitability, the first being to sell more (expansion), secondly to sell for more (value addition of better value communication through marketing), and lastly to produce for less (efficiency/productivity). This is where I believe a paradigm shift is needed in transformation.

In addition to assisting developing farmers in growing their grains and other crops profitably and sustainably (i.e., ensuring commercial viability), we as an industry need to also collaborate to diversify them. The opportunity specifically exists to assist successful grain producers in adding value to their grain.

Typically, economies of scale are a key barrier to entry for such a move, but with industry collaboration, specifically between grains, animal feeds and livestock sectors (specifically the more intensive systems), such barriers can be overcome. The key is to further enable and support our passionate and successful grain producers to integrate and thereby earn a larger portion of the consumer rand for their farms, making them more business agile.

Dr Pieter Taljaard.

Thank you to all who believed in this growth, thank you to all who are working on excelling this growth, and lastly, thank you to all who believe in and fight for agriculture daily. Let's continue to give what we have. More often than not, we tend to forget what the value of simply being present might be.

For more information, email pieter@grainsa.co.za.

Oilseeds and the future of South Africa's food security

The contribution of agriculture to the economy remains critical, despite its low contribution in percentage to the gross domestic product. The entire value chain needs to be considered – not only individual industries.

> The South African government's master plan for agriculture is a commendable initiative, especially in terms of boosting the poultry industry, which will in turn assist up- and downstream industries, including the oilseeds industry.

In order to guard the full supply chain, the old farm-to-fork principle is even more relevant now than it has ever been. Each industry needs to keep increasing its efficiencies each year in a bid to remain globally competitive and survive. Not only do we have to keep import and export parities in mind, but in the case of crops, industries must generate an income for producers that is competitive with alternative crops to avoid a shift in production.

Sustainable local oilseeds production contributes to self-sufficiency in food production and improves the chances of lower food prices and increased food security.

The bigger picture

The South African government's master plan for agriculture is a commendable initiative, especially in terms of boosting the poultry industry, which will in turn assist up- and downstream industries, including the oilseeds industry. And as we are all aware, employment in South Africa is in dire need of resuscitation.

South Africa produces just over two million tons of wheat, while the country imported 2,2 million tons mainly from Russia and Poland last year. Import value is estimated to be over R8 billion, illustrating the importance of local production.

Critical raw material to produce over 2,4 billion breads per annum and 3,5 million tons of wheat products is an integral part of the primary food chain. Meanwhile, the production of soya bean has been a great success story, increasing in production from just over 500 000 tons in 2010 to an approximate record 2 million ton crop in 2020, which is worth an estimated R15 billion.

Sights set on self-sufficiency

The Bureau for Food and Agricultural Policy (BFAP) estimates that we should reach 2,3 million tons in soya bean production by 2029, which could propel us to self-sufficiency. The current production of almost 12 million tons of animal feed is projected to increase to 14,5 million tons in 2029, absorbing just over 1,7 million tons of soya bean meal and full-fat soya.

The future of South Africa is dependent on food security and the role the oilseeds industry can play, is critical throughout the value chain.

Enjoy this jampacked 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.

Editor: Dr Erhard Briedenhann
+27 82 551 1634 • erhardb@netactive.co.za

Associate editor
Gerhard Keun • +27 11 803 2579

Published by: Plaas Media (Pty) Ltd
217 Clifton Ave, Lyttelton, Centurion, RSA
Private Bag X2010, Lyttelton, 0140, RSA
Tel: +27 12 664 4793 • *www.agriorbit.com*

Chief editor: Lynette Louw
+27 84 580 5120 • lynette@plaasmedia.co.za

Sub-editor: May Nel
+27 12 664 4793 • may@plaasmedia.co.za

News editor: Ursula Human
+27 64 890 6942 • ursula@plaasmedia.co.za

Design & layout: Annemie Visser
+27 12 664 4793 • annemie@plaasmedia.co.za

Advertising

Karin Changuion-Duffy
+27 82 376 6396 • karin@plaasmedia.co.za

Susan Steyn
+27 82 657 1262 • susan@plaasmedia.co.za

Juan de Villiers
+27 60 508 3188 • juan@plaasmedia.co.za

Rowena Simmons
+27 79 568 6025 • rowena@plaasmedia.co.za

Accounts: Marné Anderson
+27 72 639 1805 • marne@plaasmedia.co.za

Subscriptions: Beauty Mthombeni
+27 64 890 6941 • beauty@plaasmedia.co.za

Printed and bound by: Typo
+27 11 402 0571

Published on behalf of:
Protein Research Foundation
PO Box 1564, Rivonia, 2128
Tel: 011 803 2579 • Fax 011 803 2287 / 086 634 8067
Enquiries: gkeun@proteinresearch.net

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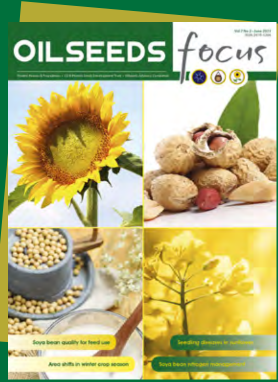

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NEWS

New South Wales lifts ban on GM crops

New South Wales' (NSW) genetically modified (GM) crop moratorium expired on 1 July 2021. This means every mainland state can now access all approved GM crops. This puts Australia's producers on the same level as their major international agricultural competitors and underpins a great productivity and environmental sustainability leap for Australian farming.

Chief executive officer of CropLife Australia, Matthew Cossey, says: "Producers should be the ones to make their own choices about which crops to grow that best fit their farming environment and business model. Having access to GM crops is only going to become more important as producers continue to face periods of drought and increasingly harsher conditions in a changing climate." – *CropLife Australia*

Bright future for genome-edited oil crops

Scientists from China conducted a review on CRISPR technology and applications for oil crops to determine its prospects in the agricultural and food industry. They are optimistic that genome editing in oil crops will soon flourish. The review was conducted to provide references for the better use of CRISPR to modify oil crops for higher yield.

The advances of the CRISPR technology can also contribute to the construction of a genome-wide mutant library for different oil crops, and the accelerated domestication of a vast majority of wild novel oil crops to address the global crop oil demand. – *International Service for the Acquisition of Agri-biotech Applications*

Analysis to predict sunflower oil properties

Skoltech researchers and their colleagues from the University of Southern California, have performed genetic analysis of a Russian sunflower collection and identified genetic markers that can help predict the oil's fatty acid composition.

"Our work is the first large-scale study of the Russian sunflower genetic collection and one of the first attempts to create new varieties using genomic selection. Predicting what a plant will be like before planting it – an idea that seemed utterly unrealistic until recently – has become commonplace in many countries, thanks to technological advances.

"Classical breeding can hardly cope with the challenges posed by global climate change, growing human needs and evolving food quality requirements. To get a head start, we should turn to genetics," Alina Chernova, Skoltech PhD and lead author of the study, notes. – *Skoltech*

Cholesterol-lowering vegetable fat discovered

Researchers at the KU Leuven University in Belgium have obtained an innovation grant from the Flemish Agency for Innovation and Entrepreneurship (VLAIO) to test and develop a new unsaturated fat, which they claim remains solid at room temperature. The product, called Sterolife, can help food companies to develop healthy alternatives to existing high-fat products.

"Our product is an odourless and colourless solid fat," says Dr Eva Daels of the food and lipids research group. "With these properties, Sterolife can reduce the saturated fat content in products without sacrificing the quality and texture."

Sterolife is made from plant sterols – substances that are naturally present in different plant products such as vegetables, fruit, nuts and grains, albeit in small amounts. – *Food Navigator*

US soya beans maladapted to climate variations

United States (US) soya bean varieties have become increasingly heat and drought resistant as agricultural production adapts to a changing climate. But the focus on developing crops for extreme conditions has negatively affected performance under normal weather patterns, a University of Illinois study shows.

"Since the 1950s, advances in breeding and management practices have made soya beans more resilient to extreme heat and drought. However, there is a cost to it. Crop productivity with respect to normal temperature and precipitation is getting lower," says Chengzheng Yu, doctoral student in the Department of Agricultural and Consumer Economics at the University of Illinois.

Climate projections indicate a mix of extreme and normal weather patterns in the next 50 years, so crops must perform well under a variety of conditions. – *Science Daily*

Insta-Pro welcomes new president and CEO

Insta-Pro International announced that Jonathan Kingsbury has been appointed president and CEO of the company. Kingsbury has more than 20 years' senior-level sales and marketing experience in industrial equipment roles, as well as international experience.

"Kingsbury joins Insta-Pro at an important time for our company, our customers and the industry," says Nick Santrizos, chairperson of Insta-Pro International's board. "Jonathan has extensive experience leading innovative businesses through hands-on engagement with clients and converting their requirements and feedback into valuable products and services, which solve their unique challenges."

"Insta-Pro has a unique company culture focussed on taking care of one another and their customers," says Kingsbury. "As the world opens up post-pandemic, I look forward to working with the Insta-Pro team and welcome the opportunity to meet with Insta-Pro customers and prospects." – *Press release, Insta-Pro*

The new president and CEO of Insta-Pro International, Jonathan Kingsbury.

Growing food from air versus growing crops

Researchers from the Max Planck Institute of Molecular Plant Physiology, the University of Naples Federico II, the Weizmann Institute of Science, and the Porter School of the Environment and Earth Sciences, compared the efficiency of growing soya beans with a food-from-air technique.

They applied a technique that uses electricity to produce hydrogen, which is combined with carbon dioxide, water, vitamins and minerals, to feed and grow a microbial biomass that produces edible protein powder with no discernible taste, which can be added to almost any snack or meal.

The researchers claimed their analysis showed that growing food from air was ten times as efficient as growing soya beans in the ground. Production of single-cell protein can therefore help close the approaching protein gap, while curtailing further agricultural land expansion and thus safeguarding biodiversity. – *Food Navigator*

Cleaner air boosts American soya bean yields

A key factor in America's prodigious agricultural output turns out to be something producers can do little to control: clean air. A Stanford University-led study estimates that pollution reductions between 1999 and 2019 contributed to about 20% of the increase in soya bean yield gains during that period.

The analysis reveals that four key air pollutants are particularly damaging to crops and accounted for an average loss of about 5% soya bean production over the study period. The findings could help inform technology and policy changes to benefit American agriculture and underscore the value of reducing air pollution in other parts of the world. – *National Science Foundation*

Soya bean innovator to close merger deal

Sustainable food tech innovator, Benson Hill, is going public at a valuation of $2 billion through a merger with special purpose acquisition company, Star Peak Corp II. Founded in 2012, Benson Hill leverages Cloud Biology®, or the combination of data science, machine learning, AI techniques, biology and genomics to unlock nature's genetic diversity in plants to create innovative food and ingredient products.

The company manifests its seed to shelf innovation through CropOS™, its platform that uses predictive analytics to simulate tens of millions of genetic outcomes for plants. This technology enables Benson Hill to accelerate and precisely develop more sustainable feed, food and ingredient options years faster than traditional crop breeding systems, through an approach that decreases development costs and shortens time to market. – *Oilseed and Grain*

Diclosulam a solution to glyphosate challenges

With the current growth in the South African soya bean market, there is increasing demand for glyphosate. Current conditions in the industry have caused challenges in the production and supply of products containing the glyphosate active ingredient.

Villa Crop Protection's Diclosulam-containing selective pre-emergence herbicide offers a solution to this challenge. Diclosulam is a selective dry formulation herbicide with long residual action and good crop safety properties.

When used in a registered programme at the right dose, it gives producers peace of mind quite far into the season. Diclosulam is classified as a group code B2 herbicide and is part of the triazolopyrimidine herbicides, which causes the inhibition of acetolactate synthesis and, when applied pre-emergence, has a post-emergence effect on growing weeds.

Several producers claim to have spared a full spray due to the excellent after-effects of the Diclosulam active. – *Press release, Villa Crop Protection*


YOUR FAMILY
YOUR FARM
YOUR DREAM

Drought tolerant crops: Assessing 20 years' plant biotechnology efforts in crop improvement

By Michael Nuccioa, Nicholas Batea and Jonathan Cohna, Syngenta Crop Protection, Matthew Paul, Rothamsted Research, and Sean Cutler, University of California Riverside

Since the dawn of modern biotechnology, public and private enterprises have pursued the development of a new breed of drought tolerant crop products. However, only a few such products have reached the market due to technical and market constraints. Advances in the biology of plant water management reveal new opportunities to improve crop response to water deficit and new genome-based tools promise to usher in the next era of crop improvement.

Biotechnology is considered one of the most promising ways to develop new cultivars with a substantially improved tolerance to water deficit. In this context, biotechnology encompasses the introduction of transgenes that directly affect plant water use. This is also known as genetic engineering, genetic modification (GM), and the creation of genetically modified organisms (GMOs).

Defining drought

Drought or water deficit is a consequence of the environment which varies across place and time. No two environments are exactly alike, and weather conditions change throughout growing seasons. The impact of water deficit on crop productivity varies with respect to crop, when it occurs in the crop cycle, and its duration and intensity.

Genetics that provide durable resistance to water deficit are likely already fixed in commercial germ plasm. Many approaches have been developed to simulate water deficit. These included imposing osmotic stress with chemicals such as sodium chloride or polyethylene glycol (PEG), among others.

The challenge is to define a practical water deficit problem that is compelling enough to initiate a product development project. The initial hypothesis needs to be granular enough to connect metabolism to the desired phenotype.

One approach hypothesises that there is a class of genes that confers drought tolerance when expressed using the CaMV 35 promoter in plants exposed to water deficit, but it does not impact productivity in well-watered environments. The bacterial cold shock protein in Monsanto's DroughtGard® trait is an example, and given the intensity of their drought research programme, the evidence suggests these genes are extremely rare.

Another approach only considers the impact of water deficit during early reproductive development. Most crop production incorporates a package of technologies to make it as efficient and profitable as possible.

Trait gene identification

A basic outline of the drought tolerant trait development process can be seen in *Figure 1*. Much research has been focussed on the discovery of genes that might form the basis for drought trait development.

Early genes were identified in forward/reverse genetic screens in model organisms such as *Arabidopsis* and rice. Genomics opened entire genomes to evaluation with respect to drought.

Large-scale differential expression analysis using micro-arrays and DNA sequencing technology identified thousands of genes that respond to water deficit. This began with direct sequencing of cDNA libraries to assemble large-scale transcriptome databases that formed the basis for micro-array technology. The draft rice genome extended the ability to probe for drought tolerant genes on a genome scale.

The role of microRNAs in drought response is also being studied on a genome scale. The accumulated data enable assembly and interrogation of drought responsive gene regulatory networks. This body of work led to the identification of candidate genes for the development of drought tolerant traits.

> Biotechnology is considered one of the most promising ways to develop new cultivars with a substantially improved tolerance to water deficit.

While the data provide insight into genes involved in plant response to water deficit, their application to drought response in production environments is not firmly established. Examples of drought responsive candidate genes include transcriptional regulators such as dehydration-responsive element-binding (DREB) protein, the feast/famine signalling kinase (SnRK1), and ABA receptors.

The DREB1/CBF transcription factor was identified for its ability to bind a drought responsive regulatory element in response to water deficit and its ability to bind C-repeats in cold responsive promoters. It was an early candidate for drought tolerant trait development, but overexpression using the CaMV 35S promoter caused pleotropic growth defects.

SnRK1 was shown to be a key regulator of the feast/famine response in *Arabidopsis*, affecting at least 1 000 genes. This activity extends to wheat, and it was later found that, in certain circumstances, the sugar metabolite trehalose-6-phosphate is an allosteric effector of SnRK1 activity directly linking the trehalose pathway to stress response. This may explain the mechanism by which expressing a trehalose-6-phosphatase in very young maize ears improves productivity when drought is imposed during reproductive development.

The ABA signalling pathway is central to plant water status, including response to water deficit. ABA sensitivity can be tuned by overexpressing ABA receptors, which can be leveraged to increase water productivity in *Arabidopsis*. However, there appears to be a threshold after which increased ABA sensitivity reduces yield by restricting growth.

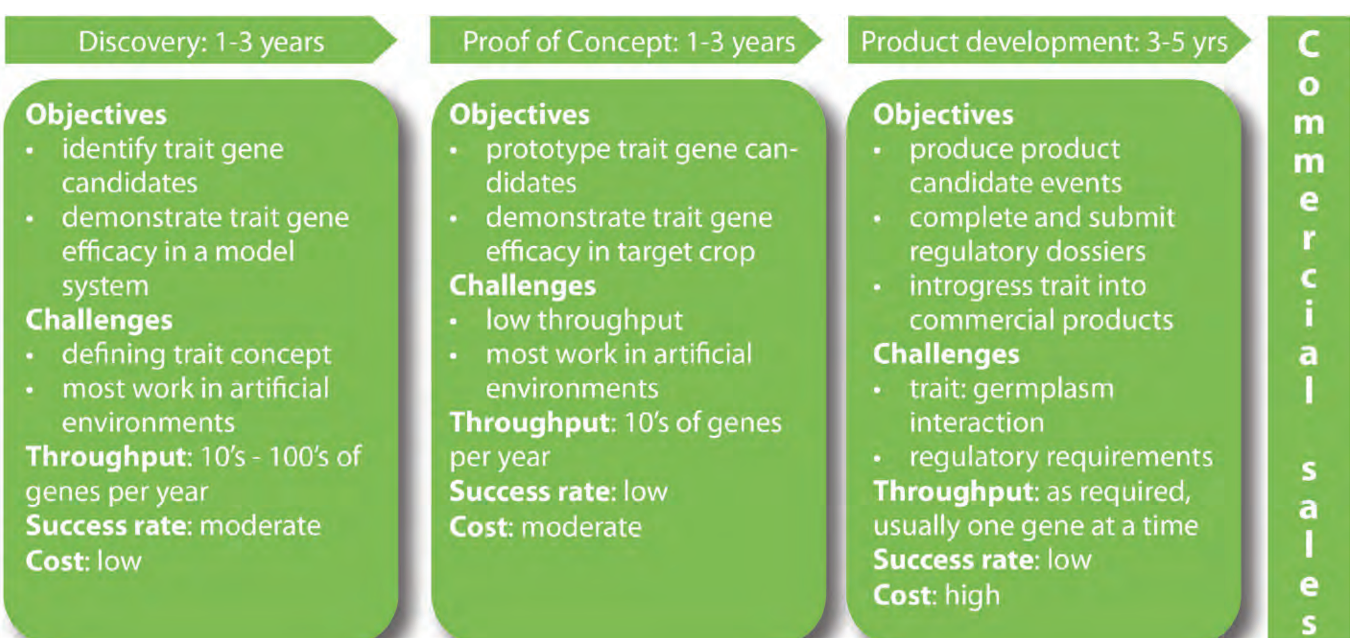
Signalling is initiated when ABA receptors bind ABA and undergo a conformational change that enables them to bind and inhibit the activity of clade A PP2Cs, which dephosphorylate a sub-group of stress activated SnRK2 kinases under basal conditions.

The ABA-mediated inhibition of PP2C activity leads to SnRK2 activation and subsequent phosphorylation of downstream effectors and activation of ABA signalling. A mutagenesis screen identified conserved amino acids in ABA receptors that alter their sensitivity to ABA and these mutants provide new tools for rationally modulating crop ABA sensitivity and water productivity by genome engineering approaches.

Directed mutagenesis even reprogrammed receptor ligand specificity so that ABA receptors could be controlled by a crop protection chemical, which opens the door to chemically modulating transpiration using existing agrochemistry.

Many attempts to improve drought tolerance in transgenic plants result in plants that survive an often-extreme drought. However, this survival is usually achieved because the engineered plant is growing more slowly than controls with less leaf area and lower stomatal conductance. Survival or resilience as a crop trait is not

Figure 1: General outline of a pipeline to develop drought tolerant GM trait technology.



acceptable if it means that productivity under good growing conditions is lower.

Monsanto's DroughtGard® trait consists of the *Bacillus subtilis* cold shock protein B (cspB) fused to a rice actin promoter, and an *Agrobacterium tumefaciens* transcript 7 terminator in event MON87460.

In bacteria, cspB is an RNA chaperone that regulates translation in response to cold stress, an adaptation to cold shock. The cspB trait gene confers tolerance to high light plus cold in *Arabidopsis* and heat, cold, and drought in rice. It also confers drought tolerance in maize and contributes positively to chlorophyll content and photo-assimilation.

This required an intact RNA binding domain indicating that the mode of action is at the RNA level. At the physiological level, the DroughtGard® trait reduces leaf growth which decreases water use and makes more water available during the critical flowering period.

Trait gene expression

It is widely accepted that genetic programmes that respond to abiotic stress such as water deficit redirect metabolic energy. This usually reduces productivity. Drought response programmes are therefore under tight control and typically express only transiently.

Most drought tolerant transgenes slow growth as described above when overexpressed this way. Drought-responsive promoters have also been described. This is not limited to drought research. There has been comparatively little work on the development and characterisation of promoters that respond to abiotic stress, relative to candidate gene identification. Detailed analyses of genes that respond to water deficit provide an opportunity to develop synthetic promoters to drive drought tolerant genes.

Next wave biotechnology products

The advent of new technologies based on genome science promises to expand the biotechnology toolkit for drought tolerant research. Additionally, knowledge of the mechanisms that contribute to crop drought tolerance have led to the development of chemical applications.

The continued advancement of DNA sequencing and plant phenotyping technology increases the capacity to detect genetic components associated with crop response to water deficit. Significant evidence suggests that variation associated with gene regulation underlies many drought-tolerant quantitative trait loci. Long-read DNA sequencing technology is addressing the repetitive nature of many crop genomes, enabling quick and inexpensive assembly of ever-larger DNA contigs.

"Modern genomic tools have the potential to identify key regulators of plant water management which earlier tools have missed. Taken together, these capabilities promise to advance our ability to define and develop effective drought tolerant trait technology.

