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OILSEEDS focus

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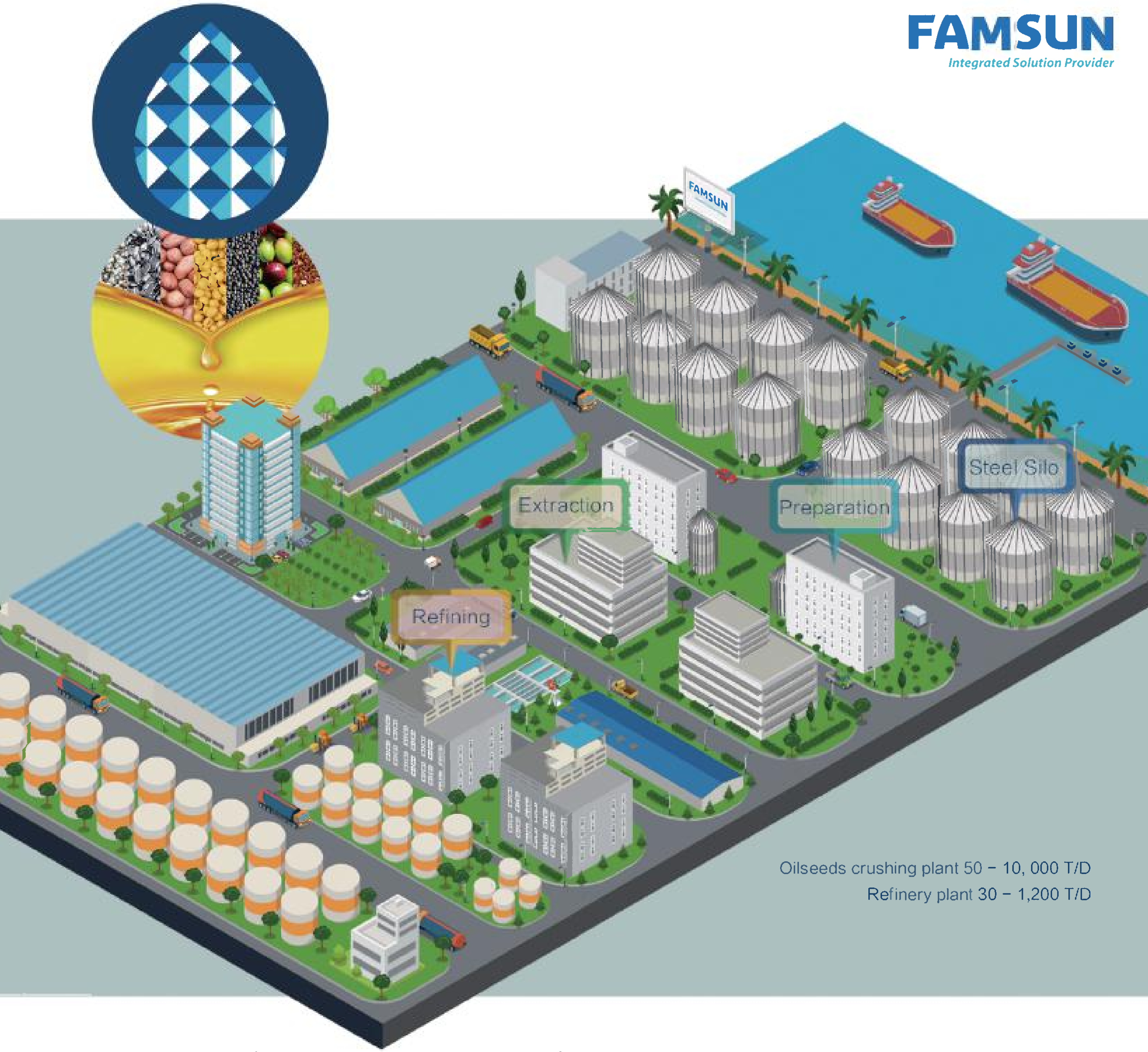

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We create plant value

The significant role of storage in the grain supply chain

By Jerry Maritz, chairperson: Agbiz Grain

Storage operators play an important role in the issuing of both Johannesburg Stock Exchange (JSE) and general silo receipts that guarantee quantity and quality. The sector must ensure that the relevant stock as indicated by JSE and general silo certificates, are available when trades take place.

For this reason, storage operators clearly play an important role in the price discovery of grains and oilseeds, and thus the functioning of an efficient market. This is also why the storage sector collaborates closely with the JSE to improve JSE rules, so as to ensure liquidity in the market.

Role of the storage operator

Storage operators are well trained and experienced in the grading and management of stock. They are a critical link in the value chain, making a direct contribution to the credibility of our grain and oilseeds market. Since deregulation, the storage sector has ensured that grain and oilseeds are graded correctly and in accordance with published grading regulations and the requirements set out in the *Agricultural Product Standards Act, 1990 (Act 119 of 1990)*. Correct grading of grain and oilseeds is necessary to determine monetary value, and to ensure the efficient management of and trade in quality stock.

Storage operators do not only play an important role in respect of safely storing stock on behalf of clients such as producers; it is also important that traders, financiers, processors and the end consumer know that stocks stored for food and feed manufacturing purposes adhere to quality and food safety requirements.

Financiers are involved in commodity financing and therefore the safe storage of grain is important to them as well. To insure stock in a silo, it is necessary for that stock to be graded correctly and stored effectively. However, storage operators cannot store grain and oilseeds if the risk-to-reward ratio is not sufficient.

Local grain and oilseeds storage is a competitive business and best global standards are applied. This serves to confirm that current grading practices by storage operators not only adhere to the requirements set by storage operators themselves, but also to standards set by producers, financiers, insurance companies, traders, millers, feed manufacturers and the JSE as a platform for price discovery in South Africa.

Importance of accurate grading

Accurate grading and efficient stock management are essential as they determine the value of grain and oilseeds. Several auditing processes take place throughout the season. For example, the JSE and South African Grain Information Service, SAGIS, audit the quality and quantity of stock in storage facilities. Storage facilities need to be registered as food business operators (FBOs) with each delivery point registered as such. Storage operators are also audited on an annual basis by the Perishable Produce Export Certification Agency, the PPECB, to ensure that they comply with FBO requirements.

Insurance companies and financiers also undertake audits to ensure that the product is graded correctly. Storage operators ensure that the self-regulation of grading as prescribed by the *Agricultural Product Standards Act,* are in fact performed successfully and regulated efficiently by the *Act* without additional costs or functions for the producer or the lower-income end consumer of staple foods.

A sizeable contribution

Compared to other sectors in the economy, the storage sector is relatively small.

Jerry Maritz.

However, the members of the sector add very significant value to the largest portion of our population by ensuring the safe storage of commodities, before they are processed into staple foods and animal feeds.

South Africa is home to more than 300 commercial storage complexes. The training of staff at these complexes takes place at no additional cost to the consumer or any other role-player in the value chain. Members of Agbiz Grain employ some 1 200 staff who are well-versed in the grading of grain and oilseeds. Training of these employees contributes directly to the economic growth of South Africa and ensures food security in terms of safe food.

For more information or enquiries, contact the author at email Jerry.Maritz@afgri.co.za.

The ebb and flow of **international trade trends**

Global trade volumes of grains and oilseeds expanded by 120 million tons, with a compound annual growth rate of 3,5%. This growth, however, falls below the previous five-year period average of 6% or 160 million tons. Oilseeds complex prices have seen a decline, while grain prices increased.

Demand from China influences market

A 17% increase in trade flow volume was seen. China's low maize stocks will continue to influence the market due to robust demand. On the African front, the continent is expected to play an important role in becoming a key grain and oilseeds importer in the long term, driven mainly by population and income growth.

> Global government policies are becoming more important, with a shift to sustainable production receiving high priority. The growing move to protectionism, however, could undermine the benefits of international trade.

Demand from China will be a main driver of growth, while a shift in supply is likely to occur away from the United States (US) and Argentina to Brazil, due to the positive farm margins and availability of land. Soya bean production in Brazil is expected to increase to 155 million tons by 2030, according to a report by Rabobank.

The Black Sea region will play a more prominent role in supply and is expected to be the third largest player, following Brazil and the US. This region is strategically located, has strong price competitiveness, with excellent soil quality and growth potential in terms of yields.

Global government policies are becoming more important, with a shift towards sustainable production receiving high priority. The growing move to protectionism, however, could undermine the benefits of international trade.

Increased demand in Asia and Africa, along with rising exports from the Americas and the Black Sea region, are anticipated to buoy global grains and oilseeds trade growth.

Positive outlook for South Africa

The requirement for animal feed is expected to continue to grow in South Africa, with an anticipated increase of 21% by 2029, up to 14,55 million tons. Oilcake demand is also expected to increase from 1,9 to 2,3 million tons per annum.

On the local soya bean production front, a projected increase to 1,78 million tons is needed to satisfy the demand for soya bean meal. The growth in soya bean production of 540 000 tons to an estimated 1,79 million tons this year is extremely encouraging for long-term self-sufficiency.

Enjoy this issue of *Oilseeds Focus*.

Dr Erhard Briedenhann

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

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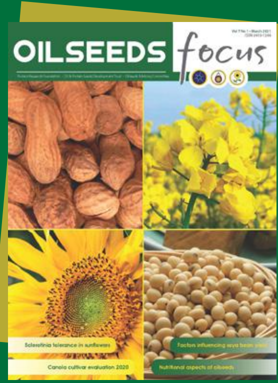

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NEWS

Two efficient CRISPR-Cas9 systems for soya bean

Scientists of the University of Brasília and the University of Georgia reported two CRISPR-Cas9 systems that can be used for soya bean's complex genome. The findings have been published in *Transgenic Research*. Genome editing tools are powerful methods used in crop improvement since their efficiency can be enhanced to be applied to crops with complex genomes, such as soya beans.

The researchers tested two CRISPR systems – one with a single component, and another with two components. A multiplex system with three targets was designed, targeting two different genes – GmIPK1 and GmIPK2 – which code for enzymes from the phytic acid synthesis pathway.