Genome editing is a relatively new and exciting technology to directly manipulate important crop genes. Most work continues to rely on traditional transgene technology to introduce gene editing reagents, but work to circumvent this dependency is underway. By directly manipulating critical genes in crop response to water deficit, gene editing may prove a far more effective approach than traditional GM technology.

Knowledge of the biological mechanisms involved in crop response to water deficit also reveals opportunities to manage crop response to water deficit using chemistry.

ABA receptors were discovered in a chemical genetic screen using pyrabactin, a selective ABA agonist. ABA has potential as an excellent tool to manage crop response to water deficit, but it is costly to produce and metabolically and environmentally unstable. Chemical library screens identified quinabactin, a novel ABA agonist that addresses ABA's liabilities as an agrochemical and provides new avenues for dynamically tuning crop water consumption throughout a growing season.

The quinabactin structure was further explored for molecules with improved properties identifying promising new variants. Modification of four amino acids in AtPYR1 enabled high-affinity binding to an agrochemical without losing its signal transduction activity.

Furthermore, novel caged derivatives of trehalose-6-phosphate were shown to improve grain size in wheat. This is complementary to genetic strategies as the target sites manipulated by these new molecules are highly conserved across angiosperms.

Solution of combined capabilities

The road to commercialising drought tolerant biotechnology products goes far beyond the identification of genes. It begins with careful consideration of the problem to be solved.

Drought tolerance is an oversimplification of the challenges that water deficit imposes on crop production. Each crop and crop production system is unique with regard to the impact water deficit has on productivity and profitability. The more accurately the water deficit problem can be defined, the likelier a tractable drought tolerant trait can be developed.

Biotechnology trait developers must be aware of the many possible solutions available to producers to effectively position drought tolerant traits. Genomics and the development of genome editing have the potential to greatly expand the plant breeding toolkit. Modern genomic tools have the potential to identify key regulators of plant water management which earlier tools have missed. Taken together, these capabilities promise to advance our ability to define and develop effective drought tolerant trait technology.

When work began, researchers did not know how to confer drought tolerance in crops. Current achievements and technology advancement provide significant opportunities to further improve crop drought tolerance. Continued efforts by public and private research groups will no doubt lead to exciting new products.

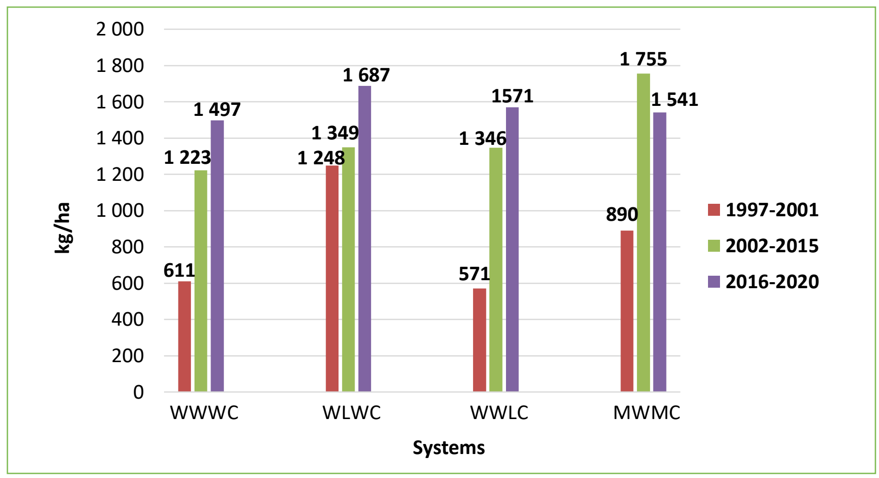
This article has been shortened for use in *Oilseeds Focus*. For the complete research document and references, visit *www.elsevier.com/locate/plantsci*.

Canola performance in **crop rotation trials in the Western Cape**

By Dr Johann Strauss, Rens Smit, Samie Laubscher and Willie Langenhoven, Research and Technology Development Services, Directorate: Plant Sciences, Elsenburg Agricultural Training Institute

Since 1996, canola has been an integral part of long-term crop rotation trials of the Western Cape Department of Agriculture. The crop was initially seen as a break crop to alleviate disease and weed pressure in wheat and barley production systems, but has since developed into a profitable crop that stands on its own feet. In this article, we examine the performance of canola in the Langgewens and Tygerhoek trials.

Figure 1: Summary of the average canola yield in the three phases of the long-term trial.



**WWWC: wheat – wheat – wheat – canola; WLWC: wheat – lupine – wheat – canola; WWLC: wheat – wheat – lupine – canola; MWMC: medic – wheat – medic – canola.*

Langgewens

The trial was initiated in 1996. Canola is featured in four of the eight crop rotation systems tested. Three of these are pure cash crop systems, of which the third includes medic pastures (*Table 1*). The trial, which saw its 24th production season in 2020, has gone through some changes over the years, including adjustments to planting methods, fertiliser applications and pest control.

From 1996 to 2001, minimum tillage was practiced using a light tine implement that loosened the soil before planting with an adapted seed drill. From 2002 to 2015, no-till was introduced using an Ausplow tine seeder. During the last five years, a Piket double disc seeder was used to plant the different crops.

Dry seasons were experienced in 2003, 2015 and 2017. In 2015, no canola was harvested at all, while rainfall of 169 and 172mm was recorded in 2015 and 2017, respectively. This gave rise to a completely different picture, even though there was even lower seasonal rainfall in those two years than in 2003 (210mm). The changes in the soil due to carbon improvement and the improved water-holding capacity of the soil played a significant role in this regard.

The positive effect of canola as a preceding crop was also evident in the wheat yield of the 2015 and 2017 seasons. In 2003, only camps where wheat followed medics were harvested, resulting in an overall trial average of 500kg/ha, while the average in 2015 was 2,1 and 2,4t/ha in 2017.

There was a marked improvement in average yield over the three phases of the long-term trial in all systems, excluding a lower average yield in systems where canola followed medics (*Figure 1*). This can be attributed to a single season where no canola was harvested due to germination challenges, resulting in very poor stance.

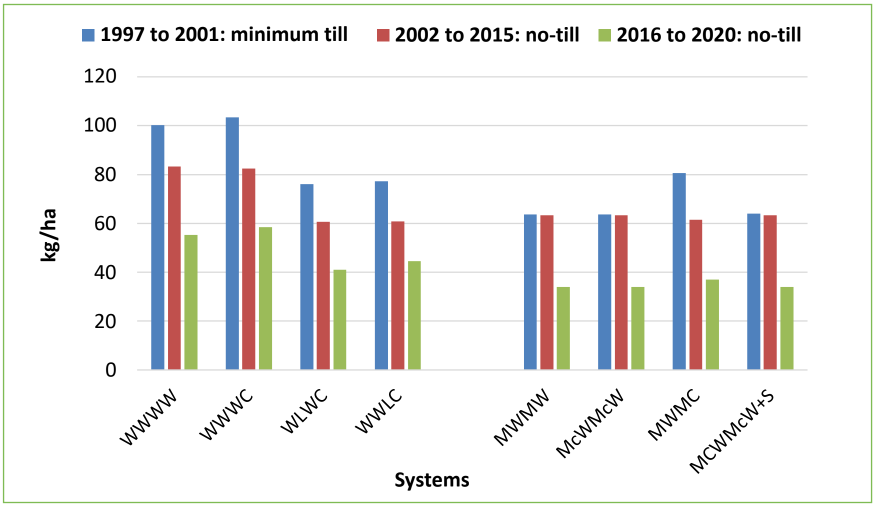
The decision was made to rather terminate the crop later in the season to control any possible weed issues the following year. In 2020, the highest canola yield of 2,95t/ha was obtained in a system where canola followed a medic pasture, on which only 14kg/ha of nitrogen was applied. This illustrates the impact of the single year without harvest.

As already mentioned, another change to the trial during the 24 years was the amount of nitrogen fertiliser applied. There was a marked lowering of nitrogen input over the three phases (*Figure 2*). Even though nitrogen application decreased, yields did not. Improvement in available cultivar choice also played a significant role. An even more startling observation is

Table 1: Cropping systems that include canola at Langgewens.

System	Crop sequence
WWWC	Wheat – wheat – wheat – canola
WLWC	Wheat – lupine (legume cover since 2016) – wheat – canola
WWLC	Wheat – wheat – lupine (legume cover since 2016) – canola
MWMC	Medic – wheat – medic – canola

Figure 2: Average amount of nitrogen (kg) applied during the three phases of the trial.



**WWWW: wheat – wheat – wheat – wheat; WWWC: wheat – wheat – wheat – canola; WLWC: wheat – lupin – wheat – canola; MWMW: medic – wheat – medic – wheat; McWMcW: medic/clover – wheat – medic/clover – wheat; MWMC: medic – wheat – medic – canola; MCWMcW+S: medic – canola – wheat – medic/clover – wheat + saltbush.*

Table 2: Average nitrogen-use efficiency and percentage of improvement from the first to the third phase in different canola planting systems in the long-term trial.

Systems	1997 to 2001	2002 to 2015	2016 to 2020	Improvement
WWWC	5kg	16kg	24kg	351%
WLWC	11kg	17kg	27kg	147%
WWLC	6kg	19kg	27kg	382%
MWMC	12kg	29kg	44kg	273%

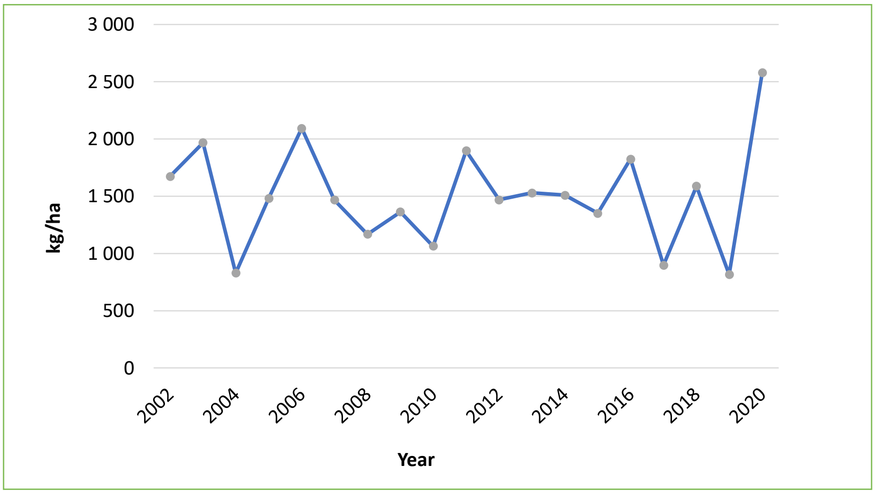
**WWWC: wheat – wheat – wheat – canola; WLWC: wheat – lupin – wheat – canola; WWLC: wheat – wheat – lupin – canola; MWMC: medic – wheat – medic – wheat.*

the nitrogen-use efficiency over the three phases of the trial (*Table 2*).

Tygerhoek

The long-term trial at Tygerhoek started in 2002 and, similar to Langgewens, canola formed part of several short-term crop rotation systems tested. There were four main systems, namely two years of pasture followed by canola (pasture – pasture – wheat, or PPW), two years of pasture followed by two cash crops (pasture – pasture – canola – wheat, or PPCW), an alternating pasture cash crop (pasture – wheat – pasture – canola, or PWPC), and two cash crop systems (wheat – lupin – wheat – canola, or WLWC, and wheat – barley – lupin – wheat – barley – canola, or WBLWBC).

Figure 3: Average annual canola yields from 2002 to 2020.



The average canola yield over the 19 years of the trial was 1 503kg/ha. The highest yield was achieved in 2020 at an average of 2,5t/ha. The yield was relatively stable over the period, but dry spells during the last four years played a significant role in yield realised (*Figure 3*).

The 2020 results were obtained from a total of 38kg of nitrogen applied per hectare. A good rule of thumb is that canola should yield 50 to 60% of what the wheat yields. At Tygerhoek, the yield ranged between 31 and 70% of the wheat yield, with an average of 40%. It must be considered that TT cultivars are used exclusively in this trial. Oil content was consistently around 40%, with an all-time high of 46% in 2020.

The average canola yield per system did not differ significantly over the 19 years. The system where canola followed two years of pasture is similar to the four-year system in terms of following on two years of pasture. These were combined to give a single result.

Canola in the systems which included legume pastures outyielded the canola in the cash crop systems by just 126kg. This difference might be attributed to the WLWC system. One of the two repetitions of this specific system is on a self-compacting soil type, which undermines active growth in both crops and weeds. There is thus constant competition between the two, resulting in poorer yields compared to the sister repetition.

Conclusion

Canola is part and parcel of the rotation systems in both the Swartland and Southern Cape and adds value by improving the overall gross margins of the rotation systems used. This is due to good commodity prices and the effect of improved wheat yield following a canola crop.

For more information, contact Dr Johann Strauss of the Elsenburg Agricultural Training Institute at johannst@elsenburg.com or 082 907 3109.

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A28733/O

Blackleg of canola: A Trojan horse

By Huibré Schreuder and Diane Mostert, Department of Plant Pathology, Stellenbosch University, and Gert van Coller, Western Cape Department of Agriculture

Blackleg, also known as stem canker or phoma stem canker, is the most notable disease in canola, both locally and internationally. It is present in all growing regions of the Western Cape, where almost all of South Africa's canola is produced. The disease can present symptoms on most parts of the plant, with common symptoms including leaf and pod lesions (*Figure 1*), as well as stem and crown cankers (*Figure 2*).

Serious yield losses are primarily the result of crown cankers later in the season, which, interestingly, are caused by leaf infection early in the season. Blackleg disease therefore acts as a Trojan horse. These damaging cankers restrict the transport of nutrients and water between the roots and upper canopy, and in severe cases, cause the plant to topple over and die.

Causal agents

Blackleg is caused by two closely related fungal species, *Leptosphaeria maculans* and *Leptosphaeria biglobosa*. The former is more virulent and responsible for upper and lower stem cankers, as well as the damaging crown cankers.

L. biglobosa causes cankers on the upper part of the stem, which is usually less damaging. The reason why *L. maculans* causes more severe damage is due to its ability to produce a toxin called Sirodesmin PL, which strengthens the pathogen that causes blackleg. Sirodesmin PL is also responsible for the yellow halo that is seen around lesions caused by *L. maculans* on canola leaves (*Figure 1A*).

Lesions caused by *L. biglobosa* are smaller, contain fewer fruiting bodies and have a thin, dark border. Both species are widely distributed in canola production areas around the world, with variation in their predominance and distribution.

No previous surveys on canola in the Western Cape exist to determine which of the two species are more prevalent. This is currently being addressed in a joint research project between the Stellenbosch University and the Western Cape Department of Agriculture. To date, only *L. maculans* has been confirmed on canola in the Western Cape.

L. maculans is known to be the dominant of the two species in Australia, from where most of our seed is imported. It is therefore possible that *L. biglobosa* may not be present nor be a significant contributor to blackleg disease in the Western Cape. Further research later in the season will confirm whether this is the case, since *L. biglobosa* is known to release spores later during the season.

Figure 1: Necrotic lesions containing fruiting bodies on leaves (A) and pods (B). (Photographs: Gert van Coller [A], Piet Lombard [B])

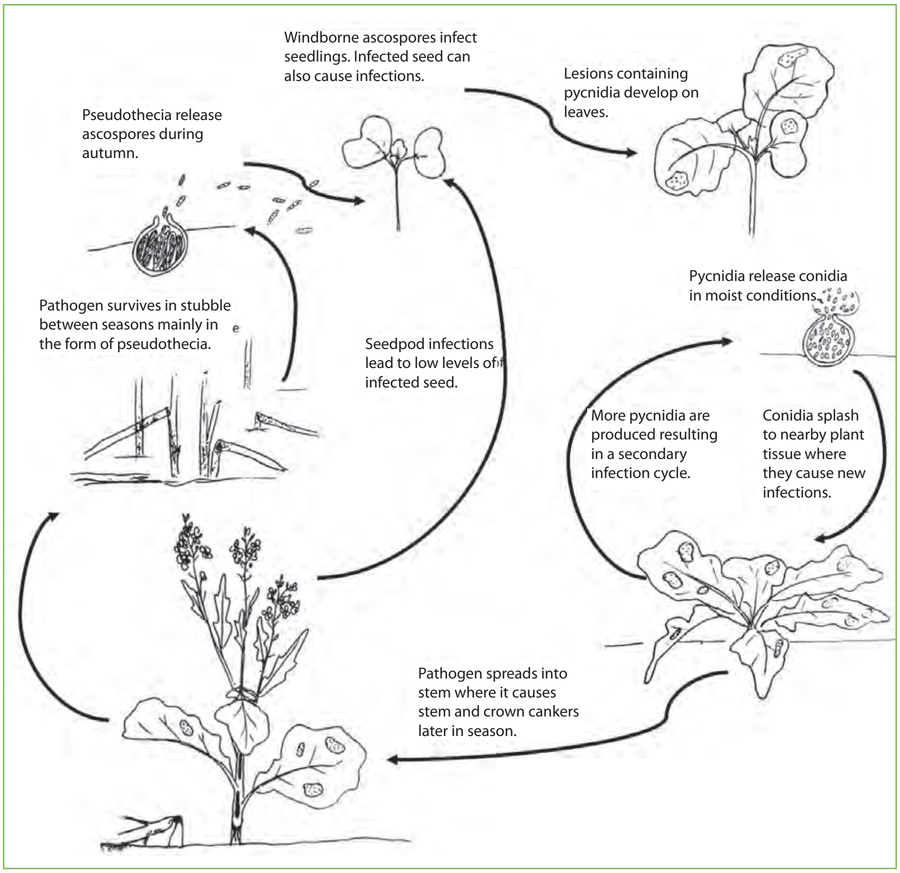
Figure 2: Cankers on canola crowns (A and B) and stems (C). (Photographs: Gert van Coller)

Disease cycle

The disease cycle of blackleg is presented in *Figure 3*. The blackleg pathogens survive on canola stubble left in the field between growing seasons. During this period, sexual reproduction can occur by which genetic material is exchanged between individuals of the pathogen. This process leads to the formation of sexual fruiting bodies (pseudothecia) which are visible as small black dots on the stubble (*Figure 4*).

Pseudothecia begins to release sexual spores (ascospores) in wet conditions during autumn, shortly after canola has been sown in the new season. Airborne ascospores can be transported by wind over vast distances to infect surrounding canola fields.

Figure 3: The disease cycle of blackleg.



Ascospores landing on the leaves and cotyledons of canola seedlings cause characteristic leaf spots. Within these leaf spots, asexual fruiting bodies (pycnidia) become visible as small black dots after a few days (*Figure 1*). Pycnidia releases asexual spores (conidia) when wet, which can splash along with raindrops to cause new infections on nearby plants, leaves and seed pods.

Leaf infection caused by ascospores up to the five-leaf stage is largely responsible for the damaging crown cankers later in the season. From infected leaves, the pathogen grows through the petiole into the developing stem and crown region, and remains dormant without presenting any symptoms. Later in the season, however, this relationship changes when the pathogen becomes necrotic, and causes stem and crown cankers.

These cankers usually become visible from full flowering onwards. From the crown area, the pathogen can grow into the taproot and cause root rot. After harvest, the pathogen survives on infected canola stubble, which allows it to subsist throughout the summer and cause disease during the following growing season.

Figure 4: Pseudothecia on canola stubble. (Photograph: Gert van Coller)

Management challenges

Various management strategies have been implemented over the years to mitigate losses caused by blackleg, the most significant being longer crop rotations (four years), the development of resistant cultivars, and chemical control with fungicide applications. However, due to the nature of its life cycle, blackleg remains difficult to manage.

Challenges pertaining to the management of blackleg include the following:

- Ascospores can travel long distances, which means that the disease can easily spread from infected stubble to nearby canola fields.
- Blackleg pathogens are seedborne. Canola pods infected by *L. maculans* can lead to seed infection, resulting in seedling infection and subsequently cankering in adult plants. Infected seed is a major source of pathogens spreading to new areas.
- The pathogen population consists of many races. The resistant genes present in canola cultivars mean that certain races of the pathogen are effectively controlled, while others are not. Over time, these uncontrolled races can multiply and overcome a particular cultivar's resistance, resulting in substantial losses.
- Sexual reproduction introduces new genetic variants into the local pathogen population every season. This has implications for management practices as it can lead to fungicide resistance and/or overcoming host resistance.

For more information, contact the Department of Plant Pathology at the Stellenbosch University at 021 808 9111, or the Western Cape Department of Agriculture at 021 808 5111.

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Amistar® Technology for *Sclerotinia* stem rot and blackleg in canola

By Francois van Deventer, technical lead: herbicides and fungicides, Syngenta

Where producers are struggling with difficult-to-control or resistant weeds, canola offers options for the use of pesticides with alternative modes of action. Canola is unfortunately not exempt from diseases that may damage yield. Two pathogens of concern are *Leptosphaeria maculans*, which causes blackleg/stem canker, and *Sclerotinia sclerotiorum*, which causes *Sclerotinia* stem rot. Both can lead to serious short-term yield losses, while *Sclerotinia* can remain a problem for several years.

Sclerotinia stem rot

The primary inoculum could originate from sclerotia that survived in the soil, either from infected plant remains or from alternative weed hosts.

The disease damages vascular tissue in the stem, therefore water and nutrients cannot be transferred effectively. The pathogen flourishes in temperatures of around 15°C combined with long-lasting humid (high humidity) conditions in the weeks right before canola starts flowering, leading to increased pressure.

Sclerotinia stem rot has become a growing concern in canola production areas.

Infection mainly occurs at night when temperatures are slightly lower and the micro-climate within the leaf canopy of the canola field is ideal.

Blackleg and stem canker

Leptosphaeria maculans survives primarily on plant remains from the previous season. The pathogen is also seed-borne. Be cautious of low-quality, untreated or retained seed which may be an inoculum source.

The ideal conditions for the development of the pathogen are cool yet humid weather in autumn. Young seedlings are normally infected early in the season. The fungus will remain dormant in the plant until later in the season when it starts actively developing. It will then lead to stem or crown canker, and the plant will then topple over or die.

An integrated approach

Firstly, we need to manage crop conditions by looking at crop rotation systems and the planting of resistant cultivars. The micro-climate within the field plays a crucial role in *Sclerotinia* infections. In this instance, the density of the canopy can be managed through the cultivar type, fertilisation and plant density.

As we cannot always control environmental factors, chemical management is key. For effective results, a registered agent needs to be administered at the right time. Syngenta's Amistar® is registered for the management of, among others, blackleg and *Sclerotinia* in canola. Amistar® is a highly systemic strobilurin fungicide offering extended residual action. It is a valuable tool in the hands of the canola producer that, combined with agricultural practices, can help manage both diseases.

Leptosphaeria maculans, which causes blackleg/stem canker, survives primarily on plant remains from the previous season.

The timing of administration is crucial and Amistar® should always be used as a preventative measure. In targeted disease-management programmes (single administration), Amistar® at a dose of 500ml/ha must not be applied later than the two- to four-leaf stage for the management of blackleg. For *Scelerotinia* management, it is advised to administer between 660 to 1 000mℓ/ha (depending on the expected pressure) at 10 to 25% flowering.

Where both diseases need to be managed, it is advised to rather administer SCORE® at the two- to four-leaf stage, followed up by Amistar® at 10 to 25% flowering. Alternating between these active ingredients contributes to a thorough anti-resistance management strategy.

Refer to the product label for the complete guidelines. For more information, contact Syngenta South Africa on 011 541 4000.

A globally approved sunflower management solution

Article supplied by BASF

The Clearfield® production system has been widely accepted by South African producers since its introduction in 2010. BASF's continuous investment in the latest technologies primarily aims to offer value to producers. With this goal at the forefront of its objectives, BASF and its partners have developed the latest Clearfield® Plus production system, which has grown by leaps and bounds.

Clearfield® Plus qualified seed

Before sunflower cultivars can be classified and sold as Clearfield® Plus seed, BASF's seed partners undergo several years of stringent qualification trials. In addition, Clearfield® Plus cultivars are not genetically modified and contain a natural herbicide-tolerant gene that is bred into the seed companies' existing cultivars.

Euro-Lightning® Plus herbicide

BASF also offers Euro-Lightning® Plus, the Clearfield® Plus herbicide for sunflowers. The new formulation of Euro-Lightning® Plus is designed for improved weed control in Clearfield® Plus sunflower fields through higher levels of herbicide adherence to target weeds.

Euro-Lightning® Plus eradicates yield-robbing weeds, thereby delivering cleaner fields. Under no-till conditions, excellent weed control has been observed where Euro-Lightning® Plus was applied.

It can only be used on Clearfield® Plus sunflower cultivars (original Clearfield® sunflower cultivars are also excluded).

The following is recommended:

- Clean spray tanks, hoses and nozzles with a suitable tank cleaning solution prior to mixing the Euro-Lightning® Plus solution.
- Use flowable (50%), high-quality ammonium sulphate.
- Do not use any surfactants that contain acidifying agents.
- Applications must be done within 32 days of planting.
- For good control, thorough coverage of the target weeds must be completed by the two- to six-leaf stage and the weed must be actively growing.
- Do not add any other crop protection products to the solution.
- Do not mix Euro-Lightning® Plus with any organophosphate or carbamate insecticides and do not apply where these products have already been used.

Table 1: New follow-up crops and their waiting periods.

Crop	Waiting period	Changes
Clearfield® Plus sunflower	None	–
Wheat	Four months	–
Maize	Nine months	One-month reduction
Dry beans	Nine months	New crop and waiting period
Soya beans	Nine months	New crop and waiting period
All other crops	20 months	–

Euro-Lightning® Plus label update

Some of the challenges experienced with Euro-Lightning® Plus included waiting period limitations for follow-up crops. These have been reduced and a few new crops have been added (*Table 1*).

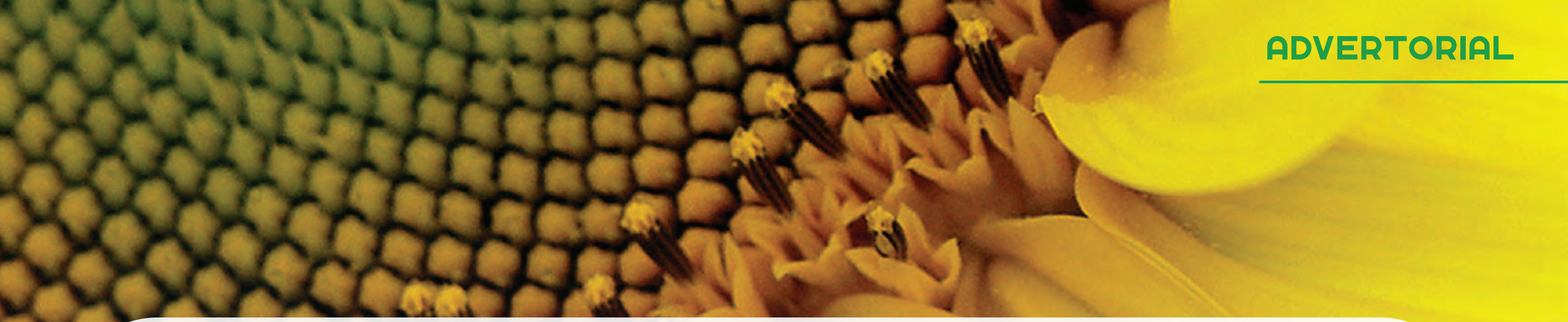
Bellis®

Bellis®, BASF's flagship sunflower fungicide, contains two key active ingredients: Boscalid and F500®. These ingredients, along with the AgCelence® effect, are a powerful combination offering excellent control of *Alternaria* leaf spot. With AgCelence®, producers can expect yield increases through additional benefits such as increased plant health and stress tolerance. Bellis® is also registered for use in soya beans for rust control.

Bellis® Active

BASF now offers an AgCelence® solution for producers in lower disease pressure areas. Bellis® Active is the latest fungicide in row crops for the control of rust and *Alternaria* leaf spot in both sunflower and soya beans. Bellis® Active's optimal formulation is more suited to lower disease pressure areas, while still offering the AgCelence® effect of yield increase and ultimately a higher return on your investment.

For more information, contact BASF South Africa on 011 203 2400 or visit *www.agro.basf.co.za*.



An improved root system for higher yield

PHILAGRO

PRODUKTE WAT WERK
VAN MENSE WAT OMGEE

By Bennie Buys, product manager: EndoMaxx® and herbicides, Philagro

Improved plant root systems that lead to higher yield are now within producers' reach. Philagro's EndoMaxx® enables improved performance of several row crops. EndoMaxx®, which comprises four optimised mycorrhizae fungal species, is administered during planting. These mycorrhizae live in symbiosis with plant roots, drastically boosting the efficacy of the root system.

EndoMaxx® is a 100% biological product from the Mycorrhizal Applications stable in the United States and has been marketed since the 1990s. The company was recently purchased by the Sumitomo Chemical group and EndoMaxx® is being used around the world with great success (in 2019 the global market was worth US$268 million).

It is a natural, organic product of which the use is encouraged by authorities. This adds to Europe's objective of a sustainable, organic approach, essentially leading to effective control and results, improved soil nutrition and environmentally friendly application.

How does it work?

The beneficial EndoMaxx® fungi create fungal threads, also known as hyphae, which penetrate soil gaps that the roots of the crop cannot normally reach. The hyphae network means that the functional root surface is able to expand. The development of mycorrhizae allows for a mutually beneficial relationship between the fungus and the plant.

Several benefits

- Mycorrhiza fungi enlarge the total rooting volume as much as 100 times. This is a significant expansion of the plant's root system, which boosts absorption of water and nutrients.
- Mycorrhiza fungi colonise the plant roots and advance the nutrient absorption in the plant.
- The fungi enable the plant roots to absorb and utilise small amounts of water which usually cannot be absorbed.
- The hyphae network can store water which is then accessible to the roots. This network can form if there is an excess of water structures (vesicles) that can store water and nutrients to be utilised at a later stage.
- Plants show increased performance if there are drought- and temperature-related stressors.
- Soil structure and nutrient status tend to improve.
- These benefits lead to substantial yield increases and boost producers' profits.

This improvement in yield is correlated with a decrease of certain stress factors that would otherwise negatively influence yield.

In addition to the benefits and the role of mycorrhizae in terms of plant health, it also improves the soil nutrient status. In 1996 it was discovered that the hyphae structures produce an excess of the glycoprotein, glomalin. Glomalin functions as 'soil glue' that binds micro soil particles to form stable macro soil aggregates, which contribute to improved root penetration, increased oxygen levels in the soil and decreased compaction.

Effective on various crops

Philagro is conducting research into various crops and legumes such as dried beans, green beans, peas, chickpeas, soya beans, groundnuts, lupins and clovers, as well as maize, sorghum, potatoes and sunflowers are showing positive results. These crops already feature on the product label.

After several statistical field and demonstration trials, it can be confirmed that especially sunflowers in South Africa have a positive reaction to EndoMaxx® applications. Yield increases of more than 20% have been recorded in some of the trials. Naturally, these increases are not the same for all areas and climate conditions, and therefore cannot be guaranteed.

EndoMaxx® is applied at a rate of 10g/ha. EndoMaxx® comes in handy 100g packets and will mainly be marketed by Laeveld Agrochem and Farmers Agri-Care for the remainder of 2021. Always refer to the EndoMaxx® label for the complete usage instructions.

EndoMaxx® (Reg No M200, Act 36 of 1947) contains arbuscular mycorrhizal fungi (Rhizophagus irregularis [5625 propagules/g], Claroideoglomus luteum [5625 propagules/g], Claroideoglomus claroideum [5625 propagules/g] and Claroideoglus etunicatum [5625 propagules/g]). EndoMaxx® is a registered trademark of Mycorrhizal Applications LLC, Grants Pass, OR, US.

For more information, contact Bennie Buys on 082 809 5447 or visit *www.philagro.co.za*.

Storage facilities: **Invest in the best**

Article supplied by Sensako

Seed is a valuable monthly input purchase. Should the quality of seed deteriorate due to inadequate storage conditions, producers risk facing severe yield and financial losses. Inadequate storage can also lead to poor germination and yield, which may then result in complete crop failure.

Seed quality is determined during production, processing and packing, as well as harvest and storage processes. Seed companies such as Sensako go to great lengths to provide producers with high-quality certified seed.

The deterioration of seed quality can mainly be attributed to factors relating to temperature, relative humidity, seed moisture content, micro-organisms and insects. Temperature fluctuation, storage location and circumference, as well as seed moisture content therefore need to be taken into consideration.

Storage conditions

Another major determining factor of the lifespan and quality of seed, is the storage environment. According to Sensako production manager, Wikus Bergh, seed must always be stored in a dry-storage facility and variation between minimum and maximum temperatures should be kept to a minimum.

"Avoid using open storage facilities or a room with poor insulation. The fluctuating humidity and temperature levels in open storage can cause variation in seed moisture content," says Wikus.

Establishing optimal storage conditions include the following actions:

- Store in a dry-storage facility.
- Manage temperatures to avoid excessive heat.
- Avoid temperature fluctuations. Keep temperature as consistent as possible.
- Manage insects and pests effectively.
- Keep the storage facility clean.
- Monitor the moisture content of the seed or grain.

Storage preparation

During the planning or construction of a seed storage facility, ventilation must be kept in mind. There should ideally not be any windows, with only one door that can be sealed and locked. The foundation should be set with stone or cement. Tiled flooring is preferred but in the case of cement flooring, any cracks that form must be sealed properly.

> Seed quality is determined during production, processing, and packing, as well as harvest and storage processes.

To prevent insects from lurking in the facility, construction of the flooring, walls and roof should be done in such a manner, that no cracks are formed. All gaps near power outlets, wiring, insulation and doors must be sealed.

Management and sanitation

Management of storage is vital and thorough record-keeping must be ensured. Different types of seed should also be stored separately to avoid cross-contamination.

Frequent inspection for insects, birds, or other pests such as rats and mice, is also crucial. Ensure that there are no leaks in the roof and keep record of temperatures for future reference.

Correct sanitisation is necessary to manage fungi, bacteria, mites, birds, insects and rodents. Any seed that is spilled must be swept and discarded, and the floors and walls must be treated with a residual pesticide on a regular basis. All chemical pest-management spraying should be done in consultation with a chemical agent.

Storage period

The higher the moisture content, the more the seed will be affected by high temperatures. Minimising temperature and seed moisture content is therefore an effective method of preserving seed quality in storage.

Relative humidity and temperature are the most important aspects in determining how long seed remains in storage. When exposed to consistent levels of humidity, the seed reaches a particular moisture content. The micro-climate within the storage facility has a significant effect on quality; a rise in temperature of only 6˚C or an increase of 1% in moisture content can cut shelf life and germination by 50%.

According to Dr Sierk Ybema, an independent seed specialist, there is a direct correlation between the initial seed moisture content and the temperature in the storage facility. The higher the temperature and moisture content, the greater the chance of lower seed quality.

At a temperature of 5˚C within the facility and 20% moisture content in the seed, for example, grain can be stored for one year with no effect on quality. However, the period decreases drastically to around 25 weeks if seed with a 25% moisture content is stored at 10˚C. Similarly, when stored at 20% moisture content at 25˚C, the seed will only last ten weeks.

"Purchasing quality seed with a high yield potential is necessary for the next planting season. It is therefore extremely important that producers ensure this seed is stored under optimum conditions," says Wikus.

For more information, contact the Sensako head office at 058 303 4690, email customercare@sensako.co.za, or visit *www.sensako.co.za*.

New technologies on the horizon for South African soya bean farmers

By Dr Antony Jarvie, consultant to Corteva Agriscience

Seed is an effective conduit for the transfer of new technologies in agriculture. While hybrid maize seed has been at the forefront of new genetically modified (GM) trait technology rollouts, soya beans have not had the same fortune. The fact is that GM innovation is incredibly costly to develop and deploy.

It must be noted that not all new technologies or genetic improvements are considered GM. Much progress is delivered through seed via conventional plant breeding. Still, even this approach is a long-term investment that requires the support of a healthy seed industry.

Ten years ago, the industry was heading towards stagnation, but the introduction of the end-point royalty scheme has given the local soya bean sector a much-needed 'jab'.

Recent technological advances

Could the movement of soya bean into the dry western part of our summer production area be considered a technological breakthrough? It certainly could, even though this was achieved through organic growth rather than just a single jump in technology.

While we are yet to find the equilibrium between crops rotating with maize in the west, soya beans are secure in a rotation above a 1t/ha threshold. This is likely due to their growth habit and maturity class, which enables them to tolerate the erratic rainfall characterising the region. This, combined with deep rootedness, has accelerated sustainable soya bean production in rotation on the water-table soils.

New trait technology prospects

A new Corteva GM trait which will be released in industry-leading genetic backgrounds, is on track for launch in South Africa. The lessons learnt from 30 years' cultivar development in the east, along with the newer knowledge of the western production areas, will be leveraged when deploying this technology.

Weed control is one of the most critical aspects to soya bean production.

The new Corteva technology will be available in two iterations – CE3 and E3. The premier five-gene stack, CE3, includes two Bt genes for Lepidopteran insect resistance and three for herbicide tolerance. The E3 version only has the same three genes for herbicide resistance and will be used where a refuge is required for CE3 production, or where insect protection is not required.

As with maize, the principle of protecting resistance efficacy using a refuge crop also applies to soya beans. Varieties with the same herbicide tolerance (E3) will be released to provide a refuge to the Bt cultivars (CE3), eliminating the need to manage different herbicide regimes between the Bt crop and the refuge.

In South Africa, Lepidopteran insect damage to soya bean production occurs sporadically over seasons. Consequently, conventional producers are often ill equipped to address infestations. The introduction of Bt soya beans will add another layer of production stability.

Herbicide resistance

The bouquet of herbicide resistances offered in the E3 and CE3 trait platforms substantially improves the flexibility of production systems. For over 20 years, glyphosate has offered a cheap and broad-spectrum solution. While it is still effective, there has been growing global resistance to its usage because of overutilisation. Experts have noted that the number of weed species showing signs of resistance build-up is still low, but alternatives to this herbicide will inevitably be required.

In addition to glyphosate tolerance, E3 and CE3 varieties have resistance to a new formulation of 2,4-D known as Enlist. The Enlist formulation eliminates the volatility issues that previously plagued the use of 2,4-D.

The third herbicide resistance in E3 and/or CE3 is to glufosinate. This herbicide, exhibiting a similar broad-spectrum action, offers a viable alternative to glyphosate. Enlist, used in combination with either glyphosate or glufosinate, will significantly improve weed control prospects.

Soya bean cultivation is on the verge of entering a new era. The enhanced flexibility of production options will ease the integration of soya bean as a crop in rotation with wheat or maize. Soya beans have always leveraged economies of scale and these new trait developments will only add to producers' ability to effectively manage additional hectares and remain globally competitive.

For more information, contact Dr Antony Jarvie at antony.jarvie@podsquad.co.za or 033 503 1319.

Boost your profitability with high oil content

With the merging of Syngenta and Sensako, South African producers can benefit from the latest genetics and high-oil sunflower cultivars with additional tolerance against diseases and herbicides.

The thorough and focussed use of technology is the foundation upon which Sensako's activities rests. According to Kobus Lindeque, commercial director: Syngenta Seeds, sub-Saharan Africa, the research, breeding and development of new cultivars is centred around bringing certified seed to the market that will benefit the producer and, eventually, the consumer.

Sensako boasts more than 60 years' involvement in the South African seed industry and is renowned for their leading research, breeding and seed production over the years. Although well known for its contribution to the wheat industry, Sensako also offers producers excellent soya and sunflower products.

SY 3970CL is one of the new generation sunflower hybrids. "The future of sunflower rests in oil. In the past, the focus was always on yield, with processors getting the short end of the stick. Now, the focus is on cultivars with a high oil content that can boost both the processor and producer's profitability," says Andries Wessels, product development manager at Syngenta.

More than the standard cultivar

Over the past two seasons, Unigrain and Sensako launched a project which completes the sunflower value chain and holds great benefit for producers. Accredited partners contract producers and assist with production and logistics. Producers can earn a notable premium by delivering seed with a high oil content.

> In the past, the focus was always on yield, with processors getting the short end of the stick. Now, the focus is on cultivars with a high oil content that can boost both the processor and producer's profitability.

"The current standard for oil content of sunflower seed is between 36 and 38%, but with Sensako's new SY 3970CL cultivar, producers can realise between 42 and 50% oil content. Plantings of the 2020 season delivered oil percentages of between 45,7 to 50,5%. According to Unigrain, yield was also higher than expected in many cases," says Andries.

Not only does SY 3970CL have good yield potential, but it also offers good drought tolerance. The seedling has exceptional growth vigour, and it takes around 125 to 130 days to reach relative maturity, and 69 to 72 days to flowering.

This medium grower does not grow very tall and possesses the 'stay green' trait, which prevents plants from falling over before or during harvest. The plant forms a good arched neck at the end of the season and has excellent seed lodging. The seed is black in colour, which helps ensure identity preservation in the value chain.

SY 3970CL is well adjusted to minimum tillage systems, but is also suited to conventional tillage. It can be planted at average to higher plant populations. SY 3970CL is equipped with Clearfield® technology for easier management of broadleaf and grass weeds, and the seed is treated with only the best seed treatment products.

For more information about the project or to place an order, contact your nearest Sensako agent. Alternatively, send an email to Pieter Craven at pieter.craven@syngenta.com or Andries Wessels at andries.wessels@syngenta.com.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DONMARIO: Technology in genetics for those who want high performance in farming.

We all know the importance of soybean in the global scenario, a commodity that has several functions in our society, a real power. However, what you may not be aware of is that of the planted grains in the world have GDM genetics, a global group and owner of DONMARIO Seeds.

With 40 years in the market, DONMARIO is a company with expertise in soybean genetic improvement. Today, established in the main soy-producing countries such as Brazil, Argentina, Uruguay, Paraguay, the United States and South Africa, the brand is projected for the future and aimed at farmers who perform differentiated work in their crops, aligning technology and information to their productivity.

Working daily with the most advanced technology, DONMARIO builds its entire structure based on three pillars: genetics, management and quality.

A DNA built by three pillars

All complexity starts with a simple and powerful premise. DONMARIO chose three to create its way and conquer, through commitment and results, the crops of so many farmers around the world.

Genetics: DONMARIO's upper genetics are obtained through one of the largest and most important research and development programs in the world called Rendimento Sem Fronteiras, or in English, Yielding Without Borders, which provides seeds with the maximum productive potential to the farmer;

Management: Through our development program, we seek the best understanding of the culture and material to take to the field the ideal management recommendation, with the maximum precision, so that the farmer can make a safe decision for his crop. This work allows the farmer to explore the maximum productive potential.

Quality: A key feature for DONMARIO, seed quality is the consequence of a work carried out by selected and certified multipliers that results in varieties with greater force and purity, generating more productivity and safety for the field.

Watch our number:

+ 25 % of sales
invested in
R&D practices;

+ 25 localities
for product
development in
South Africa;

+ 300 localities
intended for product
development;

+ 300 people
dedicated to the
R&D program;

16 R&D STATIONS
in Argentina,
Brazil and USA;

1.5 million installment
of our germplasm in
15 countries;

Study, improvement and investment, the secret to solid results.

Innovation and dynamism are features that define the way in which the brand operates, which has one of the most extensive research and development programs in the world. Through this global program and investment in cutting edge technologies, DONMARIO has a vast knowledge of each variety and offers solutions and specific management information for the demands of each territory where it operates.