The two systems were tested using the hairy-root soya bean methodology. The results showed gene-specific editing. For the GmIPK1 gene, the editing was evident in both systems, but the two-component system exhibited a higher rate of insertion/deletion. For GmIPK2, major exclusions were found in both systems, but the simple system had lower editing efficiency.

Both systems were able to help effective gene editing in soya bean, but the two-component system was preferable due to its higher efficiency. The single-component system was less efficient but has a smaller CRISPR-Cas cassette. – *International Service for the Acquisition of Agri-biotech Applications*

Oilseeds demand shifts to Asia and Africa

Increased demand in Asia and Africa and rising exports from the Americas and Black Sea region, are anticipated to buoy global grains and oilseeds trade growth, according to the *World Grains and Oilseeds Map 2021* report by Rabobank.

The report noted changes in trade destinations as Africa has become a rising grains and oilseeds importer. One of the top commodities imported is soya bean. However, China's rising feed demand is affecting grains and oilseeds trade flows due to the country's low stock of maize.

"Higher Chinese imports of soya bean are expected to continue," says Maria Afonso, senior analyst of sugar, grains and oilseeds for Rabobank. "We estimate that Brazil's soya bean production will reach 155 million tons by 2030, versus 122 million tons in 2019/20, with soya bean area growth likely to come at the expense of underutilised pastureland." – *World Grain*

Sri Lankan planters told to destroy oil palm trees

Palm oil suffered another blow as Sri Lanka banned imports of the world's most-consumed cooking oil and told planters to get rid of all the tropical trees in the country. The island nation joined other countries in banning palm oil.

The United States has stopped inbound shipments from some top producers in Malaysia based on allegations of forced labour in the second-largest grower, while the European Union plans to phase out palm-based biofuels by classifying the commodity from large plantations as unsustainable.

Sri Lanka's president, Gotabaya Rajapaksa, ordered companies and other entities that grow oil palm, to remove the trees in a phased manner. They have been asked to uproot 10% of the trees each year and replace the fields with rubber or other environmentally friendly crops. The cultivation of oil palm will be completely banned. – *The Straits Times*

South Australia plants GM crops after lifting ban

Producers in South Australia have started sowing genetically modified (GM) crops following the lifting of their 16-year ban on GM crops. GM canola and Bt cotton were the first genetically engineered crops approved for growth in South Australia.

Producers have begun dry-sowing GM canola crops despite below-average rainfall in March and April. They were hoping to save as much moisture as possible before the rain season starts. "I understand there has been good uptake in the GM crop stewardship programme and I assume those growers are all putting their toe in the water to have a look at it this year," says Adrian McCabe, chair of Grain Producers South Australia (GPSA).

"At GPSA, we've always encouraged choice and understand that growers need to use different agronomic tools to help with their environmental impact, and they've now got a larger choice of crops to pick from." – *International Service for the Acquisition of Agri-biotech Applications*

Large crushing site to be built in Canada

Viterra and the government of Saskatchewan announced plans to build the largest canola crushing facility in the world in Regina, Saskatchewan. This location was chosen for its consistent and expanding access to canola seed, as well as its access to railways and the Regina bypass.

Currently in the feasibility study phase, the project is expected to begin construction in early 2022, with production to be launched in 2024. The project is projected to employ 1 000 people during construction and 100 people full-time once operational.

This facility, which will have a capacity of 2,5 million tons, will dwarf Viterra's largest crushing facility in Eastern Canada, which has a capacity of 1,1 million tons. It also aligns with the Government of Saskatchewan's Growth Plan, outlining a goal to crush 75% of the canola produced in the province.
– Oilseed and Grain News

Plans for new canola processing site unveiled

Cargill has announced plans to break ground on a new canola processing facility in Regina, Saskatchewan, to support the growing global demand for canola products. The company expects to begin construction on the $350 million project – which will have a similar design to Cargill's existing Camrose facility – early next year, with plans to be operational by early 2024.

The company will also update and modernise its canola facilities in Camrose and Clavet over the next twelve months to increase volume and broaden capabilities at both locations. The new state-of-the-art facility is projected to have an annual production capacity of one million metric tons and will provide a consistent and fast point of delivery for farmers and end users.

This investment will generate approximately one million hours of employment throughout the construction phase. Upon completion, the company expects the facility will add approximately 50 full-time positions. *– Cargill.com*

Positive outlook for global 2021/22 season

The International Grains Council (IGC) paints a generally optimistic view for key grains and oilseeds production for 2021/22. The IGC forecasts a 6% increase in 2021/22 global soya bean production, to a record 383 million tons.

The current higher global prices are expected to incentivise producers to increase plantings and there are expectations of better yields, which would also boost the output. The major contributing countries are the United States, Brazil, Argentina, India, Paraguay, Russia and Ukraine.

For the Southern Hemisphere countries, whether the optimism in plantings holds will only be seen at the end of this year. Ultimately, the initial production forecasts for the 2021/22 global grains and oilseeds production paint a slightly better picture than many had feared.
– Wandile Sihlobo, Agbiz

Biodegradable sponge from sunflower pollen

A biodegradable sponge made of sunflower pollen, has been created by scientists. Scientists of Nanyang Technological University in Singapore (NTU Singapore) and Sungkyunkwan University in South Korea said the sponge's ability to soak up oil and other organic substances meant it could be used to clean up marine oil spills and, when scaled up, remove contaminants from water bodies.

Pollen not used for plant pollination is often considered biological waste. "Through our work, we try to find new uses for this 'waste' and turn it into a natural resource that is renewable, affordable and biodegradable," says the study's lead scientist, Prof Cho Nam-Joon of the NTU School of Material Science and Engineering.

As pollen is abundant and sunflower pollen retails for around US$7,50/ton, the pollen-made sponge was a relatively low-cost material. *– Oils & Fats International*

Ukraine sees rise in soya bean production

A change in tax legislation has made Ukrainian soya bean production more profitable and led to a 21% increase in planting, according to data from the US Department of Agriculture (USDA). Ukraine is expected to plant 1,6 million hectares of soya bean in the 2021/22 marketing year, compared to 1,3 million hectares the previous year, according to the Global Agricultural Information Network (GAIN) report.

The USDA estimated Ukraine's soya bean production in the 2021/22 marketing year would be 3,8 million tons – a 36% increase compared to the previous year's total of 2,7 million tons. Soya bean exports in the 2021/22 marketing year were expected to be two million tons, up 20% compared to the previous year's total of 1,7 million tons. *– Oils & Fats International*

Canada launches revitalised market access strategy

As the second anniversary of restrictions of canola seed exports to China approaches, the Canola Council of Canada (CCC) has launched its revitalised market access plan.

Ongoing market access restrictions for canola seed to China continue to have a significant impact on the industry since they were first implemented in March 2019. Seed exports to China have fallen from $2,8 billion in 2018 before the restrictions, to $800 million in 2019 and $1,4 billion in 2020.

Expert analysis estimates that this has cost the industry between $1,54 and $2,35 billion from lost sales and lower prices between March 2019 and August 2020.
– Canola Council

Soya bean inoculants in Brazil: Success bolstered by interaction between research, industry and legislation

By Marco Antonio Nogueira and Mariangela Hungria, Embrapa Soja, Londrina PR, Brazil

The soya bean crop in Brazil is one of the most successful examples of the application of beneficial micro-organisms in large-scale agriculture by using biological nitrogen fixation (BNF). This process provides most of the plant's nitrogen needs (approximately 83kg/ton of grains, of which about 60% goes to the grains), which are attained by inoculation with elite strains of bacteria belonging to the genus *Bradyrhizobium*.

By the time rootlets start emerging, an intense exchange of molecular signals from plants and bacteria triggers a biochemical dialogue to establish the symbiosis that culminates with the formation of functional nodules, able to convert atmospheric nitrogen (N_2) into ammonia, followed by ammonium. Ammonium is converted into organic compounds and transported to the plant demanding parts, where metabolisation and assimilation occur.

N fertilisation vs inoculation

Considering the 36,9 million ha of soya bean cropped in the 2019/20 season, the Brazilian soya bean producer saved approximately US$15 billion to produce 125 million tons of soya bean grains without using N fertilisers. Moreover, part of the fixed N by soya bean remains in the soil with the next crop in succession, such as wheat, corn, cotton, or pastures sown as a second crop after soya bean in the autumn/winter period in most parts of the country.

This residual N also represents an economy of N fertilisers for the following crops. Decades-long research carried out by Embrapa, the Brazilian Agricultural Research Corporation, has shown that soya bean inoculated with elite *Bradyrhizobium* strains at each sowing (either on the seeds or in-furrow) increases yield by 8% on average, even in areas long cropped with soya bean and where there is an established population of *Bradyrhizobium* in the soil.

Such a yield increase justifies inoculating soil on an annual basis since it is an extremely affordable practice, usually costing fewer than US$1/ha. Since 2013, soil scientists have recommended a second bacterium for inoculation of soya bean with *Bradyrhizobium*: the plant-growth promoting bacteria, *Azospirillum brasilense*, during a process called co-inoculation. This improved inoculation method has resulted in an average yield increase of 16% at the cost of approximately US$2/ha.

A substantial increase in yield

In the State of Paraná, one of the largest soya bean producers in Southern Brazil, an institutional collaborative work of Embrapa and the Institute for Rural Development of Paraná (IDR) for the diffusion of sustainable technologies, including co-inoculation, indicated an average yield gain of approximately 8%. This is equivalent to approximately 290kg/ha spanning three seasons. However, in some cases, yield increased to above 20%.

Compared to non-inoculation, the co-inoculation resulted in average increases in the producer's income of approximately US$71/ha in 2017/18, US$54/ha in 2018/19, and US$63/ha in the 2019/20 crop seasons. There is no doubt that co-inoculation is profitable for producers and contributes to the increase in the sustainability of the soya bean production system.

In addition to economic gains, the BNF in Brazilian soya bean contributes significantly to preserving the environment. This is because the replacement of synthetic N fertilisers by inoculants avoids the emission of 180 million tons of CO_2 equivalent, besides preventing the pollution of surface and underground water pounds with nitrate, which are easily lost through N fertilisers. The adoption of inoculation in Brazil has increased significantly over recent years.