> *"DONMARIO is giving us the best varieties. But also, through the trials, DONMARIO is giving a lot of information and data about the varieties and also about soybeans management. If you plant DONMARIO you receive more than a good variety, you receive the information about the variety like days to flowering, to physiological maturation, the best population, the best planting window... And I see DONMARIO in trials , which DONMARIO itself promotes every week, so we see that the DONMARIO is very concerned about the quality of the trials and the information you give farmers."*
>
> **DANIE BESTER, BALFOUR - MPUMALANGA**
> Producer for 20 years, planting 8 with DONMARIO, in Balfour

The future is here and it is happening now.

In South Africa since 2014, DONMARIO has 120.000 hectares of soy planted, with its genetics, in South African territory. It has materials adapted for the regions and continues to work so that its varieties can reach more and more places.

DONMARIO varieties are distributed in RSA by AGRICOL (Pty) Ltd.

Sunflower makes giant strides internationally

By Ikageng Maluleke, agricultural economist, Grain SA

Global sunflower seed production and consumption are mostly aligned, while consumption is driven mainly by production. In the 2020/21 season, both production and consumption declined significantly. Production declined mainly due to poor conditions in Russia and Ukraine, which are the leading production areas in the world. Consumption also declined as stocks in these countries were significantly lower. This contributed to shortages of vegetable oils and provided good support to international prices.

Global supply and demand

Table 1 depicts an expected increase of approximately 14,9% in production for the 2021/22 season. According to data from *Oil World,* a record forecast is anticipated for Russia, Ukraine and Romania. However, these countries have been experiencing hot and dry weather conditions. Although the situation is not critical, additional rainfall is required to sustain a favourable production outlook.

In general, sunflower imports are expected to increase by 18,6% year-on-year; however, there is an anticipated decline in sunflower oil and meal imports by China for the same period. Global exports are also expected to increase by around 28,1% compared to the previous season, while consumption is expected to increase by around 12,9%, mainly due to domestic consumption.

Sunflower seed crushing in Argentina has increased sharply on a year-on-year basis. Ending stocks for sunflower seed is expected to decrease by approximately 13,6% in 2021/22. In June, the European Union (EU) already experienced tight old crop supplies and earlier than usual shutdowns for seasonal maintenance, which significantly reduced oilseed crushing in the region.

Figure 1 indicates the increase in international sunflower prices which, as already alluded to, is due to unfavourable weather conditions and low stocks. Between July 2020 and July 2021, sunflower

Figure 1: International sunflower prices. (Source: International Grains Council)

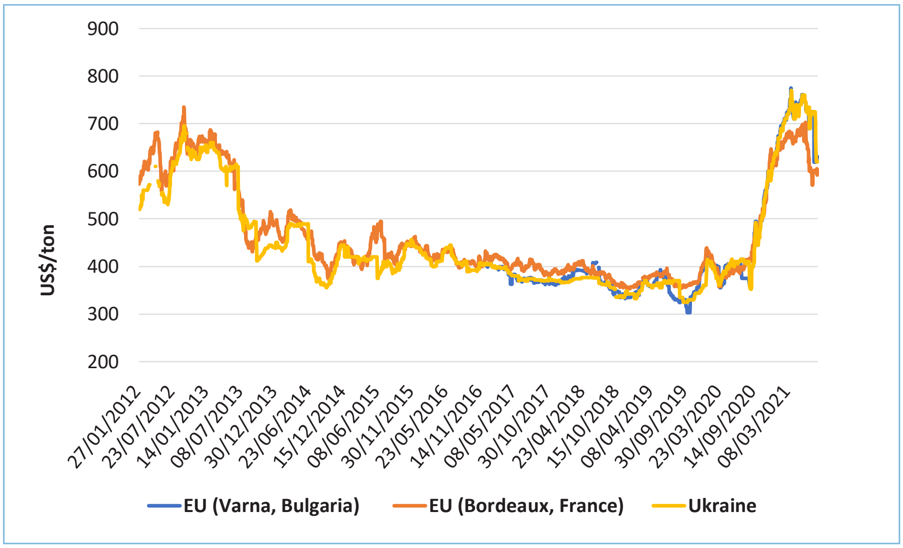
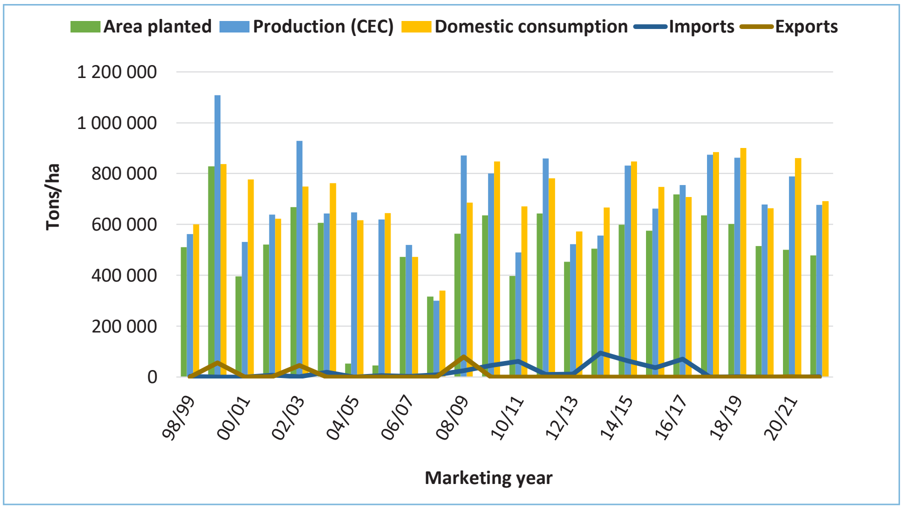


Table 1: Global supply and demand of sunflower seed. (Source: United States Department of Agriculture)

	2017/18	2018/19	2019/20	2020/21	2021/22*	Year-on-year changes
Beginning stocks (1 000 mt)	3,426	2,697	2,420	2,495	1,866	-25,2%
Production (1 000 mt)	48,010	50,659	54,754	49,546	56,937	+14,9%
Imports (1 000 mt)	2,467	2,943	3,436	2,883	3,418	+18,6%
Exports (1 000 mt)	2,747	3,231	3,638	3,033	3,885	+28,1%
Consumption (1 000 mt)	48,459	50,648	54,477	50,025	56,468	+12,9%
Ending stocks (1 000 mt)	2,697	2,420	2,495	1,866	2,119	+13,6%

2021/22 August 2021 (Source: USDA)*

Figure 2: Local sunflower production, consumption ending stocks and trade flows. (Source: South African Grain Information Service, the National Agricultural Marketing Council)



seed prices for Bulgaria increased by 75%, France by 49% and Ukraine by 69%. Weather conditions for the 2021/22 season are still uncertain, thus prices continue to increase, making sunflower an attractive crop in terms of profitability.

Local trends

Sunflower in South Africa has gained the reputation of an ideal crop to grow under low-input and marginal cropping conditions, with consistent yields under adverse conditions. However, it is not uncommon for producers in certain production regions to leave sunflower as a last resort, waiting until the very last day to plant, especially during dry seasons.

Sunflower production in South Africa has remained relatively flat over the past two decades, with a visible decline in the area planted over the past five years. During the period depicted in *Figure 2*, South Africa produced a decent sunflower crop, including seven seasons in which production exceeded 800 000 tons.

Fundamentally, when prices increase towards import parity levels, expansion occurs, but this typically causes a correction in the market and prices to decline to export parity levels. Consequently, profitability deteriorates, and producers start cutting back on the sunflower planting area.

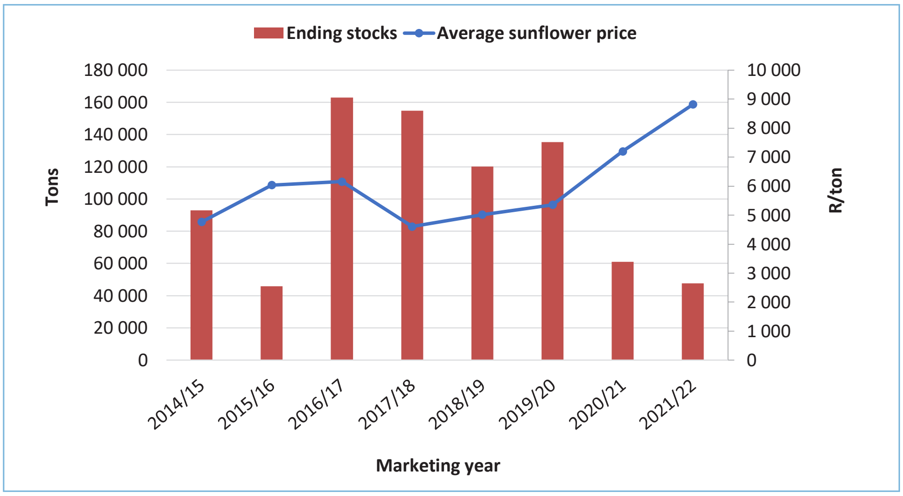
According to the Crop Estimates Committee's (CEC) sixth production forecast for 2021, the sunflower crop is estimated to drop by 14% to 677 240 tons, compared to the final estimate of 788 500 tons for 2020. The area estimate for sunflower seed is 477 800ha – around 4,5% lower than the previous season – while the expected yield is 1,46t/ha.

Sunflower processing in South Africa has been variable over the years, but mostly trending upwards, generally determined by production. Demand for sunflower exports is minimal. Over the past five years, sunflower imports have decreased significantly, which can be attributed to the local increased crushing capacity and the use of locally produced sunflower. During years of lower sunflower production, the activities at crushing plants are reduced and the refineries import more crude oil as it is more cost-effective than importing sunflower seed.

As can be seen in *Figure 3*, the past few seasons have been marked by fluctuating ending stocks. For the 2020/21 season, ending stocks were 54% lower, fundamentally pushing prices up. It is expected that ending stocks for 2021/22 will be 21% lower.

The average price between 2019/20 and 2020/21 increased by 25,5%, from R5 359 to R7 201/ton. Between July 2020 and July 2021, sunflower prices increased by 31,5% and moved from R6 029 to R8 804/ton. On a month-on-month basis, prices increased by 5% between June and July 2021.

Figure 3: Ending stocks and average sunflower prices. (Source: Grain SA, South African Futures Exchange)



In conclusion

Although record production is expected internationally, especially for Ukraine, Russia and Romania, weather developments will determine the ultimate outcome. Another aspect to consider is the expected decrease in ending stocks, which could lead to further increases in prices for the 2021/22 season.

South Africa is expected to follow a similar trend to the rest of the world, with lower ending stocks and less than expected production. This will have an impact on prices for 2021/22, making sunflower an attractive crop for most producers in the coming planting period, given the current price and minimal input requirements for sunflower.

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

A look at soya-derived products for human consumption in South Africa

By Dr Hester Vermeulen, Bureau for Food and Agricultural Policy, and Dr Melissa van der Merwe, Stellenbosch University

A comprehensive understanding of the market for soya-derived products in South Africa is critical to support strategic decision-making. In 2020, an investigation was undertaken by the Bureau for Food and Agricultural Policy (BFAP) based on secondary data, observations and discussions with industry experts, specifically soya bean crushers, producers of soya bean products and importers of soya proteins.

The aim was to better understand the lay of the land in the derived soya industry. The Oilseeds Advisory Committee (OAC) funded this study.

Complexity of the value chain

The South African soya bean value chain involves a complex combination of key players and processes to move soya bean from seed to feed, or from seed to food for human consumption (*Figure 1*). What makes the soya bean value chain even more complex, is that it also links to many other value chains such as livestock, food, textile and industrial value chains.

Soya bean processing

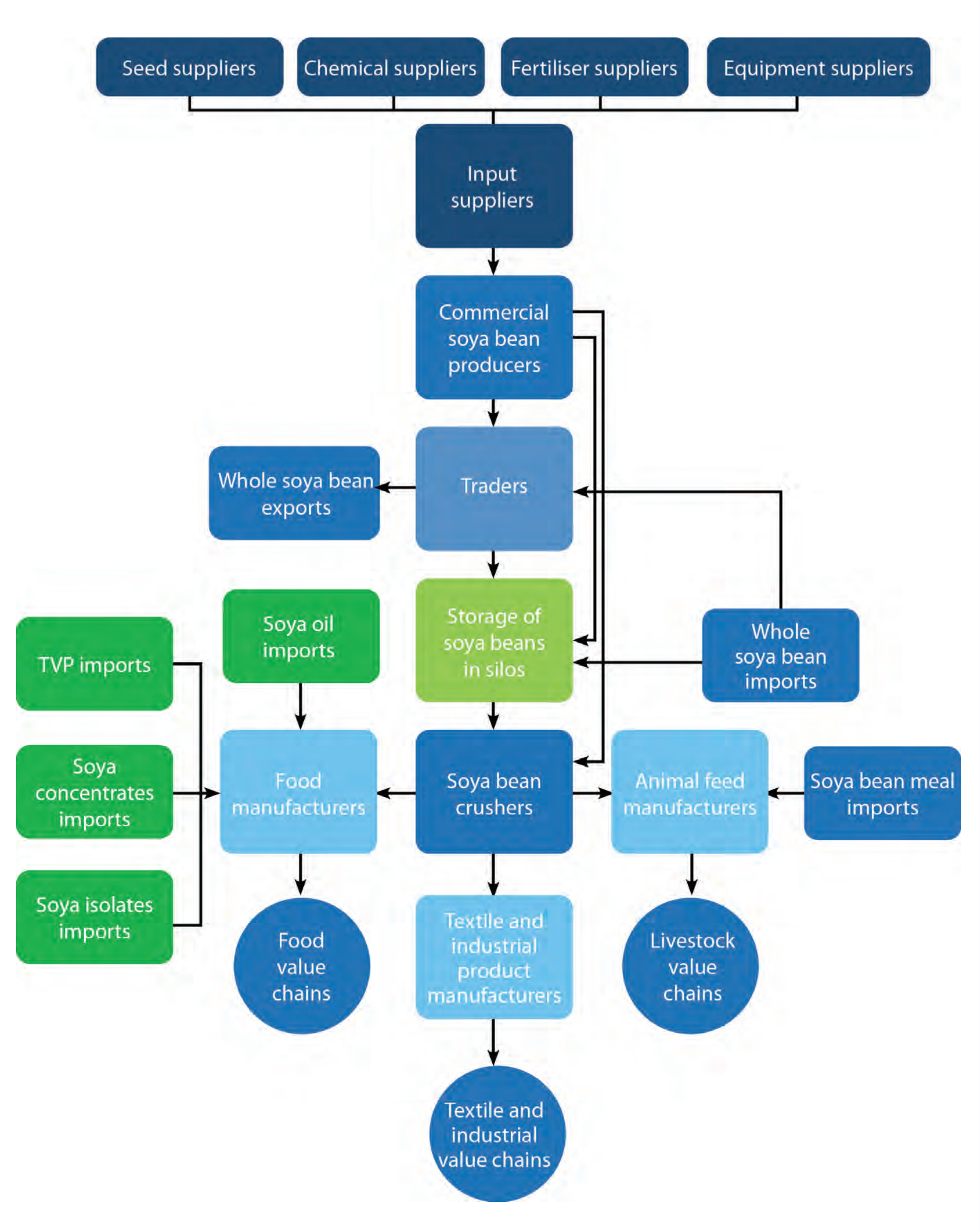
Over the past decade there has been a rapid growth in South Africa's soya bean crushing capacity, due to the investments made in pursuing the governmental import replacement strategy (*Figure 2*). In 2020, South Africa crushed a total of 1 230 399 tons of soya bean compared to 406 900 tons ten years ago – representing a 202% increase over ten years. According to industry discussions, two crushing plants account for approximately 90% of the soya bean destined for the human market.

Soya bean trade

Despite the increasing soya bean production levels over time, South Africa still imports soya bean to satisfy oilcake demand from the animal feed sector – driven by increases in the demand for high protein food, specifically meat, within the growing middle class and more affluent market segments.

In 2020, soya bean imports amounted to 62 063 tons, mainly originating from Brazil (88,9%), followed by Zambia (6,7%), Mozambique (2,6%) and Malawi (2,1%). South Africa generally exports small amounts of soya bean – in 2020, exports went mainly to neighbouring African countries such as Botswana (63,1%), Mozambique (34,8%), Lesotho (1,1%),

Figure 1: The South African soya bean value chain. (Source: The National Agricultural Marketing Council [NAMC], 2011, the Department of Agriculture, Forestry and Fisheries [DAFF], 2014, and BFAP interviews with industry role-players)



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BASF SOYBEAN INOCULANTS

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Farmers planting soybeans should purchase an appropriate inoculant at the beginning of the season to treat the seed prior to planting.

An inoculant is not a chemical seed treatment. Farmers should remember they are purchasing a living organism, namely *Bradyrhizobium japonicum*. Being a living organism, it needs to be treated as such. Farmers should handle the product accordingly, from the time the inoculant is purchased, to its application onto the seed and ultimately, its planting in the field.

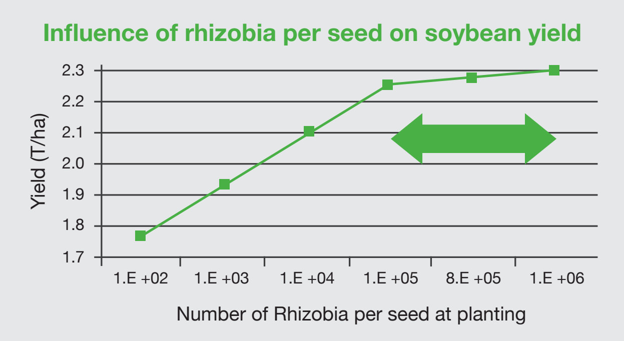
What is the shelf life of a soybean inoculant?

There are two important aspects to note with almost all biological products. Firstly, the rhizobia will slowly die over time - this is expected and factored into the expiry date stated on the product. The second point is that the shelf life expectancy is based on the product being stored under certain conditions. As a rule, the higher the temperature, the faster the rhizobia will perish. Important to note is that *Bradyrhizobium japonicum* will, when frozen, immediately die. The product and inoculated seed should always be stored in a cool place prior to application or plant.

What is the importance of the number of rhizobia in the final product?

BASF has conducted extensive studies to prove that when soybean inoculants are applied and the seed is planted, a direct correlation between the number of rhizobia per seed and the final yield of the soybeans becomes evident.

BASF trials show that if an application delivers less than 100,000 rhizobia per seed, the maximum yield potential is under achieved.



It is important to note that a double dose of inoculant should be applied when a field is being planted with soybeans for the first time as no endemic population occurs in the soil.

Insist on fresh.

When purchasing a soybean inoculant, it may be difficult to ascertain whether the product has been freshly produced. Farmers must check the date of manufacture and/or expiry to ensure that the purchased product will perform as expected. No expired product should be applied for the use intended.

All BASF inoculant packs include highly specialised TTI labels (inserted into the packaging carton). This “TTI label” has a Viability Indicator sticker which is time and temperature sensitive. A graphic illustration indicates how the inoculant has been stored prior to being delivered on farm and allows the farmer to immediately confirm if the product has been exposed to excessive temperatures and is unsuitable for use or not.

Producers can rest assured that BASF only markets freshly manufactured products each season.

What is the importance of soybean inoculant packaging?

Bradyrhizobium japonicum, being a living organism, requires oxygen to survive. Without oxygen the viability of the bacterial spores will diminish with death ultimately occurring.

Packaging plays an important role to ensure that farmers receive product that has the highest possible quantity of viable rhizobia prior to application and planting.

All BASF’s inoculant products are packaged in a patented dual layer packaging system that is designed to hold the contents but allows for oxygen to permeate freely. The physical configuration of the packaging furthermore ensures that the largest surface area possible is exposed to enable oxygen transfer to the rhizobia.

BASF caters for various farmer preferences including the offer of peat or liquid based products, same day treatment and plant solutions as well as on-seed survival inoculants.
HiStick® – Peat based inoculant for treatment and plant within 24 hours.
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HiStick® Reg No. L8898 Act No. 36 of 1947. Active ingredient: *Bradyrhizobium japonicum* minimum 4 x 10^9 viable cells/g. Caution. **RhizoFlo™** Reg. No. L8899 Act No. 36 of 1947. Active ingredient: *Bradyrhizobium japonicum* minimum 5 x 10^9 viable cells/mℓ. Caution. **RhizoFlo™ Professional** Reg. No. L9352 Act No. 36 of 1947. Active ingredient: *Bradyrhizobium japonicum* minimum 1 x 10^{10} viable cells/mℓ. Caution.

Table 1: Soya-derived products for human consumption.

Soya product	Full-fat soya bean meal	White flakes	TVPs	Soya protein concentrates	Soya protein isolates
Composition	40 to 42% protein, 20% oil	50 to 54% protein, 1% oil	50 to 54% protein, 1% oil	65 to 70% protein, 1% oil	90 to 92% protein, 1% oil
Example of end-use products	Breakfast products, blended cereals.	Meat analogues, (absorption agents, extenders).	Processed meat, meat analogues (soya mince), meat extenders, soya milk, smoothies, milkshakes, yoghurt, infant formulas, baked goods, flour, baked goods pre-mixes, porridges, soups, sauces and nutritional shakes.	Processed meat (polony, Viennas, burger patties), health supplements (protein shakes, health bars), meat and dairy analogues, malnutrition packs and breakfast cereals.	

Source: Muller et al., (2018); BFAP interviews with industry role-players.

the Kingdom of Eswatini (0,8%) and Zimbabwe (0,2%).

Aside from whole soya bean, South Africa at times also imports soya oilcake for the animal feed market. Textured vegetable proteins (TVPs), soya protein concentrates and soya protein isolates mainly destined for the food market are also imported.

Human consumption vs animal feed

In South Africa, approximately 98% of soya bean products produced in local crushing facilities, feed into animal feed value chains as meal (10,3%) and soya bean oil or oilcake (88,1%). Only around 2% of soya bean crushed in South Africa is destined for the human market, either as white flakes or as TVPs to be used in food value chains.

According to industry discussions, one ton of soya bean yields 180kg oil, 630kg white flakes, or just over 500kg TVPs. In January 2021, industry experts reported the prices of white flakes as between R8,50 and R10/kg, TVPs at R35/kg, soya concentrates at R48/kg and the price of isolates at R50/kg.