From a little over 30 million doses of inoculants commercialised in the 2013/14 season, there was a 160% increase in six years, reaching more than 80 million doses in the 2019/20 season – more than 85% designated to the soya bean crop. During the 2019/20 season, according to the National Association of Inoculant Producers and Importers (ANPII), about 80% of the soya bean areas were inoculated.

This range varied from 61 to 100%, depending on the State. The impact of the adoption of co-inoculation has been surprising. It grew from 15% of the soya bean areas in 2018/10, to 25% in the 2019/20 season. Considering that the soya bean co-inoculation was first recommended during the 2013/14 season, this increase indicates that soya bean producers are prone to adopt new sustainable technologies that boost yield gains.

However, there is still plenty of room for the adoption of this new technology among producers. For an efficient inoculation or co-inoculation capable of rendering full benefits, it is necessary to guarantee bacterial survival on the surface of co-inoculated seeds.

Chemicals threaten bacterial survival

The use of chemicals (e.g., fungicides, insecticides and micronutrients) as seed treatment is one of the main factors that could threaten bacterial survival due to incompatibility. The use of adjuvants, such as cell protectors, can relieve the stress, but several other factors, like high temperatures and low soil moisture after sowing, could negatively affect the protective effect.

One should avoid contact of the inoculant with the chemicals used in the seed treatment. For such, inoculation or co-inoculation can be applied directly in-furrow, using a spraying tank exclusively intended for inoculation during sowing. The use of such an inoculation method among producers increased from 10% in the 2018/19 season, to 20% in 2019/20, according to ANPII.

More than 100 years of research

The success of the inoculants in the current Brazilian soya bean cropping systems grew over approximately 100 years of basic and applied research, based on innovative decisions along the way. The first studies on the identification of efficient *Bradyrhizobium* strains for soya bean started in the 1920s. The first distribution of inoculants to producers took place in the 1930s, even before the crop had any significant economic importance in the country.

In the 1940s, a group of researchers led by Dr João Ruy Jardim Freire at the Rio Grande do Sul State University, created the first culture collection for bacterial strains for use as inoculants in soya bean and other legumes, named the SEMIA (Section of Agricultural Microbiology). The first private plant for the production of inoculants in the country was established in 1956, using elite, selected rhizobial strains for soya bean.

Until 1960, Rio Grande do Sul was the only Brazilian soya bean producing state, especially in succession after the main crop, wheat. In the 1960s, Drs Freire and Joahanna Döbereiner, a soil microbiologist who played an essential role in research on N-fixing micro-organisms, integrated the former National Soybean Commission, which recommended the use of rhizobial inoculants in substitution of N fertilisers for the soya bean crop, as a state policy.

> The success of the inoculants in the current Brazilian soya bean cropping systems grew over about 100 years of basic and applied research, based on innovative decisions along the way.

Since then, the use of rhizobial inoculants for soya bean and other legumes in the country has increased. Several scientific meetings were organised to discuss and recommend the best and more effective rhizobial strains for each crop, in addition to issues related to production and the minimum quality standards of an inoculant.

Legislation, protocols and criteria

The first legislation dealing with production plants and minimum requirements for producing inoculants, was put in place in 1980. In May of 1985, a meeting involving research, the inoculant manufacturers and the ministry of agriculture was organised to discuss these issues. The meeting, held every two years, was named the Meeting of the Network of Laboratories for Recommendation, Standardisation and Diffusion of Technology of Microbial Inoculants of Agricultural Interest (RELARE).

Protocols and criteria were established by scientific researchers, manufacturers and lawmakers regarding the Brazilian legislation for inoculants. The normative instructions established the minimum requirements for the registration and commercialisation of inoculants in the country. For example, the current legislation dictates that *Bradyrhizobium* inoculants must contain one or more of the strains SEMIA 587, SEMIA 5019, SEMIA 5079, or SEMIA 5080 to be acquired annually from official culture collections.

Also, at the expiring period, which must be six months from the fabrication/packing date, it must contain a minimum concentration of 1×10^9 viable cells per gram or millilitre of inoculant, whether peat- or liquid-based formulation, respectively, and free from contaminating micro-organisms at the dilution of 1×10^{-5}.

Regarding the plant growth-promoting bacteria, such as *Azospirillum*, in addition to minimum requirements for *Bradyrhizobium*, the strains must be previously assessed by official research institutions in terms of harmlessness to plants, animals, and the environment under severe laboratory, greenhouse and field trials.

Formulation of inoculants

The development of an inoculant goes far beyond the selection of microbial isolates capable of efficiently fixing N or promoting plant growth. The inoculant formulation must assure the microbial survival in the minimum established concentration to retain its efficiency. The culture medium for multiplication in the industry is also essential for optimising the microbial growth and ensures the survival up to its use.

After release in the field, protective additives help preserve bacterial survival under harsh conditions, such as dryness, UV radiation or chemicals. Consequently, the steps in obtaining an efficient inoculant that adheres to the legislation requires long-term research, development, validation and strict quality control to assure the maintenance of all beneficial properties of the selected strains.

The harmonic interaction among researchers, manufacturers and legislation has contributed to the success of BNF in soya bean crop in Brazil. It also assists in the sustainability of a production system that collaborates to feed about one billion people worldwide and places the country among the larger players in the international agribusiness arena.

For more information,
visit *www.embrapa.br/soja.*

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Role of reproducible research tools in quantifying Sclerotinia disease prevalence survey

By LA Rothman, NW McLaren and EM del Ponte

During the Southern African Society for Plant Pathology's virtual conference this year, Dr Lisa Rothman delivered an overview of data collected from a ten-year *Sclerotinia sclerotiorum (S. sclerotiorum)* survey conducted by the Crop Estimates Committee (CEC). Although the research summarised the national survey, the focus was on the role of reproducible research in plant pathology.

The adoption of R (R Core Team, 2021) and Rstudio (R Studio Team, 2021) platforms for statistical programming, as well as Git and GitHub (©GitHub, Inc, 2021) to manage data and statistical workflow, was encouraged by providing an example in a real-world scenario.

S. sclerotiorum, a polyphagous fungal pathogen, causes diseases such as *Sclerotinia* stem and head rot of soya bean and sunflower, respectively. The study aimed at summarising the *Sclerotinia* disease intensity across soya bean and sunflower production regions in South Africa, based on data collected over a ten-year period.

Producers contribute to research

The CEC conducted a national *Sclerotinia* disease survey from 2006 to 2015, to which 285 soya bean and 324 sunflower producers responded. A total of 1 331 completed surveys were included in the study, representing 87 towns.

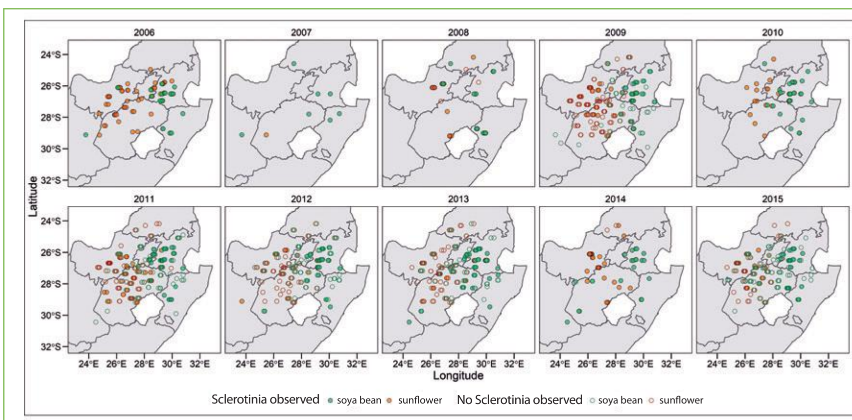
Sclerotinia disease intensity was assigned as a percentage of the producer's perceived area (hectares) affected by the disease. The responses at farm level were categorised into binary values, classified as healthy (0) or diseased (1) to calculate *Sclerotinia* prevalence, or the percentage of disease responses relative to the total responses. Binary disease responses were mapped per annum for each crop *(Figure 1)*.

The survey area and the extent to which these were representative of the population was determined by assessing total provincial area planted per annum, relative to the reported *Sclerotinia* survey provincial area planted per annum. This was mapped for each crop during the survey. The responses reflected prominent production regions (Free State, KwaZulu-Natal, Mpumalanga, and North West.).

The survey represented between 1,3 and 16,7% of the area planted to soya bean, while sunflower representation ranged from 0,4 to 94,3%. A 100% *Sclerotinia* prevalence in soya bean and sunflower was observed across multiple years, although the lowest prevalence of 15,2 and 3,2% was recorded in 2015 (n=112) and 2013 (n=95) for soya bean and sunflower, respectively.

The North West (n=57) and Limpopo (n=49) had the lowest mean prevalence of 7 and 10,2% in soya bean and sunflower, respectively, whereas the highest mean prevalence of 55,7 and 100% in soya bean and sunflower, respectively, was reported in Mpumalanga (n=244) and the Northern Province (n=3).

Figure 1: Binary *Sclerotinia* disease responses for each crop mapped per annum.



Weather affects disease intensity

The association between mean January, February and March weather parameters as well as disease intensity and prevalence was investigated through correlation analysis, to determine parameters potentially responsible for variation observed. A negative association between *Sclerotinia* and maximum and minimum temperature, as well as a positive association between precipitation and relative humidity was reported.

The relationship between the previous crop planted, maize/soya bean/sunflower, and *Sclerotinia* intensity was explored through conducting a Mann-Whitney U test (n=379). There was no significant reduction in *Sclerotinia* disease where maize had been planted the previous year for either crops.

This survey renders a historic overview of *Sclerotinia* and indicates the extent of *Sclerotinia* diseases in South Africa, emphasising the need for future research. The sporadic nature of this pathogen, the current epidemics observed, and potential spread to canola in the Western Cape further underpin the need to understand the underlying processes driving epidemic development.

*Citation: *Rothman, LA; McLaren, NW; and del Ponte, EM; 2021. The role of reproducible research tools in quantifying a decade-long survey of Sclerotinia disease prevalence in South Africa. Presented at the Southern African Society for Plant Pathology's virtual conference, 20 January 2021. Future Africa, City of Tshwane, South Africa. DOI 10.17605/OSF.IO/TQ3WJ*

For more information, contact Dr Lisa Rothman at coetzeela@ufs.ac.za. Follow the SA *Sclerotinia* Research Network on Facebook, Twitter and Instagram, @SclerotiniaZA, to get access to updates on *Sclerotinia* diseases. Presentation slides of these findings can be found at *https://osf.io/2r4fm/*.

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Amistar®

Amistar®-tegnologie vir die beheer van Sclerotinia-stamvrot en swartstam in kanola

Deur Francois van Deventer, tegniese bestuurder: swam- en onkruiddoders, Syngenta

As kontantgewas en belangrike rolspeler in wisselboustelsels, het kanola baie potensiaal. Buiten 'n groot aanvraag na olie en byprodukte soos oliekoek, bied die gewas ook talle voordele in 'n langtermyn-wisselboustelsel. Dit lei onder andere tot 'n verhoging in graanopbrengs weens beter wortelontwikkeling, en kan tot 'n verlaging in siektedruk vir opvolggewasse lei.

Alternatiewe meganismes

Waar produsente sukkel met moeilik beheerbare of weerstandbiedende onkruide, bied kanola ook opsies om onkruiddoders met alternatiewe meganismes van werking te gebruik. Kanola is ongelukkig nie kwytgeskeld van siektes wat 'n wesenlike impak op opbrengs kan hê nie.

Twee ekonomies belangrike patogene in kanola is *Leptosphaeria maculans* (ongeslagtelike fase is *Phoma lingam*) wat swartstam/stamkanker veroosaak, en *Sclerotinia sclerotiorum* wat stamvrot veroorsaak. Beide kan oor die kort termyn tot ernstige opbrengsverliese lei, terwyl *Sclerotinia* vir jare daarna nog 'n probleem in vatbare gewasse kan wees.

Sclerotinia-stamvrot

Sclerotinia-stamvrot het oor die jare 'n toenemend belangrike siekte in kanolaproduserende gebiede geword. Die primêre inokulum kan afkomstig wees vanaf sclerotia wat in die grond oorleef het, hetsy van geïnfekteerde plantreste in of naby die land, sowel as vanaf alternatiewe onkruidgashere.

Dit beskadig vaatweefsel in die stam, en gevolglik kan water en voedingstowwe nie doeltreffend vervoer word nie. Die patogeen floreer waar klimaatstoestande in sy guns tel. Temperature van sowat 15°C met gepaardgaande langdurige, vogtige (hoë humiditeit) omstandighede in die weke net voor kanola begin blom, sal tot hoë druk lei.

Infeksie vind hoofsaaklik snags plaas wanneer temperature effens daal en die mikroklimaat binne die bladerdak van die kanola-land ideaal is.

Swartstam en stamvrot

Swartstam/stamvrot (*Leptosphaeria maculans*) oorleef primêr op die vorige seisoen se plantreste. Die patogeen is ook saadgedraag. Waak dus teen swak gehalte, onbehandelde of teruggehoue saad wat 'n inokulumbron kan wees.

Die ideale omstandighede vir die patogeen is koel, vogtige weer in die herfs. Jong saailinge word gewoonlik vroeg in die seisoen vanaf besmette plantreste geïnfekteer. Die swam bly latent in die plant tot later in die seisoen, wanneer dit weer aktief begin ontwikkel. Dit sal dan lei tot stam- of kroonkanker, wat gevolglik tot omval of plant-afsterwe lei.

'n Geïntegreerde benadering

'n Geïntegreerde benadering is die sleutel tot die suksesvolle beheer en onderdrukking van hierdie siektes. Eerstens moet gewastoestande so ver as moontlik bestuur word, deur te kyk na gewasrotasiestelsels en die plant van weerstandbiedende kultivars.

Die mikroklimaat binne die land sal ook 'n rol in *Sclerotinia*-infeksies speel, en hier kan die blaardakdigtheid bestuur word deur die kultivarkeuse, bemesting en plantestand te bestuur.

Chemiese beheer is noodsaaklik

Omgewingsfaktore kan nie altyd beheer word nie; daarom bly chemiese beheer die kern tot die beheer van hierdie siektes. Vir effektiewe resultate moet 'n geregistreerde middel op die regte tyd toegedien word.

Amistar® van Syngenta is geregistreer op kanola vir die beheer van, onder andere, swartstam en *Sclerotinia*. Amistar® bied uitstekende lang nawerking en is 'n hoogs sistemiese strobilurienswamdoder. Dit is 'n waardevolle stuk gereedskap in die hand van die produsent om, saam met landboukundige praktyke, beide siektes te help beheer.

Tydsberekening van toediening is krities en Amistar® moet altyd voorkomend gebruik word. In geteikende siektebeheerprogramme (enkelbespuiting) word 'n bespuiting teen 500ml/ha nie later as die twee- tot vierblaarstadium aanbeveel nie.

Vir effektiewe *Sclerotinia*-beheer word 'n bespuiting van tussen 660 tot 1 000ml/ha aanbeveel by 10 tot 25%-blom. Waar beide siektes beheer moet word, word aanbeveel dat die eerste bespuiting by twee- tot vierblaar vervang word met Score® en by 10 tot 25%-blom opgevolg word met Amistar®. Die afwisseling van aktiewe bestanddele ondersteun dan ook 'n deeglike antiweerstandsbestuurstrategie.

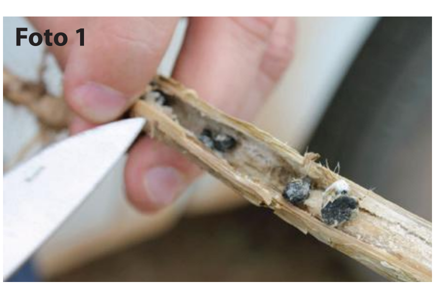

Foto 1 links toon 'n geval van Sclerotinia sclerotiorum *of stamvrot in kanola, en regs is 'n geval van swartstam, ook in kanola. (Foto's verskaf deur Pieter Burger)*

Lees die produk-etiket vir volledige inligting. Amistar® bevat asoksistrobien (Reg. nr. L6230, *Wet 36 van 1947*): VERSIGTIG. Score® bevat difenkonasool (Reg. nr. L5132, *Wet 36 van 1947*): VERSIGTIG. Amistar® en Score® is geregistreerde handelsmerke van die Syngenta-groep. Vir meer inligting, kontak Syngenta Suid-Afrika by 011 541 4000 of besoek *www.syngenta.co.za*.

Manganese

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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].

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

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Soya bean nitrogen management and effectiveness

By Jonathan R Etherington, director of MBFi (Pty) Ltd

Soya bean inoculants have come a long way on a global scale over the past decade, with higher quality products and increased efficiency of *Bradyrhizobium japonicum* (*B. japonicum*) products in nodulating soya beans.

In South Africa we have seen the soya bean production area grow considerably and expand to new areas throughout the country. There are very different growing conditions from the east to the west of our country, and consideration must be given to each situation that could influence the treatment of nitrogen-fixing bacteria.

Environmental impact

I would like to congratulate soya bean growers for reducing their impact on our environment and requirement for chemically based petroleum fertiliser, chemical nitrogen (N). As soya beans require high amounts of N of between 70 to 105kg/ton of yield, we will require a lot of N to produce this amount of protein.

As soya bean growers in South Africa, we will need to use around 405 287 820 litres of oil to produce around 306 000 tons of urea fertiliser for our crops (figures based on estimated N and hectares of soya bean production). By using high quality inoculants, we can reduce this dependence on oil and N, making farming more sustainable for future generations to come.

Every producer has to decide which product to use on their soya bean crop and how to manage the treatment. This article contains some basic guidelines on which to base this decision.

Registration process

Nitrogen-fixing bacteria resort under the pesticide registration process of the Department of Agriculture, Land Reform and Rural Development (DALRRD) in South Africa. All products must be registered under the aforementioned *Act 36* in order for them to be sold. The supplying company must prove the efficacy of the product over a minimum of three trials for the specific treatment of the product.

South Africa is currently one of the countries experiencing more difficulty registering *Rhizobium* products, with regulations similar to Canada, Brazil and Argentina. We have seen a number of new products come into the market that are not on specification this year and a number of which are not registered. This is cause for concern, given the magnitude of problems this may cause to the soya bean yield.

The role of *B. japonicum*

All soya bean varieties rely on *B. japonicum* for biological N fixation. The Agricultural Research Council (ARC) in South Africa isolated *B. japonicum* WB74 many years ago and this isolate has since been used as an effective means to nodulate soya bean plants. There are, however, various strains around the world which can and will fix high volumes of N, e.g. USDA 110, 442, Semia 5081 and many more.

Although all these isolates fall under the same species, they sometimes display differences in nutrient requirements, growing conditions and formulation requirements which the manufacturers or suppliers will need to understand. Product effectiveness will also have to be proven in a greenhouse and in the field in order to be registered under *Act 36* as a legume inoculant for N fixation. All the strains mentioned above have been registered in South Africa and are effective, but will have different application guidelines to be truly effective.

Active ingredient concentration

Multi-strain products can sound great to the ear as it implies a dual or triple mode of action, but in biological products, active ingredient concentration is critical to the performance of the product. At a formulation of 1-2 x 10^{10} CFU/ml, we are very close to the maximum number of

When planting soya beans, the best conditions are crucial for good nodulation and plant germination.

cells that can be produced under liquid fermentation, unless you can centrifuge the product and make it a more concentrated formulation of 1-2 x 10^{11} CFU/ml.

Once a saturated solution has been achieved, the numbers of the one *B. japonicum* strain need to be reduced in order to add another to the formulation. Now, there are two or more strains of *B. japonicum* in the product, one of which will be more dominant in performing the targeted action – in this case, N fixation on soya bean. Essentially, you now have a reduced volume of the dominant strain of bacteria performing the task.