> The South African soya bean value chain involves a complex combination of key players and processes to move soya bean from seed to feed, or from seed to food for human consumption.

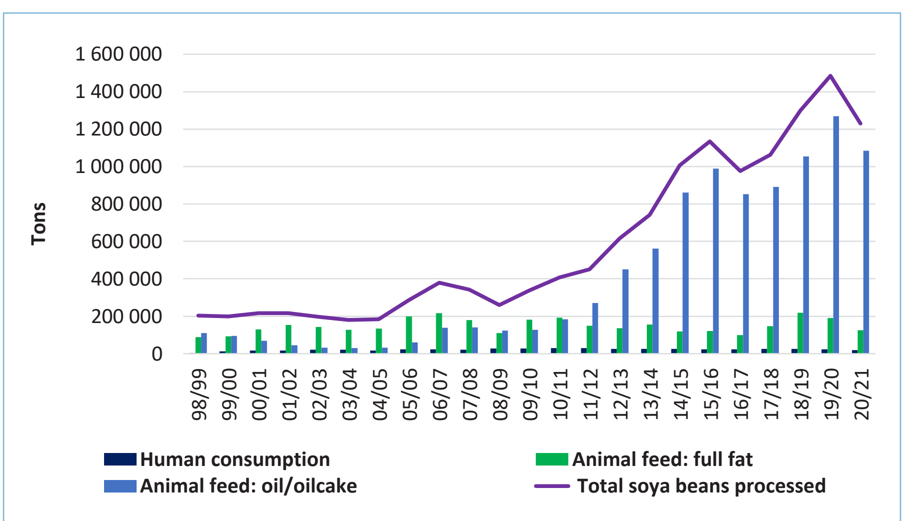
Soya derivates such as full-fat soya bean meal, isolates and concentrates used in the South African food manufacturing sector are imported either because the market demands non-GMO products, or because the specific soya-derived product is not produced in South Africa. Soya bean and its related products are used in a multitude of forms in different food products (*Table 1*), which is mainly based on functional properties and the enhancement of protein content.

The main soya-derived products produced for the human food market are full-fat soya bean meal, white flakes (also referred to as defatted soya bean meal), TVPs, soya concentrates and soya isolates. In South Africa, the main soya product consumed remains flavoured soya mince made from TVPs.

Soya milk and 'fresh products', such as plant-based mince, nuggets and patties (made from wet TVPs) displayed in fridges in either the meat section or the vegetable section of stores, are mainly imported from Europe. These products often contain pea, and not soya protein, as one of the main ingredients due to sensory considerations.

The main reason why food companies use imported full-fat soya bean meal is that the market demands non-GMO soya bean, yet South Africa produces mainly GMO soya bean. The main reason why soya concentrates and soya isolates are imported, is that South African soya bean crushers do not have the equipment to further process white flakes into concentrates and isolates.

Figure 2: Soya bean processing in South Africa from 1998 to 2020. (Source: The South African Grain Information Service [SAGIS], 2021a)



Stimulating product demand

Both internationally and locally, several characteristics of soya-based products are stimulating product demand – pertaining mainly to health, affordability, convenience, sustainability and culture.

Health

- Fewer 'negatives' such as a low saturated fat content and no cholesterol.

- More 'positives' such as a high polyunsaturated fat, Omega-3 and -6 fatty acid content, good source of fibre, lower glycaemic index, anti-cancer properties and good protein substitute for traditional protein sources such as meat; it is also a good extender in processed meat products.
- Soya-based food offers consumers a healthy alternative or supplementary food to animal-protein food.

Affordability

Soya-based products are also a more affordable alternative compared to other protein-rich food (*Table 2*).

Table 2: Comparing the affordability of soya-derived products and selected animal-source food.

Food product	Cost per single serving[1]	Protein content per single serving	Estimated cost per gram of protein
Soya bean	±R1,40	11g	R0,13
Soya mince	±R1,90	7,1g [(2)]	R0,27
Egg	±R4	12,6g	R0,32
Canned fish (pilchards in sauce)	±R5	17g	R0,29
Chicken (individual quick-freezing pieces)	±R8	26g	R0,31
Lean beef (mince)	±R13	28g	R0,46

[1]Based on online prices at two large food retailers in South Africa in April 2021.
[2]Varies between soya mince brands. Source: Muller et al., (2018); BFAP calculations.

Convenience

Soya-based products can also be viewed as a more convenient alternative for the less fortunate and those living in rural areas, who have limited access to infrastructure and cold storage facilities for food and fresh meat at home. Therefore, in addition to being a cheaper, more nutritious and protein-dense option, the shelf life of soya-based proteins also makes it more convenient and less expensive to store.

From the perspective of consumers who are more financially stable, soya-based products such as snack products, bars and nutritional shakes are a convenient and healthy product offering to supplement their diets.

Sustainability and culture

Particularly in developed countries, consumers are looking to balance plant and animal products as a protein source in their diets, rooted in health and environmental concerns associated with the consumption and production of animal protein food.

Soya products generally have a longer shelf life, are cheaper to handle and store, and are more environmentally friendly than their protein equivalents.

Protein-rich plant food (such as soya bean-derived food) are also important protein sources within cultures with restrictions regarding the consumption of certain animal protein food.

Take-home message

- The processed meat market (such as polonies and vienna sausages) does not seem viable for expanding the market for soya products for human consumption, as South Africans consume relatively small amounts of processed meat (12g per person per day, according to the Food Advisory Consumer Service, 2021). The soya products included in these products are also mainly imported soya concentrates and isolates.
- The production of high-value products (such as plant-based mince, patties and nuggets) is likely not a feasible option, based on import dominance and sensory considerations leaning towards pea protein and not soya protein. For the South African crusher to enter this market, it will have to make the necessary investments to produce soya concentrates and isolates. It will have to compete with pea protein which does not have the typical 'beany' taste, or the non-GMO label of imported soya bean products.
- The butcher meat market where TVPs are added as extenders or absorbents to mince, wors and hamburger patties could be a feasible option to grow the market for TVPs.
- The low-value soya or soya-based products (specifically those containing TVPs such as soya mince) show the most growth potential. Some of the crushers highlighted the importance of including soya-based products in school feeding programmes and social grants as an excellent, yet cheaper protein source to support food security.
- There seems to be a significant opportunity for growth (particularly TVPs) in the African market. However, potential preferences for non-GMO soya in African countries could have a significant impact in this regard.

Future actions for market expansion

- Consumer education regarding the health and environmental benefits of soya-based food, as an alternative or supplementary protein source.
- Improvement of the 'beany' taste of soya products through, for example, improved cultivars or processing innovation. Sensory consumer research could yield a more detailed understanding of consumers' taste preferences and product perceptions (also among children in lower-income households in terms of school feeding programmes).
- Quality improvement and consumer education to address consumers' perceptions regarding the possible low quality and 'poor person's meat' stigma of soya-based meat alternatives.
- Since some food manufacturers demand non-GMO soya derivates, the local capacity to produce non-GMO soya bean could be expanded (currently less than 1% non-GMO soya bean is produced in South Africa).

The research for this study was funded by the OAC. For more information, contact Hester Vermeulen at email hester.v@bfap.co.za.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Projected protein requirements for animal feed consumption in South Africa

By Dr Dirk Strydom and Dr Erhard Briedenhann

Over the past few years, the grain and oilseeds industries have realised the importance of the animal feed industry and the impact it has on demand structures. In South Africa, this has become even more evident as local production of soya beans increased substantially over the last ten years. This led to growth in local processing, creating additional local supply of oilcake for the animal feed industry.

The recurring question within an agricultural value chain is whether local demand will be enough to consume the produce should there be an increase in supply. In a complex supply environment such as with proteins, this is always a difficult question to answer.

The Protein Research Foundation (PRF) annually funds a research project to do projections and provide an indication of consumption trends. In order to do these projections, two models are utilised, the first being the well-known projections by the Bureau for Food and Agricultural Policy (BFAP) in terms of production and trade of commodities, population forecasts, per capita consumption of protein products and commodity prices.

The BFAP data is then used as input data within the agricultural product requirements (APR) model. The APR model is a least-cost optimisation feed simulation developed by Dr Erhard Briedenhann, which calculates the animal feed consumption of different animal species.

Base scenario for 2020

Based on the BFAP data, the APR model was used to calculate a base scenario for the 2020 season. Based on the 2020 per capita consumption of animal products, it is estimated that the requirement for animal feed in South Africa is 11,9 million tons (*Table 1*). Broilers and beef cattle are the biggest consumers of animal feed.

The model calculates various raw materials within the animal feed industry. However, based on oilcake, consumption of soya oilcake tops the list at 1,2 million tons, followed by sunflower oilcake at 351 480 tons (*Table 2*). Total consumption of oilcake within the base scenario is 1,9 million tons.

Given the increase in the production of grain and oilseeds, it is vital for the local industry to substitute imported products with locally processed products. On the local market, South Africa progressed well in terms of substituting imported soya oilcake with local oilcake. In 2020, local soya oilcake made up 70% of total oilcake requirements (this was only 16% in 2009). In terms of total oilcake, the local share increased from 34% in 2009 to 79% in 2020.

Projections of protein requirements

In order to project the consumption figures of the different species, it is important to determine demand.

Demand was calculated using the following macro variables obtained from the BFAP, in combination with animal feed conversion ratio (FCR) growth figures and animal feed matrixes:

- Population growth.
- Per capita consumption growth.
- Imported animal products.
- Exported animal products.

Based on these projections, total animal feed will have increased with 8,35% by 2023 and with 21,47% from 2020 to 2029. Oilcake consumption will have increased with 16,3% from 2020 to 2029, while an increase of 17,6% is projected for soya oilcake consumption.

As previously stated, soya oilcake remains the dominant protein source in South Africa. This dominance has increased over time and will continue to do so.

Table 1: National animal feed production in 2020.

Feed types	National feed consumption (ton)
Aquaculture	5 000
Beef cattle	2 894 960
Broiler	3 320 366
Dairy cattle	2 568 226
Horses	124 205
Layers	1 326 955
Ostriches	83 823
Pets	359 304
Sheep	254 145
Pigs	1 036 398
Various	10
Total	11 973 392

Table 2: Usage of different oilcake in 2020.

Oilcake type	National consumption (ton)
Cotton full fat	20 483
Soya full fat	240 000
Canola oilcake	55 000
Soya oilcake	1 213 700
Sunflower oilcake	351 480
Palm kernel meal	5 000
Total	1 885 663

Table 3: Oilcake usage projection in 2023 and 2029.

Raw material	National consumption per year		
	2020	2023	2029
Canola oilcake	55 000	76 190	93 483
Cotton full fat	20 483	20 483	26 000
Palm kernel meal	5 000	5 701	6 000
Soya full fat	240 000	240 000	290 000
Soya oilcake	1 213 700	1 218 087	1 427 406
Sunflower oilcake	351 480	374 748	410 925
Total	**1 885 663**	**1 935 209**	**2 253 814**

Table 4: Projected national animal feed production in 2023 and 2029.

Feed type	National feed consumption per year (ton)		
	2020	2023	2029
Beef cattle and sheep	3 149 104	3 507 445	3 975 199
Broiler	3 320 366	3 575 615	4 093 900
Dairy	2 568 226	2 661 446	2 855 846
Layers	1 326 955	1 427 903	1 490 083
Pigs	1 036 398	1 177 981	1 452 286
Other	572 342	623 116	676 969
Total	**11 973 392**	**12 973 505**	**14 544 284**

Future consumption figures are highly influenced by the FCRs. With the constant increase in FCRs, the projected consumption stabilises over time. However, exports of beef, mutton and the prospect of poultry exports increase the consumption of feed and have a major impact on projected end consumption figures for 2029 (*Table 3* and *4*).

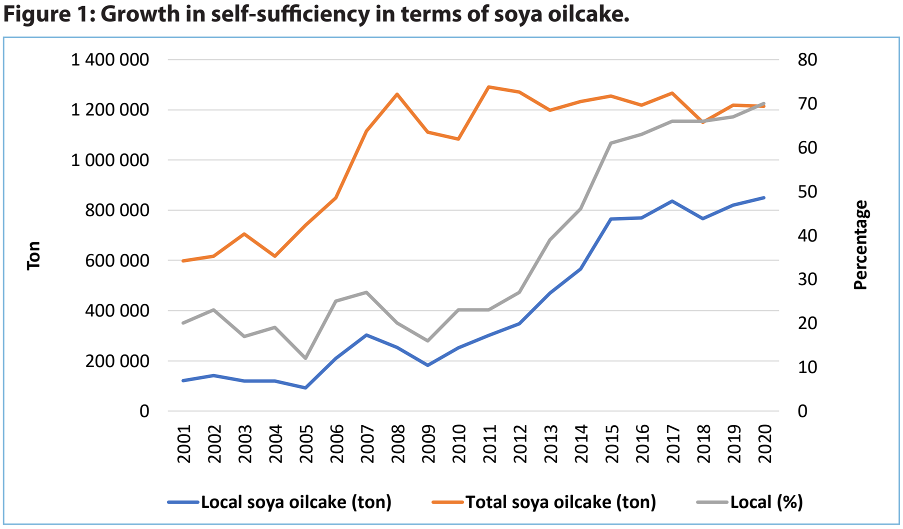
In terms of substituting imported oilcake, the increase in local oilcake production from locally produced soya beans, will make South Africa increasingly self-sufficient in terms of protein requirements (*Figure 1*).

Soya oilcake produced in South Africa in 2020 provided 79% of the country's soya oilcake requirements. It is projected that this can increase to 97% in 2023 and to 100% in 2029. According to the projections, feed requirements will increase to 12 973 505 tons in 2023 and to 14 544 284 tons in 2029. Soya oilcake requirements will be 1 218 087 tons by 2023 and 1 427 406 by 2029.

What needs to be kept in mind is that logistics still create challenges in terms of competing against imports. Thus, the projection indicates the supply and demand that can be expected. However, market dynamics need to be sufficient in order to supply oilcake at competitive prices, specifically in the coastal regions. In order to meet the projected local demand, 1 784 257 tons of soya beans need to be produced in 2029.

Broiler and layer diets play an enormous role in the grain and oilseeds industries. Growth and sustainability in the poultry industry will also play

Figure 1: Growth in self-sufficiency in terms of soya oilcake.



a major role in oilcake requirements in the future. The second biggest role-players are the beef cattle and sheep industries. It is vital for all these industries to improve and efficiently manage biosecurity in South Africa.

> Based on the 2020 per capita consumption of animal products, it is estimated that the requirement for animal feed in South Africa is 11,9 million tons.

This will increase export growth and sustain the consumption of animal feed in the local market. Other than normal population growth figures, the largest contributor to animal feed consumption increases are the exportation of products such as mutton, beef and poultry. This needs to be sustained in order to keep up with local soya bean production and provide opportunities for local processing.

If these exports are not sustained, the surplus soya beans produced will need to be exported. In any economy, the goal would be to rather process and consume these commodities within the local market, which will benefit local producers as well as consumers.

South Africa can be self-sufficient

The prospects of feed for animal protein look promising. However, these prospects are highly dependent on certain factors. With increasing efficiencies in FCRs, it is important to find additional demand (predominantly found in the exportation of animal products).

Other crucial factors are the prices of and competition for raw material. In order to utilise these local consumption levels, raw material prices tend to be closer to export parity levels. This means that a lot of work will need to be done to increase the feasibility of producing raw material at these levels.

The raw protein material basket is complex and any slight change in one raw material affects the utilisation of oilcake, specifically soya oilcake. If there is an increase in production or imports of a protein source, it will have a direct impact on the consumption of soya oilcake.

Lastly, logistics and biosecurity will play a crucial role in the future. If the export market for animal products cannot be expanded, there will be pressure on utilisation in South Africa, which has a direct impact on production. If all the aforementioned fall into place, South Africa can be entirely self-sufficient while leaving room for an increase in soya bean production.

For more information, send an email to Dr Dirk Strydom at dirks@grainsa.co.za.

Understanding contributing factors in a year of rising feed costs

By Volac Wilmar Feed Ingredients

Call it a perfect storm or a series of unfortunate events, dairy producers around the world have seen an uptick in bought-in feed costs as the global market pulls through a pandemic, extraordinary weather events, logistics disruptions and growing competing markets for raw feed ingredients.

Looking at historic data, this has been a time of unchartered waters for the global feed ingredient market, says Arlan Suderman, agricultural and soft commodities market analyst for StoneX trading group. "The purpose of the market is to bring supply and demand into balance. Low prices discourage production while stimulating demand, and vice versa.

"Global feed demand has been increasing for a number of years, but low prices discouraged sufficient expansion of production," explains Suderman. "Several factors acted to speed up the draining of supplies while money supplies rose US$4,6 trillion during the pandemic.

"A portion of that money made its way into the markets, making it easier for buyers to bid up prices in a short market. The role of high prices is to encourage expanded production to bring it back into balance with this expanding demand base."

Weather impacts soya bean supplies

While dairy ration composition will vary in each region based on local crop production, soya beans and their by-products are common denominators in global dairy diets. By-products such as soya hulls are effective at stretching forage and supporting rumen function as a high-quality source of digestible fibre.

Requiring a combination of heat, sunlight units, humidity and moisture, soya bean production is limited to a handful of countries, with Argentina, Brazil and the United States (US) accounting for more than 80% of the global soya bean crop from 2020 to 2021. Following China, the European Union (EU) is the second highest importer of soya beans.

Historically, the US has been the world leader in soya bean production, producing 120,52 million metric tons from 2018 to 2019. Recently, Brazil has overtaken the US, with forecasts projecting the South American country to have a record 137 million metric tons at the close of this year's harvest.

However, Brazilian producers were challenged by environmental conditions related to La Niña. This comes at a time when soya bean production in the US is still recovering following extreme weather conditions during the 2019 spring planting season. The Midwestern region, where most of the crop is produced, experienced double the season's rainfall through the typical planting window from April to June, delaying planting and reducing yields.

For context, 74% of the soya bean crop was planted by late May 2018, whereas only 29% was planted by late May 2019. These delays also resulted in nearly 31 million hectares of land intended for production to be used for other crops.

With a more favourable 2020 season, US soya bean production was at more typical production levels. Midway through the 2021 growing season, maize production was being challenged by low rainfall totals and extreme heat in the region.

Maize reaches record highs

Due to maize and soya beans doing well in the same climate regions and in feed rations, price movement in one tends to influence the other and adverse weather tends to impact both, says Bill George, senior agricultural economist for the US Department of Agriculture's (USDA) Foreign Agricultural Service.

"Maize requires a lot of nitrogen for top yields while soya beans fix nitrogen in the soil, which enhances a planting schedule that rotates maize and soya beans. Soya beans also work well on the farm as the planting and harvest schedule fits well with maize, and allows for better use of manpower and equipment," explains George.

In 2020, the US produced almost 32% of the global maize crop, followed by China with 23% and Brazil with nearly 10%. Even with its high levels of domestic production, China is the world's largest importer of maize, followed by Mexico and the EU.

Given the synergistic climate relationship between maize and soya beans, delayed soya bean plantings and harvests seen in Brazil this year were also experienced in its maize crop. "In Brazil, the delay pushed planting of the second maize crop, which is the largest share of Brazil's production, beyond the optimum planting window.

"Subsequently, the critical reproductive phases of the maize crop were pushed back beyond the end of the rain season, significantly reducing production prospects for the current year, and further tightening global maize supplies while global demand surges to record high levels," explains Suderman.

Recent reports by the USDA show that Brazil's 2020/21 marketing year maize crop yield is estimated to be down 10% from last year. US maize producers have been challenged with the same environmental challenges during the 2019 season with delayed planting and fewer production hectares, resulting in a 4,8% decrease in production compared to the previous year. Improved growing conditions saw the 2020 harvest revert to typical production levels.

Influence of international markets

With many moving pieces influencing supply and demand for grain and oilseed markets, China is a prime factor impacting prices, says George. "China represents close to 60% of global trade in soya beans and is a major importer of many agricultural products."

> Recent reports by the USDA show that Brazil's 2020/21 marketing year maize crop yield is estimated to be down 10% from last year.

In 2018, China's national swine herd, the world's largest, was cut in half within a year as African swine fever (ASF) ripped through the country and competition for feed commodities decreased. In the four years prior to 2018, average annual growth in China's soya bean imports was just over eight million tons. Annual growth in 2017/18 was only 500 000 tons and in 2018/19, down nearly twelve million tons. Nearly two years on, China is resuming its place of buying competition for feed commodities.

"Any shortfall in China's demand has a positive impact on soya bean and maize prices," explains George. "Currently, the return of China to the feed market has been the primary driver."

For the US, large soya bean stocks that developed during the height of ASF quickly evaporated with the return of Chinese demand. This strong demand also chewed through supplies in Brazil, exacerbating the issue with this year's delayed harvest.

"With ASF waning, China's demand rose 16 million tons in 2019/20. The 2019 US soya bean harvest was down 24 million tons with the maize harvest similarly impacted. In some ways, this was fortunate as it absorbed all the decline in China's demand plus pulled stocks down ten million tons.

"However, the stock volume was still near record highs, setting up the current situation. The low prices and large stocks kept US plantings in check at 6% below 2017 and 2018. This cut 2020 production by eight million tons from 2018, with similar yields," explains George. "In Brazil, soya bean supplies were already tighter with a short harvest in early 2019. By 2020, with China poised to ramp up purchases, the supplies were not there, running stocks down to the minimum and bolstering prices."

Another factor driving the maize and soya bean market is that both commodities are globally used to produce biofuels, notes Suderman.

"There is a rising new generation of renewable fuels made from edible oils, such as soya, canola and palm. These renewable fuels have high value for uses stretching from truckers to passenger airlines," he says. "They are willing to pay virtually any price for the fuel to meet emerging global green fuel requirements, dramatically increasing demand for soya oil and maize oil."