Effect of product quality

The quality of the product is a very important aspect of *B. japonicum* and will influence effectiveness in the field. Due to the slow growth rate of these micro-organisms, the final product must be contaminant-free and contain a high amount of the micro-organism. It will be easily noticeable if a *B. japonicum* product is contaminated, since this micro-organism does not produce a foul-smelling product. Any bacterial contaminant will result in a foul-smelling product and possible swelling of the bladder.

Looking back ten years, most of the products in the market were manufactured at 1-2 x 10^9 CFU/ml with one to six months' shelf life, with 24 hours to treat and plant the product. With new technologies, however, products can be produced at 1-2 x 10^{10} CFU/ml and 18 months' shelf life, with 60 days between treatment and planting. This illustrates how products are now more stable and of higher quality with added technology to protect the bacteria on the seed. With the longer shelf life, improved seed survival and ten times more bacteria per millilitre, we have clearly come a long way over the past decade.

Nodule placement

The placement of nodules is also very important, as the amount of plant available N it can produce, is ten times more on the primary root as opposed to the secondary root structure. Be careful not to look at the number of nodules only, but rather at the positioning on the root zone. This is very important – the same amount of N can be fixed by one nodule of the same size in dry weight on the primary root, as ten nodules on the secondary root.

Various technologies such as OSMO protection, signal generation, microbial membrane protection (MMP), extracellular polysaccharide (EPS) and bacterial protectors, result in superior inoculants compared to normal *B. japonicum* products.

OSMO protection, one of the most common technologies, utilises compounds known as osmolytes to maintain the integrity of the cell under environmental pressures. This makes the bacteria hardier and increases survival during desiccation when cells are placed on the seed or in the soil. During the production process, the cells are exposed to sufficient moisture, away from UV radiation. These ideal conditions are, however, removed once the product is applied to seed or in soil.

We need to utilise the best technologies available to help bacteria overcome these stressors in order to increase effectiveness in the field. There is a fine balance between sticky/wet seed and practical planting ability of the seed, the best seed being slightly sticky/wet to increase bacterial survival. In all cases, calibration of your planter must be done using treated seed.

Influence of planting conditions

Planting conditions are extremely important as bacteria and seed require moisture to germinate and grow. This is often easier said than done with our local growing season. Producers are constantly pushing the boundary to plant or not, due to dry soil and a very hot top 5cm of soil at 40 to 50°C. When planting soya beans, the best conditions are crucial for good nodulation and plant germination.

The South African environment is far more arid compared to the rest of the world. Take the three biggest soya bean growing regions in the world. In winter, the United States (US) has snow of 0,5 to 1,5m deep, and high organic matter. They need the soil to dry out before planting. Brazil has a high rainfall figure and high humidity, similar to the east coastal region of KwaZulu-Natal, with a fair amount of organic matter but low pH soils.

Argentina generally receives a few hundred millimeters of rainfall in winter with high organic matter ranging from 2 to 5%. They can normally plant winter wheat with great yields under dryland conditions but moving west, this changes to more arid conditions with organic matter from 0,5 to 2% and reduced moisture.

All these major regions are generally at sea level whereas South African conditions are at 5 000 to 6 000ft above sea level. A more suitable comparison is the western region of Argentina. South African producers face challenging conditions of low organic matter of 0,25 to 0,75%, low soil pH (KCl) 4 or pH (H_2O) 5, and a dry starting point. Of course producers can enjoy good yields, but they must be mindful of these conditions under which soya beans are produced in South Africa.

Aspects to consider during treatment

When treating biological products to your seed via seed treatment or through in-furrow application, temperature and sunlight must be taken into account. *B. japonicum* must be stored at a maximum of 25°C ambient temperature and away from sunlight.

Operations must be managed strictly. For example, when undertaking a seed treatment, take only the seed you will use for the morning planting and return to the store more frequently to collect fresh treated seed that is stored carefully and responsibly in your shed. Managing the treatment and treated seed on farms, is very important for great results.

The physical treatment of seed is vital to a good start, and every seed must be treated with the same amount of *B. japonicum* as the next. Ensure that the treatment machine is clean and free of any chemicals that will influence the bacterial treatment. Seed treatment machines must be calibrated at least daily. Calibrating the seed treatment machine when moving from one variety to the next is also very important, as seed size will influence the flow rate of the seed through the machine. If this is not done, the product's results could vary.

Treatment methods

There are three types of treatment methods, namely slurry mixture, wet sequential, and dry sequential. When using a slurry mixture, all products must be added into one container. These include *Rhizobium*, biologicals, chemicals, nutrients, and/or water. You will need to treat and plant as soon as possible, as this method poses a massive risk for bacterial survival.

The most economical method is wet sequential treatment, which entails creating wet layers of treatment: first liquid chemical treatment, then *Rhizobium* and thirdly, drying powder or DS/WP fungicide. This method can be achieved in a seed treatment machine using various applicators on the machine. The best method is to allow each treatment to dry between each application. This is often not feasible and is very impractical, but from a treatment point of view, this is by the far the best way.

Molybdenum and cobalt

Molybdenum and cobalt are vital to the functioning of the nitrogenase enzyme which acts as a catalyst to N fixation in soya bean and legume plants. Without molybdenum and cobalt, the N fixation process will be limited. Certified seed producers will apply three to four applications of molybdenum in the production cycle of the seed to increase the molybdenum in the seed.

Various journals show that a soya bean seed can contain more than 1 000 times molybdenum within the seed, if applied during the production cycle rather than a seed treatment on the seed. Molybdenum and cobalt can be applied as a seed treatment or foliar application in the growing season, and will help your nitrogenase activity.

There are some warnings, as both are salts which will dry out bacteria on the seed when treating them together with a *Rhizobium*. Be sure when applying molybdenum and cobalt to the seed treatment, to plant within 4 to 6 hours after seed treatment. Use a very high quality *Rhizobium* inoculant with OSMO protection technology to increase survival of the bacteria, as this will be crucial to nodulation.

Use of fertilisers

Fertilisers are important to soya bean yield, but managing the type and placement is very important. Too much N is highly problematic. Around 10kg/ha is more than sufficient for planting. Any more than this will hamper nodulation and delay the process.

Placement needs to be a minimum of 50mm below and 50mm on either side of the seed to prevent moisture and salt burn. Far too many growers are being advised to use maize fertiliser blends for their soya beans, when they really need to use P, K, S, Ca, Mg and micro-elements to increase soya bean yield. However, this needs to be specially created for your soya bean crop.

The R1 growth stage is when growers and agronomists need to evaluate the nodulation process and assess its success. If not, action is needed. Apply high volumes of N fertiliser of 100 to 200kg/ha of N, which would be around 100 to 450kg of urea or 200 to 700kg of LAN, depending on the conditions and soil type. Talk to your local agronomist for final details of this application. Between 70 and 105kg of N is needed per ton of soya beans. This is much more than maize which requires around 15kg/ton of N.

In-furrow or seed treatment?

I have run many trials statistically and commercially in side-by-side trials, and both methods of application of *Rhizobium* are effective. It really depends on how growers manage their farm operations. If you are comfortable with either method, choose the best one for you.

In-furrow treatment yields slightly, but not significantly more secondary nodulation and can in some cases seem more effective. Once harvested, though, you generally don't see any significant yield advantage due to the placement and efficacy of the nodules on the secondary root structure. Many growers treat the seed and apply the product in-furrow to cover any treatment mistakes. This works well to ensure effective results.

As we are increasingly planting in sandy soils in the western region, nematode pressure and control are vital to good soya bean production but also influence *Rhizobium* nodulation, N fixation and the ability to have space on the root structure. Contact your chemical agent for registered options available.

Soya bean inoculants are very important to your farming operation, as they provide high amounts of N to your soya bean crop. Its impact can range from 200 to 1 500kg of yield per hectare. Depending on the soil, region and yield of your planted crop, it could equate to as much as 40% of your crop yield. Be sure to get the treatment correct via seed treatment or in-furrow applications.

For more information, email the author at jonathan@mbfi.co.za or phone 082 738 0080.

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Introducing Pannar's exceptional soya bean range

By Nico Barnard, agronomist: Central Highveld, Pannar Seed

Pannar's soya bean cultivars demonstrate excellent performance and stability over different yield potentials, production areas and seasons. These cultivars provide a winning combination of yield and agronomic traits, allowing producers to plant with confidence. The package includes a full range of maturity groups (MG) covering almost all planting dates, planting densities and production areas' needs.

The new PAN 1479R

This is a new glyphosate-tolerant quick (MG 4,6) cultivar that replaces PAN 1454R. PAN 1479R is recommended for the main planting window in cool production areas. It is also recommended for eastern temperate production areas as part of a cultivar package, or where a quick cultivar is required to extend the harvesting phase over a longer period.

Cultivars for different areas

Plant density, planting date and growth class are crucial factors to consider when selecting cultivars. Cultivars are classified into twelve MGs, from maturity group 00 to 9, with 00 being the quickest and 9 the longest or latest growth class. This division is determined by the daylight length a cultivar needs to develop optimally.

Table 1: Five-year average for different growth classes, according to the ARC's trials.

Growth class	Year/s	Cool	Temperate east	Temperate west
4,5 to 5,4	2015 to 2016	98	87	94
	2016 to 2017	103	88	99
	2017 to 2018	103	87	87
	2018 to 2019	98	90	95
	2019 to 2020	108	84	91
	Average	**102**	**87**	**93**
5,5 to 6,4	2015 to 2016	102	110	103
	2016 to 2017	99	101	101
	2017 to 2018	95	103	103
	2018 to 2019	103	104	102
	2019 to 2020	98	100	102
	Average	**99**	**104**	**102**
6,5 to 7,5	2015 to 2016	73	107	102
	2016 to 2017	97	104	94
	2017 to 2018	89	101	103
	2018 to 2019	97	104	101
	2019 to 2020	96	103	104
	Average	**90**	**104**	**101**

An MG 9 cultivar is suitable for planting in areas close to the equator, and MG 00 for areas as far north or south of the equator as possible. In South Africa, cultivars in MG 4,5 to 7,5 offer good crop security for local conditions.

Soya beans should be planted at the same time or even before maize. As daylight length decreases along with the season after 22 December, plants start transitioning from vegetative growth to reproductive development (flowering). Regardless of the planting date, different plantings flower close together. The benefit of planting early is larger plants due to better vegetative growth. This results in more plant internodes and then buds, from which flowers form to produce pods.

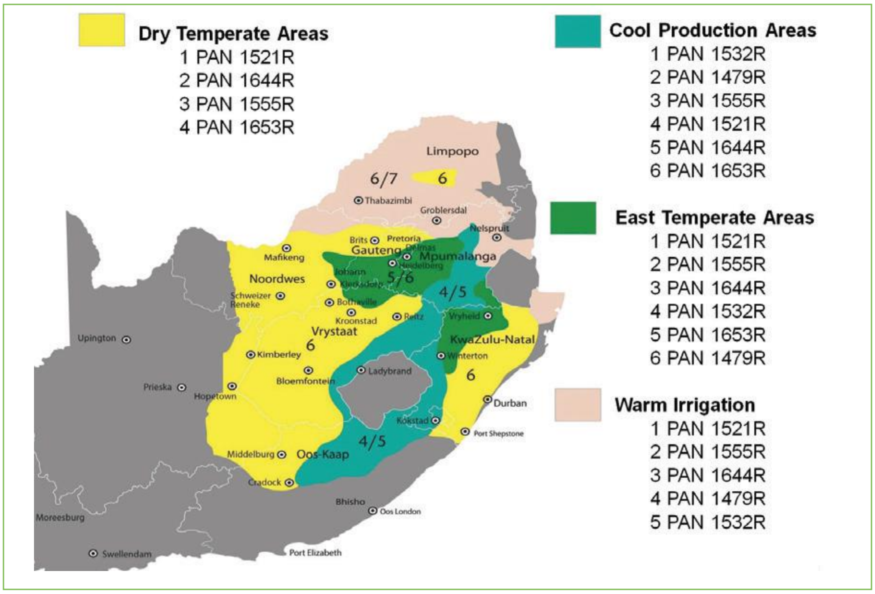
Regarding plant density, the seedlings need to be protected for an optimal plant population. In the period between germination and emergence, the neck of the soya bean seedling is extremely sensitive and can easily break off. Tillage and planting depth greatly influence the survival of seedlings. The deeper the seed is planted in the soil, the thinner the neck extends to get above the soil surface and the greater the risk for damage.

Disc harrowing a soya bean field between planting and the emergence of seedlings is not recommended. Plant population depends on soil type, farming practices, row widths and

Table 2: Cultivars arranged according to different growth classes and optimal package compositions.

MG	Quick	Medium	Late
	4,5 to 5,4	5,5 to 6,4	6,5 to 7,5
	PAN 1479R	PAN 1555R	PAN 1644R
	PAN 1532R	PAN 1521R	PAN 1653R
Area recommendation as a percentage of package			
Cool	50	40	10
Temperate east	10	50	40
Temperate west	–	50	50
Hot irrigation	10	50	40

Figure 1: Cultivar recommendations in a preferred order by region.



planting date. With early planting dates, a slightly reduced plant population can still be effective, but it is better to establish a higher plant population.

Selecting cultivars from MGs

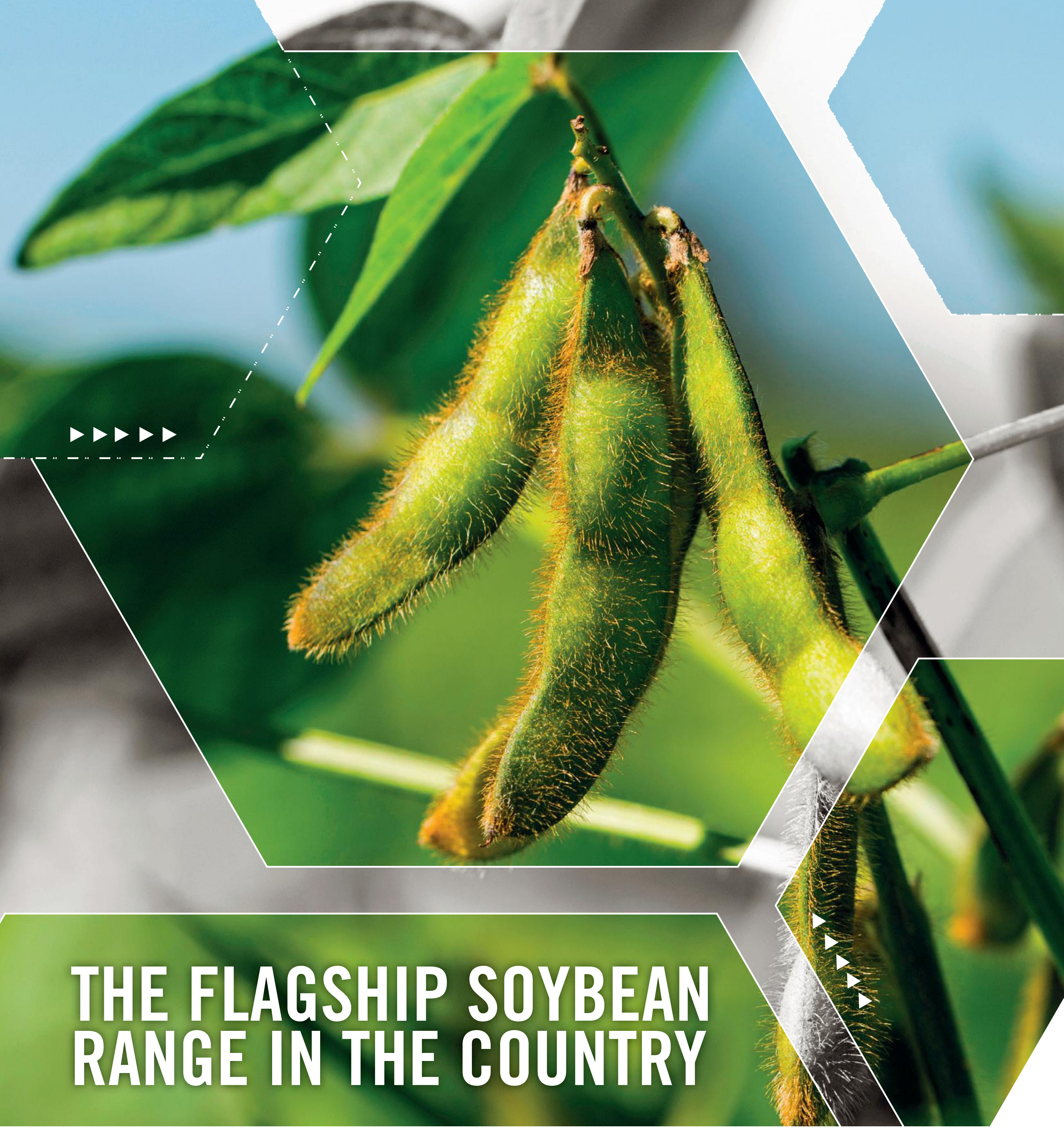
A package of different cultivars is highly recommended. *Table 1* summarises the average performance in the Agricultural Research Council's (ARC) national trials over five years per growth class for the different regions. This indicates the most suitable MG per production region.

In *Table 2,* the cultivars are arranged in different growth classes and the optimal package composition is indicated, i.e. the optimum percentage that each growth class can make up of the package to manage risk optimally.

When there is no rain in February or March, MG 4,5 to MG 5,5 will perform better than MG 5,5 to MG 7,5. The opposite applies if there is satisfactory rainfall during the second half of the season. Over the long term, MG 5 and MG 6 have been found to give the most stable yields and most of the cultivar package should be composed of these growth classes.

Pannar offers a complete range of cultivars composed of different growth classes and traits to meet almost all planting date and production area combinations. Coupled with our expertise in local conditions, exceptional agronomic support and development programmes, we provide excellent advice to producers to optimise production.

For more information, contact Nico Barnard at nico.barnard@pannar.co.za or 082 850 1503.



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Area shifts expected in South Africa's 2021 winter crop season

By Divan van der Westhuizen and Tracy Davids, Bureau for Food and Agricultural Policy

Over the past year the Covid-19 pandemic and the measures implemented to contain its spread, sent shockwaves through the global economy. Initially, this period saw a decline in investor confidence, which resulted in a major sell-off in financial markets and a drastic depreciation in many emerging market currencies, including South Africa.

Reduced economic activity and a persistent price war in major oil-producing countries caused the largest oil price crash in decades. As the global vaccine roll-out continues and economic recovery gains momentum, oil prices have risen once more, and the rand has recovered to levels last observed prior to the first lockdown in South Africa.

By the second half of 2020, the signs of a perfect storm brewing in agricultural commodity markets became more evident, with different factors considerably shifting supply-and-demand dynamics. This article highlights some of these trends and provides context on how they affect domestic agricultural markets, with specific focus on prices as well as supply-and-demand movements for the upcoming winter crop season and profitability at farm level.

Sharp rise in commodity prices

Globally, agricultural commodity prices have increased sharply. According to the FAO Food Price Index, which is indicative of underlying agricultural commodity prices, a steady increase has been observed since June last year, which accelerated in recent months. By February 2021 it had increased by almost 17% relative to February last year, mainly driven by vegetable oil prices (+51% y/y), followed by cereals (+27% y/y), sugar (+10% y/y) and dairy products (+10% y/y).

These price increases were driven by a combination of supply-and-demand dynamics. Import demand from China has been particularly strong for both maize and soya beans. This is predominantly due to the rapid rebuilding of its pig herd, which had been reduced by roughly 30% in 2019 amid the outbreak of African swine fever, as well as a fast-growing poultry sector.

On the supply side, palm oil production growth had been under pressure. This was exacerbated by labour shortages in Malaysia caused by Covid-19-related travel restrictions. At the same time, sunflower seed harvests in the Black Sea region were below average due to weather-related challenges, and persistently drier weather in South America raised concerns about soya bean supply.

Winter crop production outlook

Global price dynamics spill over into South African markets. They will continue to influence planting decisions for the upcoming South African winter crop season. Domestically, several lockdowns over the past year prohibited the sale of alcoholic beverages in South Africa, reducing the demand for malting barley.