In early July 2020, US soya bean prices hovered around US$328,85 per metric ton, reaching US$610,31 by 12 May 2021. The market quickly dropped by nearly 9,5% by 26 May. Recovering to US$582,02 by 4 June, the market closed at a low of US$532,41 on 16 June. This is attributed to weakened global vegetable oil prices and demand uncertainty.

Coming off its record production year, Brazil has also seen high soya bean prices. In June 2020, soya beans were selling for US$383,57 per metric ton, landing at US$678,98 by May 2021.

China has also been aggressively increasing maize purchases, with coarse grain imports from the US forecast at

46,3 million metric tons. "Chinese purchases of US maize have added to demand, pulling down domestic supplies and boosting price increases," explains George.

In early July 2020, US maize prices saw a high of US$137 per metric ton, which quickly increased month-on-month to a peak of US$304,31 in early May 2021. Prices broke from their month-and-a-half climb of 35% from the start of May to 12 May, dropping to US$257,07 per metric ton by 17 May, and recovering to US$275,18 by 10 June.

Global palm market

Rumen-protected fat supplementation is an effective tool to meet the high energy requirements of dairy cows, while also delivering fatty acids to support cow performance. Palmitic acid (C16:0) effectively increases milk fat production, with palm being the only prime source of C16:0. Palm also contains significant levels of oleic acid (C18:1), which improves cow fertility and body condition.

Most of the world's palm production comes from Indonesia and Malaysia, says Alvin Ong, commodity market expert connected to Volac Wilmar Feed Ingredients. According to Ong, the pandemic, government policy and competition all influenced price increases.

"Indonesia is the largest producer of palm, but harvesting volume has been down due to Covid-19 outbreaks among plantation employees. The Indonesian Palm Oil Association has become involved, urging plantations to improve biosecurity protocols," says Ong. Palm oil supplies are already tight in the region, with Indonesia mandating a 30% biodiesel programme in late 2019, which has not only cut into the country's export supply, but contributed to increases in export levies.

According to both Suderman and George, palm oil prices have reflected the overall tightness in the vegetable oilseeds balance sheet. Data from the Malaysian Palm Oil Council shows that palm oil increased by 5% in mid-May to close near a record high on the soya bean rally.

"There is a correlation between soya bean and palm oil prices, so the overall bullish sentiment in soya bean oil has contributed to palm oil's strong performance. Furthermore, tightness in the canola and sunflower crops in the EU and Black Sea also place greater strain on the vegetable oil global balance sheet," says Suderman.

Challenging logistics

While commodity markets and freight prices regularly influence feed prices, a novel factor has been long-lasting disruptions to the global shipping industry. This was initially triggered by national lockdowns due to Covid-19, says Lionel Margaka, group supply chain manager of Volac Wilmar Feed Ingredients.

Imports and exports of agricultural commodities are directly tied to consumer goods logistics. With most consumer goods being manufactured in Asia, shipping liners will transport these products to Europe or the US where containers will be brought inland to be unloaded. Some of these containers will then be reloaded with export goods to be sent back to Asia for trade, along with empty containers so the cycle can continue.

"In January and February 2020, we saw hold-ups starting in China as liner companies reduced the number of cargo ships being sent out due to lockdowns slowing consumer trade. Strict lockdowns also prevented the return of empty containers, leading to a build-up in certain parts of the world and a severe shortage in others.

"This combined with a shortage of ships led to a huge imbalance, with some ports having no containers and no shipping space, to others having no space and an abundance of containers, or plenty of space and no containers," explains Margaka.

It typically takes around five to ten days for a cargo ship to be docked, containers taken to their destination and then returned to the port. At the height of the national lockdowns, this process could take upwards of five weeks.

In the US, the container shortage has threatened agricultural exports. According to the Agriculture Transport Coalition, carriers are increasingly refusing to release containers once unloaded with consumer goods to be sent inland for less valuable products.

Instead, they are opting to send back greater numbers of empty containers to Asia to capitalise on the booming consumer trade, avoiding time delays associated with getting containers refilled in the US for export. This spurred nearly 300 US agricultural and forest companies and national organisations to urge the US Department of Transportation to intervene in late April 2021.

From a cost perspective, Margaka says they started seeing freight prices increase noticeably from July 2020. "Freight is a direct component to the total cost value of a product, with a company's margins dictating how much of it can be swallowed and how much has to be passed on to the customer."

Reaching an equilibrium

Until global supply and demand come into balance again, the market can expect the current cycle of elevated prices to last, says both George and Suderman.

"When that is going to happen is hard to predict. There are always production issues in play. In this case, we have ASF impacting global markets, sending prices below equilibrium levels, discouraging production growth and raising stocks. Then conditions rebound with equal strength in the other direction, causing tighter supply levels and sending prices higher," notes George.

"Over the long term, prices will track near this equilibrium level when supply and demand are roughly in balance, and stocks are adequate to offset any minor demand or supply changes without impacting the flow of product from producers to end-users.

"Significant events that impact supply or demand always result in higher price volatility and a bumpy ride until equilibrium is restored. That is the situation currently in play as the market adjusts and eventually moves back to equilibrium."

This article has been shortened for use in *Oilseeds Focus*. For more information, contact Laura Steeden of Volac Wilmar Feed Ingredients at laura.steeden@volac.com.

Demand from China bolsters soya bean production in the US and Brazil

Article by IndexBox

The increasing demand for soya bean in biofuel production, animal feed and food products has outpaced production growth, resulting in a significant hike in soya prices. Along with expectations of further price increases, this contributes to rising costs of many downstream products and accelerates food inflation.

In China, the rebuilding of swine herds following African swine fever (ASF) outbreaks is a new driver for the global market. These factors highlight soya bean as an attractive commodity to invest in, leading to significant expansion of crops planted in the United States (US) and Brazil.

Key trends and insights

Global soya bean consumption increased steadily from 2020 to 2021, while global stocks have been rapidly depleting. The escalating demand in China, accounting for 60% of global soya bean trade growth, is currently the key driving force of the world market.

The expected recovery in biofuel demand as the economy re-emerges following the Covid-19 pandemic, also shapes expansion of the raw soya bean market. The high prices may yet curb the biofuel market's growth rate, removing soya bean fuel as a viable competitor in terms of conventional fuel types.

The fear that the demand for soya bean will soon exceed supply, combined with rising production costs, contribute to price increases. The average soya bean price (CIF Rotterdam, US origin) in 2020 stood at US$380/ton; in the first half of 2021, prices soared to US$544/ton. This should lead to higher prices for meat, animal feed and biofuel.

The high prices for animal proteins amplify the development of the market for alternative soya bean food. In 2020, global investment in the alternative protein industry saw a twofold increase from 2019. China is forecast to record the most significant rise in the consumption of soya bean meal in animal feed and soya bean-derived protein concentrates for food products.

The promising outlook for the soya bean market is attracting investment to expand potential crop plantings. Global production is set to increase by 23 million tons to reach 386 million tons due to the increase in the land being harnessed for crop production in the US and South America (particularly Brazil). Market performance is forecast to retain its current trend, expanding with an anticipated compound annual growth rate of +3,3% from 2020 to 2030, which is projected to bring the market volume to 489 million tons by the end of 2030 (*IndexBox* estimates).

Consumption by country

The value of the global soya bean market fell slightly to US$150,9 billion in 2020, stabilising at the 2019 level. This figure reflects the total revenues of producers and importers (excluding logistics costs, retail marketing costs, and retailers' margins, which will be included in the final consumer price).

China (132 million tons) had the largest volume of soya bean consumption, comprising approximately 37% of total volume. Moreover, soya bean consumption in China exceeded the figures recorded by the second-largest consumer – Argentina (48 million tons) – threefold. Brazil (46 million tons) ranked third in terms of total consumption with a 13% share.

In China, soya bean consumption expanded at an average annual rate of +5,8% from 2012 to 2020. The remaining consuming countries recorded average annual rates of growth, with +4,4% per year for Argentina and +4% per year for Brazil. In value terms, China alone (US$54 billion) led the market. The second position in the ranking was occupied by Argentina (US$19,9 billion), followed by Brazil.

In 2020, the highest levels of soya bean per capita consumption were registered in Argentina (1 059kg per person), followed by Brazil (214kg per person), the US (105kg per person) and China (90kg per person), while the world average per capita consumption was estimated at 45kg per person.

Exports by country

Brazil (75 million tons) and the US (65 million tons) prevail in soya bean exports, together constituting 85% of the total volume. They were distantly followed by Argentina (7,7 million tons), making up a 4,7% share of total exports. Paraguay (5 million tons) and Canada (4,4 million tons) each had a 5,8% share of total exports.

From 2012 to 2020, the most notable growth in terms of shipments among the key exporting countries was attained by Brazil, while others experienced more modest paces of growth.

In value terms, Brazil (US$29 billion), the US (US$25,9 billion) and Argentina (US$3,1 billion) had the highest levels of exports in 2020, together accounting for 90% of global exports.

The average soya bean export price stood at US$395/ton in 2020, almost mirroring the previous year. Average prices varied somewhat among the major exporting countries. In 2020, these countries recorded the following prices: Canada – US$437/ton, Argentina – US$407/ton, Paraguay – US$323/ton, and Brazil – US$387/ton.

This article has been shortened for use in *Oilseeds Focus*. To read the full report, visit *https://app.indexbox.io/report/1201/0/*.

The use of soya bean hulls in animal feed

By Dr Erhard Briedenhann, vice-chairperson, Protein Research Foundation

Soya bean hulls are a by-product of the extraction of oil from soya bean seeds. Hulls are the skin of the soya bean which separates during processing. Once the beans enter the oil mill, they are broken before damaged beans and foreign material are removed. The beans are then cracked and the hulls removed. These hulls are fibrous materials that are valuable in ruminant diets.

Soya bean hulls are small and not very dense. They are often pelleted for ease of handling. Soya bean hulls have a variable chemical composition made up of cellulose (29 to 51%), hemicellulose (10 to 25%), lignin (1 to 4%), pectin (4 to 8%), and proteins (11 to 15%). Due to the composition of soya bean hulls, they are widely used as animal feed and have many advantages by serving as an energy source (*Table 1*).

Swine feed

Pressure to protect the environment by minimising the environmental impact of meat production has been on the increase. Dietary manipulation is one method that has been found to reduce unfavourable emissions from swine facilities.

Soya bean hulls are an inexpensive by-product of soya bean processing and are high in fibre, which have been shown to have a positive impact on manure nitrogen retention, odour production, aerial pit emissions, and volatile fatty acid production. The addition of 10% soya bean hulls with supplemental fat to a commercial type of diet, can have a positive impact on the environment without diminishing swine performance.

Research has shown that growing and finishing swine on diets containing 6 to 8% soya bean hulls resulted in

better daily gain. However, swine fed a diet containing 24% soya bean hulls showed decreased performance.

Growing swine on a diet containing soya bean hulls had an average bodyweight gain of 16,2 to 17,3kg after a three-week period, and a 39,7 to 40,9kg weight gain after six weeks, with an overall average bodyweight gain of 35kg. Finishing swine on a diet containing soya bean hulls produced an average bodyweight gain of 23 to 23,9kg. Back fat thickness measured 2,2 to 2,3cm and loin eye muscle 24,7 to 26,3cm, which is 6% lower than that of swine fed a diet containing wheat bran.

Research has indicated that low levels of soya bean hulls may be added to nursery diets without negatively affecting swine performance. This may reduce diet costs since soya bean hulls are cheaper than maize. Research also suggests that nursery swine weighing between 11,33 and 22,6kg can be fed diets containing 4% soya bean hulls and 15 to 22% dried distiller grains, with no negative effect on average daily gain.

Poultry diets

Soya bean hulls have shown to be poorly digested by non-ruminant animals. They do, however, have the potential to serve as an alternative feed ingredient for swine and poultry.

An inclusion of up to 20% soya bean hulls in laying hen diets lowers feed cost. The increased feed intake of birds on diets containing soya bean hulls does not have a negative impact on

performance due to soya bean hulls' high fibre content. It is an affordable and suitable energy source for laying birds.

The addition of exogenous enzymes with the soya bean hulls increases the availability of starches, proteins, and minerals, which are either enclosed in fibre-rich cell walls and are therefore not accessible to the animals' own digestive enzymes or are in a chemical form which the animal is unable to digest. The addition of the enzymes helps break down specific chemical bonds in raw materials, releasing more nutrients and improving animal performance.

Lactating dairy cows

Soya bean hulls can replace maize to supply 30% of DM in high grain diets without affecting the fermentation and digestion of nutrients negatively. Feed costs account for 35 to 50% of the total cost to produce milk. By including soya bean hulls, dairy producers can reduce feeding costs – especially when milk prices are low – to maximise the efficiency of production.

Soya bean hulls can be successfully used as a good fibre source in rations for dairy cattle when forages are either of poor quality or in short supply. The nutritional value of soya bean hulls is affected by the rate at which they are digested in the rumen and by the rate at which they pass from the rumen to the lower gastrointestinal tract. Studies have shown that ruminal micro-organisms are capable of extensively fermenting soya bean hulls at high rates.

Feedlot rations

Soya bean hulls should be considered in feedlot rations when readily accessible and priced competitively with other feedstuffs. They serve as an alternative to high-starch grains

Table 1: Nutritional analysis of soya bean hulls vs maize and wheat by-products. (Source: *Feedipedia*, 2021)

Main analysis	Soya bean hulls		Wheat bran		Maize bran	
	Unit	Average	Unit	Average	Unit	Average
Dry matter (DM)	% as feed	89,1	% as feed	87	% as feed	88,7
Crude protein	% DM	13,1	%DM	17,3	% DM	11,9
Crude fibre	% DM	38,9	% DM	10,4	% DM	12,3
NDF	% DM	64,4	% DM	45,2	% DM	44,2
ADF	% DM	46,2	% DM	13,4	% DM	14,5
Lignin	% DM	2,3	% DM	3,8	% DM	2,2
Ether extract	% DM	2,2	% DM	3,9	% DM	4,6
Ash	% DM	5,2	% DM	5,6	% DM	5,8
Starch (polarimetry)	% DM	5,2	% DM	23,1	% DM	35
Total sugars	% DM	1,6	% DM	7,2	% DM	2,8
Gross energy	MJ/kg DM	18,2	MJ/kg DM	18,9	MJ/kg DM	18,5
Minerals	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
Calcium	g/kg DM	5,5	g/kg DM	1,4	g/kg DM	4,7
Phosphorus	g/kg DM	1,6	g/kg DM	11,1	g/kg DM	3,4
Potassium	g/kg DM	13,8	g/kg DM	13,7	g/kg DM	7,3
Sodium	g/kg DM	0,1	g/kg DM	0,1	g/kg DM	0,8
Magnesium	g/kg DM	2,6	g/kg DM	4,5	g/kg DM	2,2
Manganese	g/kg DM	24	g/kg DM	114	g/kg DM	15
Zinc	g/kg DM	48	g/kg DM	89	g/kg DM	97
Copper	g/kg DM	8	g/kg DM	13	g/kg DM	7
Iron	g/kg DM	669	g/kg DM	155	g/kg DM	68
Amino acids	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
Alanine	% protein	4,2	% protein	4,6	% protein	5,5
Arginine	% protein	4,7	% protein	6,8	% protein	6,4
Aspartic acid	% protein	9,2	% protein	7	% protein	6,5
Cystine	% protein	1,8	% protein	2,1	% protein	1,4
Glutamic acid	% protein	10,1	% protein	19	% protein	11,6
Glycine	% protein	7,9	% protein	5,1	% protein	4,9
Histidine	% protein	2,5	% protein	2,7	% protein	2,9
Isoleucine	% protein	3,4	% protein	3,2	% protein	3,3
Leucine	% protein	6	% protein	6	% protein	7,1
Lysine	% protein	6,3	% protein	4	% protein	4
Methionine	% protein	1,1	% protein	1,5	% protein	1,7
Phenylalanine	% protein	3,6	% protein	3,9	% protein	4
Proline	% protein	4,7	% protein	6,3	% protein	4,4
Serine	% protein	5	% protein	4,3	% protein	3,8
Threonine	% protein	3,5	% protein	3,2	% protein	3,4

Table 1 (continued): Nutritional analysis of soya bean hulls vs maize and wheat by-products. (Source: *Feedipedia*, 2021)

Amino acids (continued)	Unit	Average	Unit	Average	Unit	Average
Tryptophan	% protein	0,8	% protein	1,4	% protein	0,8
Tyrosine	% protein	3,8	% protein	2,7	% protein	2,7
Valine	% protein	4,3	% protein	4,6	% protein	5,2
Secondary metabolites	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
Tannins (e.g., tannic acid)	g/kg DM	2,6	g/kg DM	1,3	g/kg DM	–
Ruminant nutritive values	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
OM digestibility, ruminants	%	81,8	%	73,4	%	78,4
Energy digestibility, ruminants	%	79,6	%	71,4	%	78,8
DE ruminants	MJ/kg DM	14,5	MJ/kg DM	13,5	MJ/kg DM	16,3
ME ruminants	MJ/kg DM	11,5	MJ/kg DM	11	MJ/kg DM	13,1
ME ruminants, digestibility	MJ/kg DM	6,2	MJ/kg DM	13,5	MJ/kg DM	–
Nitrogen digestibility	MJ/kg DM	6,2	MJ/kg DM	13,5	MJ/kg DM	–
a (N)	%	30,3	%	28,8	%	13,5
b (N)	%	66,5	%	66,2	%	82,9
c (N)	h-1	0,043	h-1	0,200	h-1	0,075
Nitrogen degradability (effective, k=4%)	%	65	%	84	%	68
Nitrogen degradability (effective, k=6%)	%	58	%	80	%	60
Swine nutritive values	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
Energy digestibility, growing swine	%	50,5	%	57,1	%	73,5
DE growing swine	MJ/kg DM	9,2	MJ/kg DM	10,8	MJ/kg DM	15,4
MEn growing swine	MJ/kg DM	8,6	MJ/kg DM	10,2	MJ/kg DM	14,4
NE growing swine	MJ/kg DM	4,6	MJ/kg DM	7,2	MJ/kg DM	9,2
Nitrogen digestibility, growing swine	%	40,4	%	64,9	%	71
Poultry nutritive values	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
AMen cockerel	MJ/kg DM	–	MJ/kg DM	7,8	MJ/kg DM	–
AMen broiler	MJ/kg DM	–	MJ/kg DM	7,4	MJ/kg DM	9,8

Table 2: Crush volumes and theoretical hull availability vs maize and wheat by-products.

Season	Soya beans crushed (tons)	Theoretical hull availability (%)	Wheat bran (tons)	Maize bran (tons)
2014/15	561 590	22 464	621 804	968 642
2015/16	861 631	34 465	628 416	939 692
2016/17	988 024	39 521	632 132	961 844
2017/18	852 308	34 092	640 946	998 695
2018/19	891 425	35 657	650 282	1 032 144
2019/20	1 054 566	42 183	682 920	1 077 514
2020/21	1 269 610	50 784	–	1 137 024

since they contain high levels of digestible fibre and can also be used as an energy source with similar value to other grains.

Research suggests that soya bean hulls do not affect calf weight, dry matter (DM) intake, or feed efficiency. Average daily gain on a ration containing soya hulls increased by 15 to 45%, suggesting that using soya hulls as a concentrate component in receiving diets is most effective at a level of 15 to 30%. Soya hulls provide the rumen with more digestible fibre and degradable protein when compared with maize.

Availability in South Africa

Soya bean hulls are a by-product from the solvent extraction process to produce soya bean meal. The quantity available is directly correlated with crush volumes in South Africa.

Table 2 illustrates that despite the extremely healthy growth in soya bean crush volumes, the availability of 50 784 tons is very little compared to the 1 819 944 tons of milling by-products currently available in South Africa.

Soya bean hulls will, however, always be in demand, especially if the price is reasonable and in ruminant rations where they receive preference. South Africa can easily produce animal feed cost-effectively without soya bean hulls. Nevertheless, soya bean hulls have become a sought-after ingredient and contribute to the higher fibre raw materials available in South Africa, albeit in small quantities.

For more information, contact the author at erhardb@netactive.co.za or 082 551 1634.

Sunflower in the global vegetable oil system

By Etienne Pilorgé, Terres Inovia, France

Sunflower is the third most produced oilseed, fourth most produced vegetable oil and third most produced oilseed meal among global protein feed sources. Competition has been tough on the very dynamic vegetable oil and oilseed meal markets, respectively driven by palm oil and soya bean meal. However, the sunflower sector succeeded in maintaining its competitiveness through continuous innovation in genetics, cropping practices and research on added value, leading to higher market segmentation.

Global dynamics of production

The global evolution of the sunflower crop is quite remarkable, going from 10 million tons for 9,6 million hectares in 1975, to 52 million tons for 27 million hectares in 2018 (*Figure 1*). Its seed contains around 44% oil and 16% protein. It competes with both the vegetable oil market, led by palm oil, and vegetable protein rich products, driven by soya bean.

From the world market point of view, sunflower is the third most produced oilseed in the word, with 45 million tons per year from 2014 to 2018, representing 9% of the global oilseeds production – soya bean makes up 60% and rapeseed 12%. It ranks fourth on the vegetable oils market with 9,2% in 2017/18 (19 million tons per year).

It is also the third oilseed meal worldwide with 5,6% of the global production after soya bean meal (66%) and rapeseed meal (10%). From 1975 to 2019, global oilseeds production doubled every 20 years and sunflower maintained a relatively constant share in global oilseeds production.

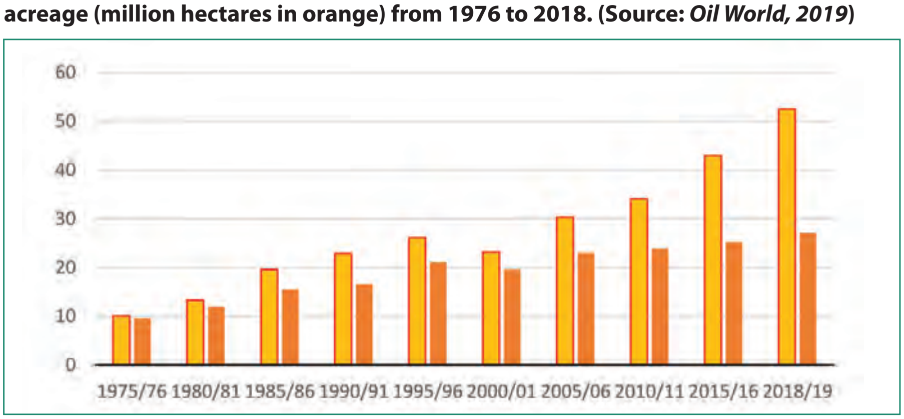
Sunflower is produced on a large scale in a limited number of countries, with two-thirds produced in Europe. From 2014 to 2018 the top ten countries – Ukraine, Russia, Argentina, China, Romania, Bulgaria, Turkey, Hungary, France and the United States (US) – represented 84% of the production and 76% of the acreage.

The observation of yield evolutions in the main producing countries is quite instructive about the capacities of the crop and its ability to keep pace with global competition between oil and protein sources.

Countries with flat or even decreasing yield curves (Spain and South Africa) maintained between 1 to 1,3t/ha of yield, while yield in France has been stagnating and decreasing since 2012. In contrast, countries in the Eastern part of Europe have seen yield increases. These tendencies reflect changes in the improvement of cultivars, including the increased use of modern hybrids and improvements in cropping practices, and should be analysed for each country.

In France, most sunflower crops (94%) are grown in non-irrigated areas and thus face climate risks in spring and summer. A study by Sarron *et al.*, (2016)

Figure 1: Evolution of sunflower seed world production (million tons in yellow) and acreage (million hectares in orange) from 1976 to 2018. (Source: *Oil World, 2019*)



comparing the periods 1989 to 1994 and 2013 to 2015, based on the crop model SUNFLO and surveys of agricultural practices, concluded that the changes in the regional localisation of sunflower crops in France would not have affected sunflower yields significantly, but that shifts in agricultural practices towards less input intensive practices would have had a negative effect, when genetic progress would have raised yields by 0,48t/ha and climate evolution by 0,06t/ha.

With the observed yield increment being 0,19t/ha, the yield gap evolution between these two periods is evaluated at 0,32ha. Studies focussed on the assessment of genetic progress (Vear and Muller, 2011) also concluded that the progress in genetic potential has been maintained at around 1% per year.

Shifts in agricultural practices seem to be a key explanatory factor for the yield evolutions. Furthermore, sunflower is traditionally a crop of which genetic resistances play a major role in the control of diseases and parasitic weeds. The durability of yield progress is also largely dependent on breeding effort of qualitative traits.

Global dynamics of consumption

Oil production and consumption more than doubled within the last two decades. Total oil consumption increased by 209% between 2001 and 2019. The total growth of 105 million tons per year in oil consumption during that time may be attributed to population growth, the development of biodiesel production, as well as changes in dietary habits and other non-food uses.

Sunflower oil almost maintained its market share in this highly competitive market, reshaped by the development of palm oil. After a decrease from 13% in the 1990s, the market share of sunflower oil seems to have stabilised at 9 to 10% (*Figure 2*).

Trade and markets

Oilseeds and oilseeds products are highly traded commodities. If we compare the export/production ratio of the main products in the vegetable oil and protein markets, we see that sunflower is traded mainly after processing: 55% of the oil volumes was exported in 2018/19, 38% of the meal and only 5% of the harvested seeds.

The specificity of sunflower compared to other major oilseeds is that it is largely processed in the production countries. Market characteristics and national investment strategies probably explain part of this situation, as well as the fact that sunflower seed has a relatively low density due to its hull and occupies 15 to 20% larger volumes compared to other seeds.

Historically, sunflower oil has been considered a premium oil and its average prices were generally significantly higher than those of soya bean and rapeseed oil until 2016. The last three years have shown a lasting inversion of this tendency.

Some main importing countries, specifically India, are structural importers and are limited in their agricultural production capacities. Most of them operate in shifts in their procurements, optimising prices and origins, but sunflower oil is regularly imported for its nutritional aspects. India protects its internal production through import tariffs, notably for oilseeds, but in times when it succeeded in maintaining a satisfying level of self-sufficiency for cereals, its imports of edible oils and fats almost doubled within ten years (from 8,7 million tons in 2008/09 to 15,3 million tons in 2018/19).

The Organisation for Economic Co-operation Development and the Food and Agriculture Organization's (OECD-FAO) Agricultural Outlook for 2019 to 2028 considers that vegetable oil prices should recover due to the global expansion of food and oleochemical demands, coupled with the new domestic demand for biodiesel in selected countries.

Figure 2: Domestic consumption of sunflower seed oil by country in 1 000 million tons in 2019. (Source: IndexMundi, United States Department of Agriculture)

Sunflower meal

Countries producing sunflower are the main consumers of sunflower meal: 90% of meal production is concentrated in the European Union (EU), Ukraine, Russia, Argentina, Turkey, China and the US. The EU, despite its high production, is also the main importer. Belarus, India, Morocco and Israel are regular importers of significant quantities.

The normal non-dehulled meal offers 29% protein and a relatively high fibre content, limiting its use to the least concentrated animal feed rations, mostly for beef cattle, sows and rabbits. This situation explains the important price spreads observed regarding soya bean meal (44 to 49% protein), usually between US$150 and US$200/ton.

Peyronnet *et al*., (2012) showed that the price of interest of normal sunflower meal (29% protein) was 43% of soya bean meal, when improved semi-hulled sunflower meal (32% protein) and dehulled sunflower meal would reach 50 and 70% of the soya bean value, respectively.

The use of sunflower hulls for energy co-generation or biomaterials makes the process profitable, contributing to the expansion of dehulled meal. The classification of feed ingredients according to their energy (AMEn cockerels) and protein values show that high-protein sunflower meal is among the best feed protein sources.

Sunflower and biodiesel

Sunflower oil is not directly involved in biodiesel, but most economists conclude that the emergence of biofuels made energy prices a driver of long-run agricultural price levels and that instability in energy markets is transferred to food markets (Serra and Zilberman, 2013).

Considering the case of biodiesel alone, 44,8 million tons represent a significant part of 48% of the global oils and fats imports and 19% of the global oils and fats consumption, and the conclusion appears consistent: strong correlations are observed between diesel prices and vegetable oil prices.

This situation might change for sunflower. According to Sofiprotéol, France, 6% of the European sunflower oil consumption would have been used in biodiesel in 2018. Sunflower oil would represent around 2,5% of the European biodiesel production. This introduction of sunflower oil in biodiesel has probably been favoured by the recent trend of prices similar to that of soya bean oil and even lower than that of rapeseed oil, and by the favourable environmental life cycle assessment of sunflower oil.

Calculations in French conditions confirm this tendency and show that sunflower oil methyl esters present lower greenhouse gas emissions compared to other oil methyl esters (Bio2010 study, cited by Debaeke *et al*., 2017). These figures still offer margins of progress and make sunflower a good candidate for sustainable biodiesel standards. If this shift is confirmed, sunflower could be directly involved in the biodiesel market.

Oleic sunflower

High oleic sunflower contains four times more oleic acid than normal sunflower, with 84% oleic acid in oil. It has the highest oleic level compared to oleic safflower (78%), oleic rapeseed and canola (75 to 73%) and oleic soya bean (73%) (Tonin, 2018).

The non-GMO nature of oleic sunflower varieties gives them a competitive advantage over oleic canola or soya bean oils on the European market, even though this could be challenged by the controversies in Europe regarding the varieties obtained through mutagenesis – often for herbicide tolerant characters – and the positions of the Court of Justice of the European Union (July 25, 2018).

On the other hand, the development of the use of cheaper oil blends – with lower oleic content – by the industries reduces the competitive advantage conferred by the high oleic content of sunflower oleic oils. For the time being, the oleic sunflower seeds may be considered a commodity in France and still a niche market in most other countries, and the still low rate of oleic sunflower in these countries reflects a high potential of development.

> Sunflower is produced on a large scale in a limited number of countries, with two-thirds produced in Europe.

The main uncertainty is the evolution of the oleic market for food industries and catering outside Europe and North America, where food safety and nutritional properties correspond to a real and growing demand from consumers.

Future perspectives and challenges

The future of sunflower must be considered in a much wider system than only production and markets. The global agricultural and food system will be largely influenced by the rapidity and intensity of climate change (Pilorgé and Muel, 2016).

Many studies have been conducted on the importance of the protein challenge, either seen as a quantitative challenge to 'feed the world' or as room for manoeuvre – a key factor to limit the impact of food consumption on the environment by diminishing the consumption of animal protein to the benefit of vegetal proteins, demanding much fewer resources.

The figures emerging from the calculations in terms of supplementary agricultural land availability are generally impressive. The answers for proper adaptations will involve both progress in animal nutrition and a larger use of vegetal proteins in human regimes, notably in the countries where animal proteins are dominant and even overconsumed.

Sunflower has the double advantage of already being used for food products and being non-GMO. If the non-GMO nature is of limited interest for oils, it is a key characteristic for the use of proteins for food. There is no doubt regarding the interest of developing added value from the protein fraction, which seems to be a real opportunity for sunflower. Knowledge and technological developments will be needed.

The valorisation of the oil fraction has been challenged for 20 years by the rapid development of palm in Indonesia and Malaysia, which puts pressure on vegetable oil prices since the growth of palm oil volumes was much faster than the evolution of edible oils demand.

Nevertheless, vegetable oils are highly valuable products for industry, able to substitute petroleum in chemistry with noticeable advantages regarding sustainability as renewable resources and biodegradable products. From 2011 to 2019, biodiesel production (based on non-recycled oils) absorbed the equivalent of 71% of the increase in palm oil production.

In the coming years, the growth in palm oil production might be slower than initially expected, due to the necessity to renew old plantations. The replantation dynamic will be influenced by the market itself and notably by incentive policies in Indonesia and Malaysia, and the development of specific demands on sustainability in the EU. According to Sofiprotéol, a slow replantation scenario would lead to the production of 79 million tons of palm oil in 2030, compared to 59 million tons in 2018 and 70 million tons in 2020, and a fast replantation scenario to 90 million tons in 2030, with a phase of stagnation, if not decline, between 2020 and 2025, followed by recovery.

The growth of palm oil production would range between 20 and 30 million tons until 2030. In the same period to 2030 the trend for edible oil consumption, due to population growth and diet evolutions, would be about 2% per year, or 25 to 30 million tons depending on scenarios. These figures tend to divert out of an 'ocean of oil' scenario, even if soya bean oil must also be considered a co-product of soya bean meal.

Non-food uses for oleochemistry could also influence vegetable oil consumption. We know that the development of oleochemistry is highly dependent on competition surrounding petroleum prices, as well as on

From the world market point of view, sunflower is the third most produced oilseed in the word, and ranks fourth on the vegetable oils market.

regulations and policies. Innovation will probably meet this developing demand.

A communication by Isso Noda of Danimer Scientific (US) at the Canola Innovation Day in December 2019, Canada, reported a new process for making bioplastics from vegetable oils, based on bacterial fermentation, possibly competing with classical petroleum plastics. This kind of development might boost the potential added value in non-food uses, progressively relaying the first-generation biodiesel and contributing to sustaining vegetable oils markets.

From a 'biorefinery' perspective, the celluloses fraction should also be considered. The technologies are ready to valorise sunflower stem fibres and pith in biomaterial such as particle boards or insulating materials from renewable sourcing. The limiting factors are the cost of collection and logistics.

Concerning agronomy and cropping practices, the past evolutions of yield levels in different conditions demonstrate the adaptation capacity of sunflower, but also that the yield gap remains high and that yield progress can still be expected.

Regarding climate change, the review by Debaeke *et al*., (2017) concluded for Europe, that sunflower could improve in the northern latitude, but could be affected negatively in the medium term in Southern and Eastern Europe if proper adaptation of cropping practices and cultivars is not achieved, even if the CO_2 fertilisation effect could compensate for the negative impacts of high temperatures, water stress and reduced crop duration. The possibility of relying on a diversity of cultivars differing in their productivity behaviour will be important for adaptation.

Conclusion

Sunflower succeeded in maintaining its competitiveness on oilseeds markets in the previous decades, through continuous innovation in genetics, production and markets, and a growing segmentation.

The plasticity of sunflower makes it a crop relatively adaptable to different kinds of agricultural policies and resulting agricultural systems. The dilemma will be in the repartition of research and innovation efforts towards different and multiple objectives. Co-ordination and collaboration are not new concepts in the world of sunflower science and are now more important than ever.

This article has been shortened for use in *Oilseeds Focus*. To read the original article, visit the *Oilseeds and Fats, Crops and Lipids* website at *www.ocl-journal.org* or send an email to the author at e.pilorge@terresinovia.fr.

Registration and monitoring of agricultural remedies: The role of testing facilities

By Wiana Louw, Southern African Grain Laboratory (SAGL)

Agricultural remedies form an important part of the agricultural industry for use in both commercial production environments and households. The requirements relating to the registration of these remedies are regulated by the *Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act 36 of 1947)*.

Part of the process to register crop protection products is to submit evidence that an independent, accredited testing facility had analysed five or more production batches of technical material from a specific manufacturer, to determine the impurity profile and assess the purity of the active ingredient(s). Testing of formulated products is also required for packaging and labelling to comply with the Globally Harmonised System (GHS), including flashpoint, boiling point, melting point and kinetic viscosity.

Testing requirements

One of the vital links in the chain of ensuring that agricultural remedies comply with regulations, is testing of the product. The required tests include confirmation of the identity of the active ingredient(s), determination of the concentration, identification, and quantification of impurities, as well as various physical and chemical tests as prescribed by South Africa's Regulatory Authority, the World Health Organization (WHO), and the Food and Agriculture Organization (FAO) of the United Nations.

Testing requirements serve as prevention against adverse effects of remedies on humans, animals and the environment, and to ensure the availability of an effective remedy for use in the food and feed production chain. Chemistry Data Requirement Guidelines were issued by the Registrar of *Act 36* in March 2021 for use by technical advisers of *Act 36* for new applicants, existing registration holders, and testing facilities.

Accreditation and compliance

In South Africa, a testing facility can apply for accreditation and/or compliance through the South African National Accreditation System. A laboratory can be accredited based on the requirements of the international standard for testing laboratories, ISO/IEC 17025, as a mechanism to confirm the technical competence of the laboratory to perform specific testing as detailed in their scope of accreditation.

Laboratories can also comply with the Organisation for Economic Co-operation and Development's (OECD) Principles of Good Laboratory Practice (GLP), which is then detailed in their certificate of compliance. Regulatory authorities use this compliance to ensure the quality and integrity of non-clinical studies as part of a mutual acceptance of data (MAD) agreement between countries.

In June 2021, draft regulations relating to agricultural remedies were gazetted for public comment. Included in the draft regulations was the requirement that support of analytical data for registration applications be in accordance with the OECD's GLP.

The Crop Protection Division of the Southern African Grain Laboratory has ISO/IEC 17025 accreditation, as well as OECD GLP compliance, which is required to assist the industry to comply with South African regulations.

Shelf life and quality control

Another important function of testing facilities is to assist the agricultural industry with stability testing on formulated products. Any shelf-life claim made by a manufacturer, must be supported by studies demonstrating the stability of the product.

During storage, chemical and physical changes can occur. The rate of these changes depends on the nature of the active ingredient(s), co-formulants, formulation type, packaging material and storage conditions. Physical, chemical and technical properties are evaluated before and after accelerated storage to assess stability and determine the shelf life of a product.

CropLife SA encourages their members to conduct real-time stability testing for their crop protection products, which entails storing the product under controlled conditions for two years and having these products tested at regular intervals to confirm the stability of the active ingredient(s).

Consistent testing results are needed for informed decisions regarding the stability and shelf life of products. Quality control analyses are needed when products are formulated. Most production plants have in-house laboratories to conduct regular analyses to evaluate continued compliance. However, there is a need for independent testing facilities when out-of-specification results must be investigated, or for benchmarking through interlaboratory exercises.

For treated seeds, testing facilities play an important role in the quality control process to determine the active ingredient content on the treated seeds, and to ensure compliance with claims made.

The value of canola meal in poultry diets

Article supplied by the Canola Council of Canada

Canola meal is fed to all types of poultry throughout the world. It provides an excellent amino acid profile and protein content and serves as an alternative or complement to other protein ingredients such as soya bean meal.

Canola meal provides greater value in egg layer and turkey diets over broiler feeds due to greater emphasis being placed on protein than on energy. However, canola meal can be a cost-effective alternative in high-energy broiler diets. Care must be taken to formulate diets on a digestible amino acid basis to ensure excellent performance with birds fed high canola meal inclusions.

Feed intake

Various publications have demonstrated that poultry, both broilers and layers, will maintain appropriate feed intake levels with diets high in canola meal that are formulated for digestible amino acids. Oryschak and Beltranena (2013) demonstrated that proper diet formulation can allow for canola meal to be included at 20% of the diet with no effect on feed intake.

Rogiewicz *et al*., (2015) also demonstrated excellent performance of hens fed 15 to 20% canola meal. Feed intake was maintained for broilers fed up to 20% canola meal from days one to 35 of life (Naseem *et al*., 2006) and broiler growers can be fed 30% canola meal (Newkirk and Classen, 2002; Ramesh *et al*., 2006).

Value of energy

Canola meal has a lower energy value for poultry compared with soya bean meal, the most common vegetable protein source. In certain diets, the greater emphasis placed on the value of energy could limit the inclusion of canola meal.

Egg layer diets and early-phase, high-protein turkey diets based on least-cost formulation include canola meal in the ration at a higher price. Research (*Table 1*) suggests that the energy value of canola meal for broilers in the grower/finisher stage is 200kcal greater than previously established (Beltranena, 2015).

Several researchers have fed dietary enzymes to increase protein, phosphorus and carbohydrate digestibility in canola meal (Kocher *et al*., 2000; Mandal *et al*., 2005; Meng *et al*., 2005; Meng and Slominski, 2005; Meng *et al*., 2006; Ravindran *et al*., 1999; Ramesh *et al*., 2006; Simbaya *et al*., 1996; Slominski and Campbell, 1990). Most studies examining the inclusion of cellulase or non-starch polysaccharides (NSP) degrading enzymes to improve canola meal digestibility have demonstrated limited benefits.

Meng and Slominski (2005) examined the effects of adding a multi-enzyme complex (xylanase, glucanase, pectinase, cellulase, mannanase and galactonase)

Table 1: Available energy values for canola meal (12% moisture basis).

Animal		Average value
Broiler chickens	AMEn (kcal/kg)	2,200[1]
Laying hens	AMEn (kcal/kg)	2,200[1]
Turkeys	AMEn (kcal/kg)	2,007[2]

[1]Beltranena, 2015; [2]Jia et al., 2012.

to broiler diets. The enzyme combination increased total tract NSP digestibility of canola meal, but no improvements were observed in other nutrient digestibilities or animal performance.

Jia *et al.*, (2012) fed broiler diets containing canola meal and a multi-carbohydrase enzyme to determine their effect on AMEn values (*Table 1*). The inclusion of a feed enzyme with canola meal increased its AMEn value from 1,904 to 2,018kcal/kg for broilers. The low AMEn values may be due to the feeding of canola meal containing only 1,8% fat (dry matter basis). The use of dietary enzymes is common in poultry feeds, especially those containing barley and wheat. Although the data is not completely conclusive, some enhancement of canola meal digestion may occur.

Layers

Canola meal is a commonly fed and economically effective feed ingredient in commercial egg layer diets. Various studies have looked at the effects of feeding canola meal on egg production and associated parameters (Perez-Maldonado and Barram, 2004; Kaminska, 2003; Badshah *et al.*, 2001; Kiiskinen, 1989; Nasser *et al.*, 1985; Robblee *et al.*, 1986).

Feeding canola meal supports high levels of egg production and has no negative effect on the number of eggs produced. Feed intake and egg size also show no difference. A negative effect on egg size was noted in some earlier studies (Summers *et al.*, 1988a, b), but in more recent experiments, this was not the case (Perez-Maldonado and Barram, 2004; Marcu *et al.*, 2005; Badshah *et al.*, 2001; Classen, 2008).

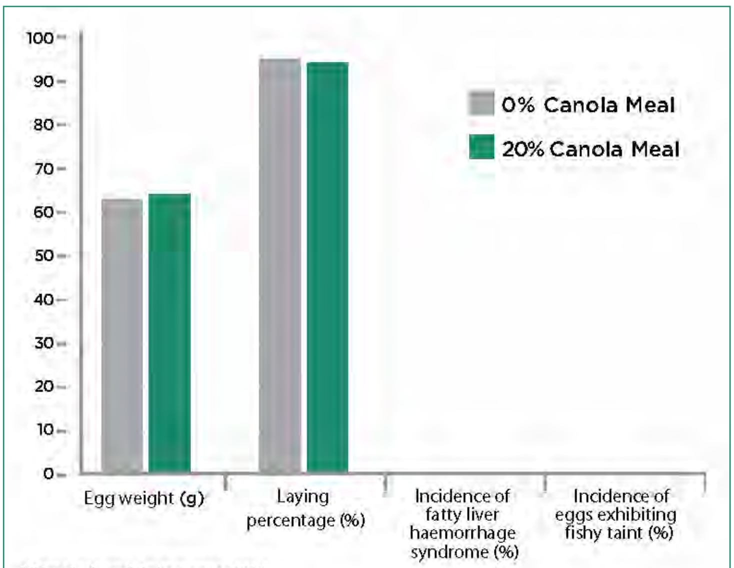
As with swine diet formulation, ileal digestible amino acids must be considered. Oryschak and Beltranena (2013) demonstrated that proper diet formulation can allow for canola meal to be included at 20% of the diet with no negative effects on egg production, egg quality or egg fatty acid content (*Figure 1*). Rogiewicz, *et al.*, (2015) also demonstrated excellent performance of hens fed 15 to 20% canola meal.