This follows a period of growing production and increased stock levels in the barley industry. To compound the situation, exceptional yields provided a record barley crop last year and, combined with weather-related quality issues, resulted in more volumes being diverted to animal feed. A lower anticipated malting barley demand for the beer market and remaining higher stocks, will result in decreased barley mandates for the 2021 season.

Consequently, the area under production will decline and a shift to alternative crops are likely, especially in

Table 1: Area and production of winter crops in South Africa from 2017 to 2021. (Source: BFAP, 2021)

Crops	Area – ha ('000)			
	Average 2017 to 2019	2020	2021 projection	Absolute change: 2020 to 2021
Wheat				
Winter region	323	326	352,1	26,1
Summer dryland region	102,7	94	78,9	-15,1
Summer irrigation region	86	89,8	91,9	2,1
Total	511,7	509,8	522,9	13,1
Barley				
Winter region	105,7	132	82,9	-49,1
Summer region	8,4	9,7	10,2	0,5
Total	114,1	141,7	93,1	-48,6
Canola	78	74,1	89,3	15,2
Crops	**Production – tons ('000)**			
	Average 2017 to 2019	2020	2021 projection	Absolute change: 2020 to 2021
Wheat	1 646	2 109	1 857	-253
Barley	358	590	335	-255
Canola	98	167	137	-30

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the dryland Western Cape production regions. *Table 1* provides a comparison between winter crop area and production over the past four years. It also provides the Bureau for Food and Agricultural Policy's (BFAP) latest projections for the upcoming wheat, barley and canola season in 2021.

The likely reduction in contracted barley volumes creates a scenario where area under barley production in the Western Cape can decrease by 49 000 hectares relative to last year, with production declining by 255 000 tons. This decline in area will most likely be substituted with wheat, canola and alternative crops such as oats, lupines and pastures.

Given favourable wheat prices, the likely retraction in barley mandates, and the risk associated with lower prices for feed grade barley, the South African wheat area is projected to increase by 13 100 hectares, largely due to expansion in the Western Cape and despite a further decrease in the summer production region. The area under canola production is projected to increase by 15 200 hectares, underpinned by robust yield performance last year and price support from vegetable oil markets.

Figure 1 presents the projected gross margins for dryland winter crop production in the Western Cape. The gross margin figures represent a weighted average for the Swartland and Southern Cape production regions.

The gross margins are computed by multiplying the region's targeted yield (which is based on agro-ecological potential) with a farm gate price (South African Futures Exchange or derived price minus deductions, including grade and transport differentials), minus direct expenditure.

It is important to note that overhead costs such as production finance interest, depreciation, administration, land rent and owner remuneration are not included in the calculations.

Robust performance is expected

The baseline projection for the 2021 season points to robust performance for all winter crops relative to previous seasons. The analysis shows that barley can perform well under the strict assumption that only malting grade is produced and in fact sold as malting barley.

Compared to last year, the gross margin for canola is projected higher, underpinned by a higher contracted price assumption for the upcoming season. *Figure 2* compares the 2021 baseline gross margin projection against sensitivity that accounts for lower quality for wheat and barley, as well as varying yield assumptions for canola production in the Western Cape.

For wheat only a modest impact is experienced, given that a larger share of output is allocated to B2 and B3 quality grade (B2 and B3 share is equal to 68% relative to the baseline of 37%). For barley, however, assuming that 40% of production is graded at feed grade and sold at 75% of a yellow maize SAFEX equivalent price, the gross margin decreases by more than R2 000/ha.

For canola, gross margins are more sensitive to yield relative to winter grain production. The analysis shows that an increase in yield from the baseline assumption of 1,6 to 2t/ha (+400kg/ha) will result in canola outperforming alternative crops and will improve the gross margin by 41%.

Figure 2: Winter crop gross margin sensitivity analysis for the 2021 production season. (Source: Own calculations using data from a collaboration with Overberg Agri, Sentraal-Suid Koöperasie and Kaap Agri, 2021)

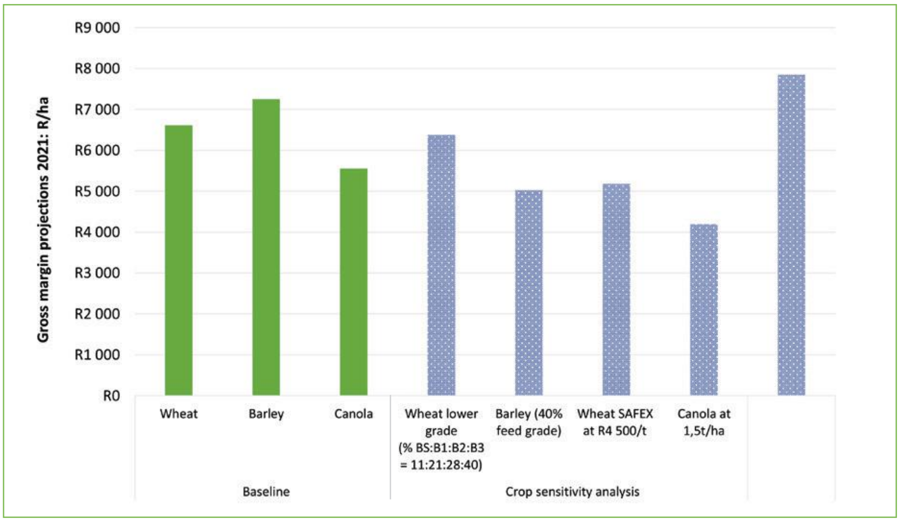
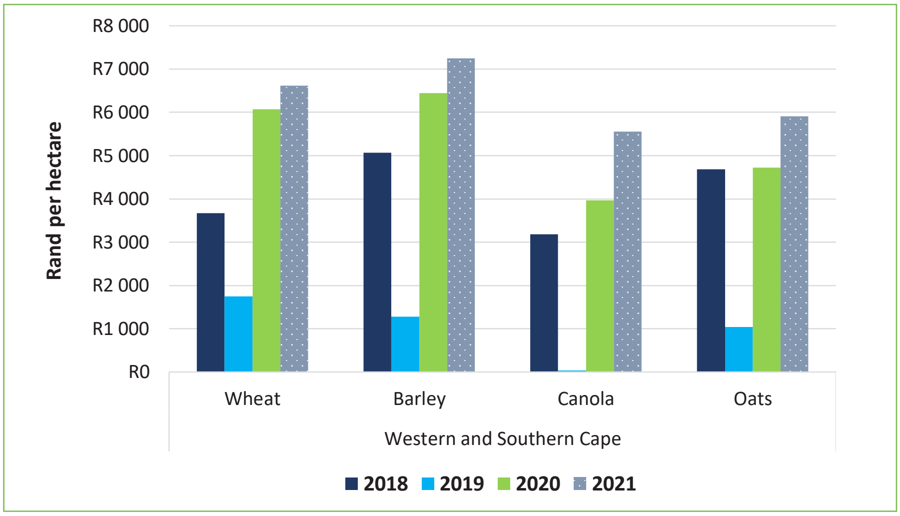


Figure 1: Winter crop gross margin projections for 2021. (Source: Own calculations using data from a collaboration with Overberg Agri, Sentraal-Suid Koöperasie and Kaap Agri, 2021)



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Role of seedling diseases **in poor sunflower establishment**

By Sandra C Lamprecht, Thabo J Phasoana, Anushka Gokul and Chris FJ Spies, ARC-PHP, Soilborne Plant Diseases Unit

Sunflower is grown in many parts of the world and is considered one of the most important oilseed crops. It is also a key crop in South Africa – in 2019, 678 000 tons were produced on 515 350 hectares. The most important production areas are in the Free State, Limpopo and North West.

Poor establishment is a major yield-limiting factor of sunflower production in South Africa. Although the contribution of other factors such as seedling vigour, seedbed preparation and soil temperature have been investigated, there was, prior to the current study, no information on the role of seedling diseases as a production constraint in sunflower production in South Africa.

Factors such as seedling vigour, plant depth, seedbed preparation and soil temperature have previously been identified as possibly contributing to poor establishment. However, seedling diseases have not been considered as playing a role in poor seedling establishment. This is most probably because information on seedling diseases of sunflower prior to the current study, was almost non-existent in South Africa.

Research conducted on soilborne diseases of maize and soya bean in South Africa, and on sunflower in other countries, showed that these field crops are susceptible to many soilborne pathogens that can cause damping-off and root rot, thus contributing to poor establishment. A study was therefore initiated to determine the role of seedling diseases in poor establishment of sunflower seedlings in South Africa.

Areas surveyed and sampling

Field trials were established with untreated and treated (fludioxonil, mefenoxam and thiamethoxam) cultivar PAN 7120 CL seed during 2014/15 and 2015/16 at six localities in the Free State, Limpopo, Mpumalanga and North West provinces. Sampling was conducted six weeks after planting and seedlings were also sampled from farm fields in these provinces. Both the seedlings and soil were collected from each sampling site for isolations and glasshouse bioassays.

Disease symptoms

Lesions were often observed on hypocotyls and cotyledons of seedlings, and cotyledons were sometimes completely rotten (*Figures 1A and B*). Dead seedlings or seedlings dying, and pre-emergence damping-off were quite rare. However, stunted seedlings were recorded at all localities, and often displayed root rot symptoms and the tap roots were usually stunted.

Pathogens

Isolations were made from diseased seedlings collected from all the areas sampled. At least 31 fungal genera, which included more than 94 fungal species, were obtained from diseased cotyledons, hypocotyls and roots. A large number of isolates representing each species from the different genera, was tested to determine their importance in causing disease on sunflower seedlings under glasshouse conditions. The effect of the standard seed treatment (fludioxonil, mefenoxam and thiamethoxam) against the pathogens that were identified, was also evaluated.

The most important pathogens were species within *Alternaria, Diaporthe, Fusarium, Macrophomina, Pythium* and *Rhizoctonia* which caused pre- and post-emergence damping-off, hypocotyl/stem rot, a reduction in growth and root rot.

Figures 1A and B: Lesions on hypocotyls and roots, and rotten cotyledons.