Published research showed a reduction in egg weight when canola meal was substituted for soya bean meal, but diet formulation on a crude protein basis resulted in insufficient lysine content in the canola meal diet (Kaminska, 2003).

Work by Novak *et al.*, (2004) supported the hypothesis that insufficient lysine can affect egg weight. They increased lysine intake from 860 to 959mg per day and observed an increase in egg weight from 59 to 60,2g but the added lysine had no effect on egg production rate.

Figure 1 shows the results of a study conducted at the University of Alberta in conjunction with Alberta Agriculture and Rural Development. Based on these findings, canola meal can be fed effectively at elevated levels in laying diets without negatively affecting egg production, egg weight, egg quality or fatty acid content as long as the diets are formulated on digestible amino acid content.

Figure 1: Performance results from feeding canola meal to laying hens. (Average over 36 weeks of production).



[1]Oryschak and Beltranena, 2013

Canola meal and liver haemorrhage

Traditionally, including canola meal in laying hen diets was limited to a maximum of 10% due to a potential association between liver haemorrhage mortality and feeding canola meal (Butler *et al.*, 1982; Campbell and Slominski, 1991). Authors suggested that this could have been the result of residual glucosinolate content found in early varieties of canola (Campbell and Slominski, 1991).

Plant breeding has steadily reduced the level of glucosinolates to the point where they are currently one-third of those found in the first canola varieties that were fed in these studies. More recent studies with current low-glucosinolate meal varieties failed to observe an incidence of liver haemorrhage, even when as much as 20% canola meal was included in the diet (Oryschak and Beltranena, 2013; *Figure 1*).

Canola meal was included in the diets of brown and white egg layers at levels of 0, 10 and 20% with no effect on liver damage and a zero mortality rate. Laying hens have repeatedly demonstrated an ability to handle high levels of canola meal as long as total diet glucosinolate levels are below 1,43µmol/g (Bell, 1993).

Fish-like smell in eggs

A wrongfully attributed effect of feeding canola meal to some strains of brown-shelled egg layers was the incidence of a fish-like smell in the eggs (Butler *et al.*, 1982). Canola meal contains sinapine, which is composed of sinapic acid and choline. In the digestive tract of birds with a genetic deficiency, choline is converted to trimethylamine (TMA). These strains of brown hens were unable to produce TMA oxidase, the enzyme necessary to convert the odorous TMA to non-odorous TMA N-oxide, which is then excreted in the urine (Ward *et al.*, 2009).

If this enzyme is not present due to the layers' genetic defect, then TMA will pass into the yolk of the egg and impart a fish-like flavour. This genetic deficiency has been well studied and many commercial breeders have developed lines of brown egg layers that no longer carry this defect (Honkatukia *et al.*, 2005; Classen, 2008, personal communication).

The data presented in *Figure 1* was conducted with Brown Nick hens. There was not one observation of a fish-like smell in the eggs produced. Canola meal has therefore not been fed at all or has been fed at extremely small amounts in brown egg hen diets. This type of formulating results in unnecessary exclusion of canola meal and greater feed costs.

Breeding chickens

Canola meal has no negative effect on egg fertility or hatchability of leghorn breeders (Kiiskinen, 1989; Nasser *et al*., 1985). The average weight of the one-day-old chick decreased with increasing canola meal, and the weight of the thyroid gland of one-week-old chicks was greater with increasing canola meal levels in these older studies. The decrease in chick weight did not result in an impairment of productive function.

A more recent study by Ahmadi *et al*., (2007) evaluated the effects of adding 0, 10, 20 or 30% rapeseed meal to the diet of broiler breeders, and it is unclear as to what the glucosinolate content of the diets was. However, they concluded that rapeseed meal can be used effectively in broiler breeder diets without affecting production, egg weight or chick quality.

Due to the potential effect on egg and chick weight and the lack of current studies on feeding canola meal to broiler breeders, many feed manufacturers do not use canola meal or limit it to low-inclusion levels in poultry breeder feeds. The high protein and fibre content of canola meal makes it an ideal feedstuff to manage weight gain in broiler breeder diets.

Broiler chickens

Current low levels of glucosinolates in canola meal do not have any negative effects on broiler mortality or feed intake. Two recent studies have shown that canola meal can be effectively fed in broiler diets of up to 30% without negatively affecting growth performance, as long as the diets are formulated on a digestible amino acid basis (Newkirk and Classen, 2002; Ramesh *et al*., 2006).

The lower assumed energy value in canola meal compared with other protein sources such as soya bean meal has limited its use in broiler feeds. However, lower cost per gram of key available amino acids and phosphorus has nutritionists considering greater dietary inclusions of canola meal in broiler diets.

It was argued that feeding rapeseed meal (high glucosinolate) to broilers resulted in an elevated incidence of leg problems, especially tibial dyschondroplasia. The leg problems have somewhat been alleviated by feeding canola meal. This could suggest that glucosinolates were partially responsible.

Summers *et al*., (1990, 1992) showed that the situation is related more to sulphur levels (a component of glucosinolates) rather than to the toxic effect of glucosinolates themselves. They noted that feeding organic sulphur in the form of cystine caused a greater incidence of leg problems. It is known that sulphur interferes with calcium absorption. Supplementing the diet with extra calcium helps to a certain extent, however, too much dietary calcium can depress feed intake.

Feed intake in broilers has been correlated with the cation-anion balance of a diet in some pioneering investigations into feeding canola meal to poultry (Summers and Bedford, 1994). Canola meal contains slightly less potassium (1,2%) than soya bean meal (1,9%) so that the electrolyte balance is lower in a diet based on canola meal compared with soya bean meal. When total cation-anion balance is considered, the higher sulphur levels in canola meal result in an even lower positive balance of dietary cations (Summers and Bedford, 1994).

These authors suggested that the decrease in feed intake when including canola meal in broiler feeds could be related to cation and anion levels in the diet. However, attempts to increase levels of dietary cations by adding extra calcium carbonate had marginal success, likely due to the feed intake depressing effects of high calcium inclusions (Khajali and Slominski, 2012). Adding potassium bicarbonate to diets is a better alternative as this corrects the problem at its source.

Canola expeller meal

Canola meal is an excellent source of protein for poultry, but the energy content of solvent-extracted canola meal can limit its use in the diets of rapidly growing poultry. Due to the remaining oil content, canola expeller meal contains more energy than solvent-extracted meal with an AMEn of 2,694kcal/kg (Woyengo *et al*., 2010), and it can be included as the sole source of protein in the diet.

A study conducted in Australia to examine feeding expeller-pressed canola meal subject to various processing temperatures determined the AMEn in broilers to be a mean value of 2,260kcal/kg (Toghyani *et al*., 2014). Expeller meal provides a high level of the essential fatty acid linoleic acid, thus exceeding the requirements of the birds without the need for supplemental fat.

Oryschak and Beltranena (2013) fed 20% expeller pressed canola meal to Brown Nick hens and demonstrated excellent egg production, egg quality and egg fatty acid content. Canola expeller meal can also be fed to turkeys as an effective protein source. Palander *et al*., (2004) studied the effects of feeding canola expeller meal in growing turkeys on protein digestibility and found digestibility coefficients similar to solvent-extracted meal.

Fat content of expeller meal varies between sources (8 to 11% crude fat) due to the efficacy of the type of press used, so the product should be tested, and the energy value adjusted accordingly. The AMEn of expeller meal can be estimated using the equation 1,800 + (% fat * 80) = kcal/kg. This assumes that each percentage point of fat contains 80kcal.

Feeding canola seed and oil

Canola oil is routinely fed as an energy source to broiler chickens. Along with its energy value, it is an excellent source of linoleic acid. Broiler starter diets that are based on barley or wheat instead of maize may be deficient in linoleic acid, especially when other saturated dietary fat sources are fed, such as tallow. In these situations, it is common to add 1 to 1,5% canola oil to the diet. Full-fat canola, after particle-size reduction (rolling), is a mainstay protein and energy ingredient in broiler feeds in certain countries such as Denmark.

This article was shortened for *Oilseeds Focus*. To read the original full document titled *Canola Meal Feeding Guide*, visit the Canola Council of Canada's website at *www.canolacouncil.org* or go to *www.canolacouncil.org/canolamazing/poultry/*.

NMR for oilseed applications

	OIL/FAT	MOISTURE	OLEIC/ LINOLEIC	PROTEIN
SUNFLOWER	•	•	•	•
PEANUT	•	•	•	
SOYBEAN	•	•	•	•
CORN	•	•	•	
COTTON	•	•	•	
WHEAT				•
OLIVE	•	•	•	
AVOCADO	•	•		
MAYONNAISE	•	•		
CHOCOLATE	•	•		
POLYMERS	•	•		
POLYMERS	•			

Unit 6, Oxford Office Park
3 Bauhinia Street, Highveld Technopark
Centurion, Gauteng, 0157

Tel: +27(0)12 940 5921
Fax: +27(0)87 231 7500
Email: info@aelab.co.za
Website: www.aelab.co.za

AES Agri-Enviro Solutions
Solutions for Analytical Technology

Oilseed quality control using NMR

Nuclear magnetic resonance (NMR) is one of the most used techniques for the study of molecular structures. Using the Spinlock SLK 200 Time-Domain Spectrometer, a fast, precise and non-destructive method to determine the hydrogen content of the solid and liquid phase of materials is possible. This process permits the quantitative analysis of moisture, solids, fats and oils in food products.

Replacing the primary method

As opposed to the traditional chemical analysis methods, NMR technology is characterised by its speed, precision and, particularly, that it does not destroy the sample being analysed. This allows for unlimited re-runs on the same sample.

The chemical methods, however, while offering maximum precision (used for NMR calibration), require a complete laboratory for purposes of the analysis, several hours to process and obtain the result, and the sample is lost during the process. Lastly, while the chemical analysis utilises solvents and other potentially hazardous substances, NMR is completely safe and environmentally (ambient) friendly, thus avoiding the use of any chemical substances.

The sample is kept intact during the analytical process. Because of this, after being analysed, the seed may be used as normal. This characteristic of the NMR method is unique, as it allows for the selection of seeds depending on their quality. This method is used especially in research laboratories and hybrid-seed production companies to increase their product quality.

Applications

The Spinlock SLK 200 NMR can be used for a variety of oilseeds and food products in general. Among the most common oilseeds, it is possible to analyse sunflower, soya bean, canola, groundnut, maize, cotton, sesame and wheat, among others. For these crops, the SLK 200 is unique in that it has the capability of measuring, besides oil and moisture, oleic acid. Oleic acid is a particularly sought-after fatty acid that is key in today's commercialisation efforts of oilseeds and vegetable oil.

In addition, for some crops, it is also possible to measure protein content, a parameter that is increasingly being monitored in the formulation of animal feed, as is the case with sunflower and soya meal. It is, furthermore, possible to analyse the intermediate products using Spinlock equipment.

The Spinlock SLK 200 Time-Domain Spectrometer is a fast, precise and non-destructive method to determine the hydrogen content of the solid and liquid phase of materials.

For other food products, the SLK 200 is also capable of analysing olive paste and pomace, avocado, palm and chocolate for oil content applications, allowing for a unique quality control process during extraction. In the case of olive, avocado, palm and mayonnaise, the SLK 200 is the only NMR equipment that can perform an analysis without drying of the sample. This fact makes it a reality for the always desired online/at-line production control.

Unique advantage

The SLK 200 is capable of measuring oleic acid in a single seed. For applications such as sunflower and groundnut, the SLK 200 allows for the control and analysis of each single seed for oleic acid content – a Spinlock-only capability appreciated by breeders worldwide.

Main technical features

- The same equipment can be used to analyse all grains. Each type of grain has its own configured parameters in the operating software.
- The basic equipment includes the NMR spectrometer, two sample holders and the application software.
- Automation: The only oilseed NMR on the market that can be completely automated using the SLK AS 30 Autosampler.
- No moving or mechanical parts, which means low maintenance and zero operating costs.

Analysis speed

- Oil and moisture: 4 seconds.
- Oleic acid: 28 seconds.
- Protein: 3 minutes.

Service and support

The Spinlock SLK 200 has a constantly expanding support network with representatives on all continents. Agri Enviro Solutions (Pty) Ltd, based in South Africa, are the service and support partner for Spinlock within Southern, Central and East Africa. In addition, we offer the Spinlock Online Support Desk, with instant access to Spinlock engineers via WhatsApp, telephone and email. AES and Spinlock proudly commit to our customers, making technical support an absolute priority.

For more information, phone Agri Enviro Solutions on 012 940 5921 or visit *www.aelab.co.za*.

Paving the way for developing black producers

By Gert Heyns, CEO of SACTA, and Leon du Plessis, managing director of L&L Agricultural Services, administrators to SACTA

Statutory levies for purposes of breeding and technology were recently approved by the minister of agriculture, land reform and rural development. The levies are intended to assist in the funding of new variety development and to ensure that South Africa has access to state-of-the-art biotechnology.

The statutory levies are imposed on different commodities and are subject to specific conditions as determined by Minister Didiza. One of these conditions is that 20% of the collected levies are to be allocated to transformation in accordance with the guidelines of the National Agricultural Marketing Council (NAMC).

In terms of the NAMC's guidelines, the South African Corporate Training Association (SACTA) is obligated to facilitate the allocation of 20% of the collected levies to transformation activities and initiatives, to annually submit a comprehensive business plan and to budget for the planned transformation initiatives for the following year, and biannually submit progress reports to the NAMC, together with audited expenditure reports for funding of the initiatives.

Transformation strategy

SACTA deems it important to fund viable and sustainable transformation projects in the grains and oilseeds industries, which complement the funding already provided by the different grains and oilseeds commodity trusts.

The most urgent need of semi-commercial black farmers in grains and oilseeds production remains a lack of affordable and available input financing. This is due to a shortage of suitable and acceptable collateral by these producers, as well as well-recorded and sustainable track records and business plans.

Table 1: Number of producers, hectares and crops planted in the 2020 production year.

Crop	Region	Hectares planted	Number of producers
Wheat	Western Cape	290	4
Soya beans	Summer rainfall	1 686	33
Maize	Summer rainfall	605	

Enterprise development

The NAMC's guidelines prescribe that at least 60% of transformation funding be allocated to enterprise development. Since most of the new developing farmers do not own the land they cultivate, it is almost impossible to qualify for production input financing. SACTA therefore decided to aid producers via dedicated service providers.

The SACTA input financial assistance programme comprises the following:

- Interest-free financial assistance for a period of three years.
- Producers must repay the amount used in full on an annual basis.
- All profits are available for producers to utilise in their personal capacity.

Agri-businesses and other service providers, such as Grain SA, FarmSol, Senwes and Agriqua Holdings, form an integral part of the SACTA financial assistance scheme as they act as primary facilitators and co-ordinators.

The SACTA input financial assistance programme was introduced in winter 2020. In the following summer, the programme was extended. Information pertaining to the programme can be seen in *Table 1*.

Skills development and training

In addition to the aforementioned strategies for transformation, SACTA also implemented bursary and internship programmes in 2019. The focus of SACTA's bursary and internship programmes is on breeding and technology studies at an honours, master's or doctorate level. Between 60 and 70 individual bursary applications are received annually and the policy is to award bursaries to deserving students who comply with the broad-based black economic empowerment (B-BBEE) requirements of government.

The conditions relating to local bursaries are as follows:

- Students must be South African citizens.
- Students must study full-time at any South African university.
- Bursaries are only awarded for post-graduate studies.
- Fields of study must be relevant to the South African grains and oilseeds industries and must be focussed on breeding and technology.
- Topics for student theses must be approved by the SACTA board.
- Nominated mentors for the study programmes, as well as the universities where studies are to be undertaken, are subject to approval by SACTA.
- Students are expected to work in the South African agricultural industry for a period equal to the time during which the bursary was awarded.
- The SACTA board annually reviews the bursary and internship amounts.

The SACTA skills development programme also makes provision for supporting internships. Internships are supported at agricultural industry related companies. SACTA currently supports an internship at CenGen (Pty) Ltd, a privately owned and well recognised laboratory in the winter cereals industry.

Five internships have also been approved for the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria in 2021.

For any enquiries or interest in applying for a bursary or internship support, email Leon du Plessis at leon@llagric.co.za or Gert Heyns at email gert@sactalevy.co.za.

Canola, key alternative to wheat in the Western Cape

By Hugo Lochner, Plaas Media

The Protein Research Foundation (PRF) recently hosted a canola information day in Hopefield in the Western Cape. The topics discussed included climate change and risk management, cultivar evaluation and selection, cover crops, the latest research on *Sclerotinia* and black stem, determining crop losses and the oilseeds market.

Growth in canola plantings

During the information day, Andries Theron, chairperson of the PRF, said the current season is the best it has been in ten years. "Over the past decade, we've become accustomed to planting on dryland while waiting for the June rain. However, this year the rain arrived on time and precipitation was enough to ensure ideal conditions for good germination and yield."

Theron reported that canola plantings in the Western Cape increased from 400ha in 1994 to more than 95 000ha this season. The average yield per hectare also increased while the total canola yield amounted to nearly 165 000 tons in 2020.

Prices of R6 500 to R6 700 per ton were realised this past season. "At these prices and with a yield of 1,8 to two tons per hectare and more, grain producers in the Western Cape can profit from producing canola," Theron said.

The wheat industry in the Western Cape is currently overproducing, while the province is the biggest importer of oilcake for animal feed. Cattle producers in the province import approximately 340 000 tons of soya oilcake per annum. "The canola industry needs to share in the 340 000 tons. This will not only benefit the Western Cape's grain producers, but the country's entire economy."

Climate change

Prof Stephanie Midgley of the Western Cape Department of Agriculture said the consensus is that climate change will cause temperatures in the Western Cape to rise even more. By 2050, temperatures could be 1,5 to 3°C warmer, with more hot and fewer cool days and nights.

The effect of climate change on wheat yield on dryland can vary between a decrease of 25% to an increase of 10%, depending on greenhouse gases.

The value of agriculture

According to Prof Ferdie Meyer of the Bureau for Food and Agricultural Policy (BFAP), the value of agriculture in rural areas is underestimated as it offers support to small businesses. Agriculture contributes more to the gross domestic product (GDP) than the official 2% – especially considering that agricultural processing contributes 5% to GDP. He emphasised that primary agriculture creates 7% and agricultural processing 3% of all jobs in South Africa.

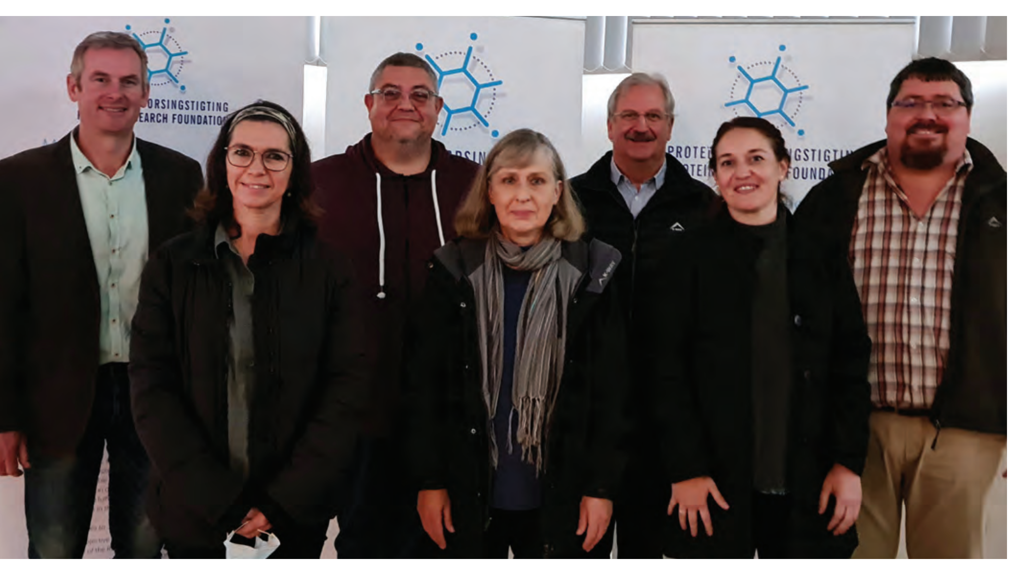
In 2020, the agricultural sector grew by 13% and was the only sector in South Africa showing positive growth. Meyer added that international trade is crucial to South Africa's economy. Last year, total agricultural exports amounted to US$10,8 billion while total imports were US$6,4 billion.

Land reform

Land reform is crucial for South Africa. "More black producers must be established sustainably. We also need to negotiate with government. If, for example, new market access is negotiated, the question posed will be: Who will have access to these markets?"

According to Meyer, land reform in South Africa has progressed more than what is generally considered. In total, 67% of the objectives of the National Development Plan have already been achieved. This progress is acknowledged among the top brass in government.

"The National Development Plan is excellent and for the most part, our policy framework is not bad at all. However, infrastructure is the biggest obstacle. We are lagging, especially in terms of roads and dams," said Meyer.



From the left are Prof Ferdie Meyer of BFAP, Lizette Nowers, Dr Johan Strauss and Prof Stephanie Midgley, all from the Western Cape Department of Agriculture, Andries Theron, chairperson of the PRF, and Huibré Schreuder and Dr Gert van Coller, both from the Western Cape Department of Agriculture.

For more information, contact the Protein Research Foundation at 011 803 2579 or 011 803 1894, or send an email to pns@proteinresearch.net.

Manganese

manvert
moving with agriculture

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

DNA Crop Protection
B 4921

Recommended usage

PRODUCT	DOSAGE / HA	APPLICATIONS
Manvert Manganese	500ml	With glyphosate application

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].

DNA
PLANT SCIENCE

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

www.dnaplantscience.co.za +27 56 212 1273

continuous advantage

Dinè Pretorius **Technical Advisor**
dine@dnaplantscience.co.za
+27 66 470 8424