Alternaria

Alternaria species were isolated from seedlings from all localities. *Alternaria alternata (A. alternata)* and *A. tenuissima* were obtained from seedlings. The predominant species isolated was *A. alternata* and very few *A. tenuissima* isolates were obtained. *Alternaria* spp. was more frequently isolated from seedlings from untreated seed than treated seed, and was significantly more frequently isolated from the cotyledons and hypocotyls than the roots.

Glasshouse tests showed that *A. alternata* was the more aggressive of the two species with certain isolates causing significant root rot, although at low severities. However, neither of the two species significantly reduced the survival of seedlings or caused a reduction in growth when planted in soil infested with the pathogen (*Figure 2A*). Many of the isolates also caused lesions on stems (*Figure 2B*).

Research conducted in other countries showed that seedborne *A. alternata* can reduce seed germination and cause seedling mortality. However, seed infected with *A. alternata* and tested by us under glasshouse conditions, did not reduce seedling survival. *A. alternata* was also reported by other researchers to cause leaf blight in sunflower in South Africa.

Diaporthe

Diaporthe species were isolated from seedlings collected in all the provinces, but was more prominent on seedlings in North West compared to the other three provinces. They were also significantly more frequently obtained from hypocotyls than cotyledons or roots of seedlings. Seed treatment did not affect the incidence of these fungi in seedlings. Four species were obtained and one of these is currently being described as a new species.

Diaporthe gulyae was the most frequently isolated species and the most virulent when tested for pathogenicity on seedlings under glasshouse conditions. The fungus did not affect seedling survival or growth and did not cause root rot. However, it caused quite severe dieback of stems of seedlings under glasshouse conditions.

Diaporthe species are important stem canker pathogens of sunflower in other countries. The isolation of these fungi from sunflower seedlings may have important implications not only for seedling health, but also for stem canker on older plants.

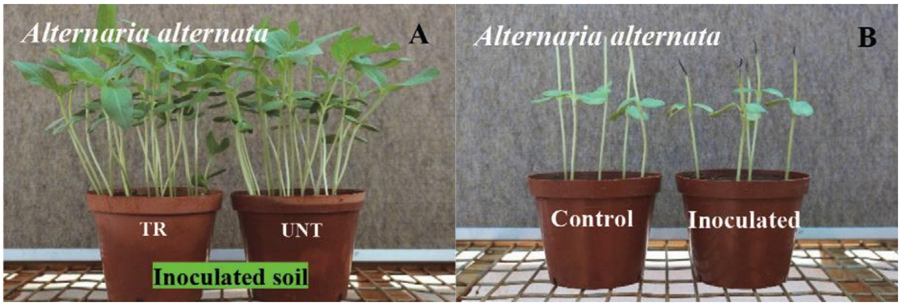
Fusarium

At least 38 *Fusarium* species or species complexes were isolated from sunflower seedlings. *Fusarium* species/species complexes were one of the predominant groups obtained from the seedlings and occurred on seedlings in all the provinces. The most frequently isolated species were species complexes of *Fusarium incarnatum-equiseti* (FIESC), *F. oxysporum* (FOSC) and *F. solani* (FSSC).

FIESC was isolated more frequently from cotyledons than hypocotyls and roots, whereas FOSC and FSSC were isolated much more frequently from the roots than cotyledons or hypocotyls of seedlings and incidences were higher on seedlings from untreated than treated seed.

Many of the species caused a slight reduction in survival and low root rot severities. However, a species within the

Figure 2: Effect of *A. alternata* on survival of seedlings planted in soil inoculated with the fungus and planted to treated (TR) and untreated (UNT) seed (A), as well as stem lesions caused by the fungus under glasshouse conditions (B).



F. solani species complex caused a significant reduction in survival and growth, as well as severe root rot that killed the seedlings. Seed treatment was not effective to manage this pathogen (*Figures 3A and B*).

Certain of the *Fusarium* species, such as *F. andiyazi* and *F. verticillioides*, also caused stunting of the taproots of seedlings (*Figure 3C*). Many *Fusarium* spp., including *F. equiseti, F. oxysporum, F. solani* and *F. verticillioides*, have been associated with diseases of sunflower seedlings in other countries, and the importance of *Fusarium* spp. as pathogens of sunflower seems to increase worldwide.

Figure 3: Effect of a species within *Fusarium solani* species complex on survival and growth of seedlings planted in soil inoculated with the fungus, and planted to untreated (UNT) and treated (T) seed (A), as well as root rot caused by the fungus under glasshouse conditions (B), and root rot and stunting of tap roots caused by *Fusarium andiyazi* (C).

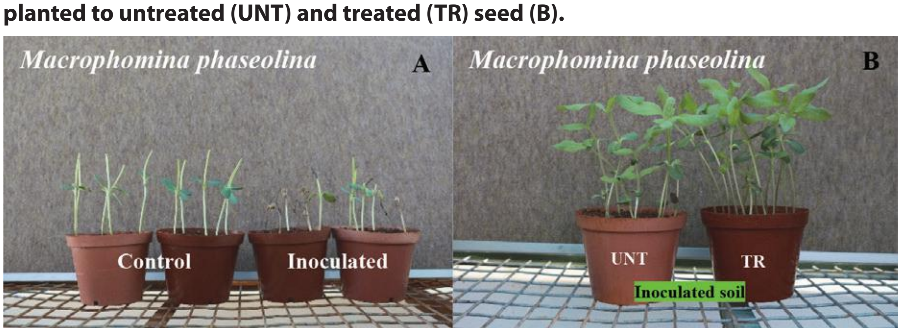
Macrophomina

Macrophomina phaseolina was frequently isolated from seedlings, and significantly more frequently from roots than cotyledons and hypocotyls. There was no difference in the incidence of the fungus on seedlings from treated and untreated seed planted in field trials. The fungus was frequently obtained from localities in the Free State, Limpopo and North West provinces.

Glasshouse tests evaluating 50 isolates for their ability to cause disease on seedlings showed that the fungus, except for one isolate, did not cause a reduction in survival and caused more severe above-ground symptoms than root rot. The seed treatment significantly improved survival of seedlings in soil infested with the isolate, which caused a reduction in survival and root rot of seedlings (*Figures 4A and B*).

It is known that *M. phaseolina* can be both soil- and seedborne, is an important pathogen of sunflower, and can cause charcoal rot and root rot. If seedborne, the fungus can reduce germination and vigour of sunflower seed and cause damping-off and seedling blight. The seed used in our trials were tested and were not infested with the fungus.

Figure 4: Stem lesions caused by *Macrophomina phaseolina* under glasshouse conditions (A), and survival of seedlings in soil inoculated with the fungus and planted to untreated (UNT) and treated (TR) seed (B).



Pythium

Pythium species were obtained from seedlings from all provinces, and more frequently from seedling roots than cotyledons and hypocotyls. There was no significant difference in the incidences of *Pythium* spp. in seedlings from treated and untreated seed. Six *Pythium* species were obtained from the seedlings that were collected, the most virulent species being *P. irregulare* and *P. ultimum* var. *ultimum*.

P. irregulare significantly reduced survival and growth of seedlings, and caused cotyledon and root rot, while *P. ultimum* var. *ultimum* only caused root rot, but significantly less than *P. irregulare*. Although seed treatment significantly improved survival and growth, and reduced cotyledon and root rot of seedlings in soil inoculated with *P. irregulare*, seedlings from treated seed were still stunted.

Information on *Pythium* spp. as pathogens of sunflower seedlings in other countries is very limited. Our information thus far showed that it is possible that *Pythium* spp., especially *P. irregulare*, is one of the pathogens that may contribute to the stunted growth of sunflower seedlings, which is quite common in many sunflower fields.

Rhizoctonia

Rhizoctonia anastomosis groups were obtained from all the localities sampled. There was no difference in the incidence of *Rhizoctonia* obtained from seedlings from treated and untreated seed and these fungi were isolated from cotyledons, hypocotyls and roots of seedlings.

Fourteen *Rhizoctonia* anastomosis groups were obtained from sunflower seedlings and four of these were pathogenic on sunflower seedlings, namely AG 2-2LP, AG 4 HGI, AG 4 HGIII and an unidentified anastomosis group temporarily labelled as SB3. These anastomosis groups caused a severe reduction in survival of seedlings, as well as hypocotyl and root rot, with AG 4 HGI and SB3 being the most virulent.

The seed treatment was quite effective in controlling AG 2-2LP, AG 4 HGIII and SB3. However, although the seed treatment improved survival and reduced hypocotyl and root rot of seedlings in soil inoculated with AG 4 HGI, it was still not satisfactory. This anastomosis group was obtained from seedlings collected from North West, whereas SB3 was obtained from seedlings from all provinces.

The information on *Rhizoctonia* anastomosis groups as pathogens of sunflower in other countries is very limited, but it appears that it may contribute significantly to poor establishment of sunflower seedlings in South Africa.

In conclusion

The results of the surveys and glasshouse studies showed that many fungal species, including important pathogens, are associated with sunflower seedlings and that certain fungi were more prevalent in some localities than others. This clearly shows that seedling diseases are caused by a complex of pathogens which can significantly reduce survival and growth of seedlings as well as cotyledon, hypocotyl and root rot, and can therefore contribute to poor establishment.

Pathogenicity studies identified the most important pathogens. Many of the pathogens identified have a broad host range and cannot be controlled with crop rotation. Since crop rotation is such an important part of conservation agriculture, crops that are susceptible to some of the same pathogens, such as maize, sunflower and soya bean, are often rotated in the same field.

Effective seed treatments can play a significant role as part of an integrated management strategy to protect sunflower against pathogens with a broad host range. The results obtained from seed treatment trials under glasshouse conditions showed that although the standard seed treatment, which targets a broad range of pathogens, is effective against many of the pathogens, it is unfortunately not effective against all the virulent pathogens identified.

Proper establishment of seedlings is very important to improve yield and is an essential component of sustainable production. Research is therefore currently being conducted to evaluate a range of seed treatments to identify the most effective treatment that will target most of the important pathogens responsible for poor establishment of sunflower seedlings in South Africa.

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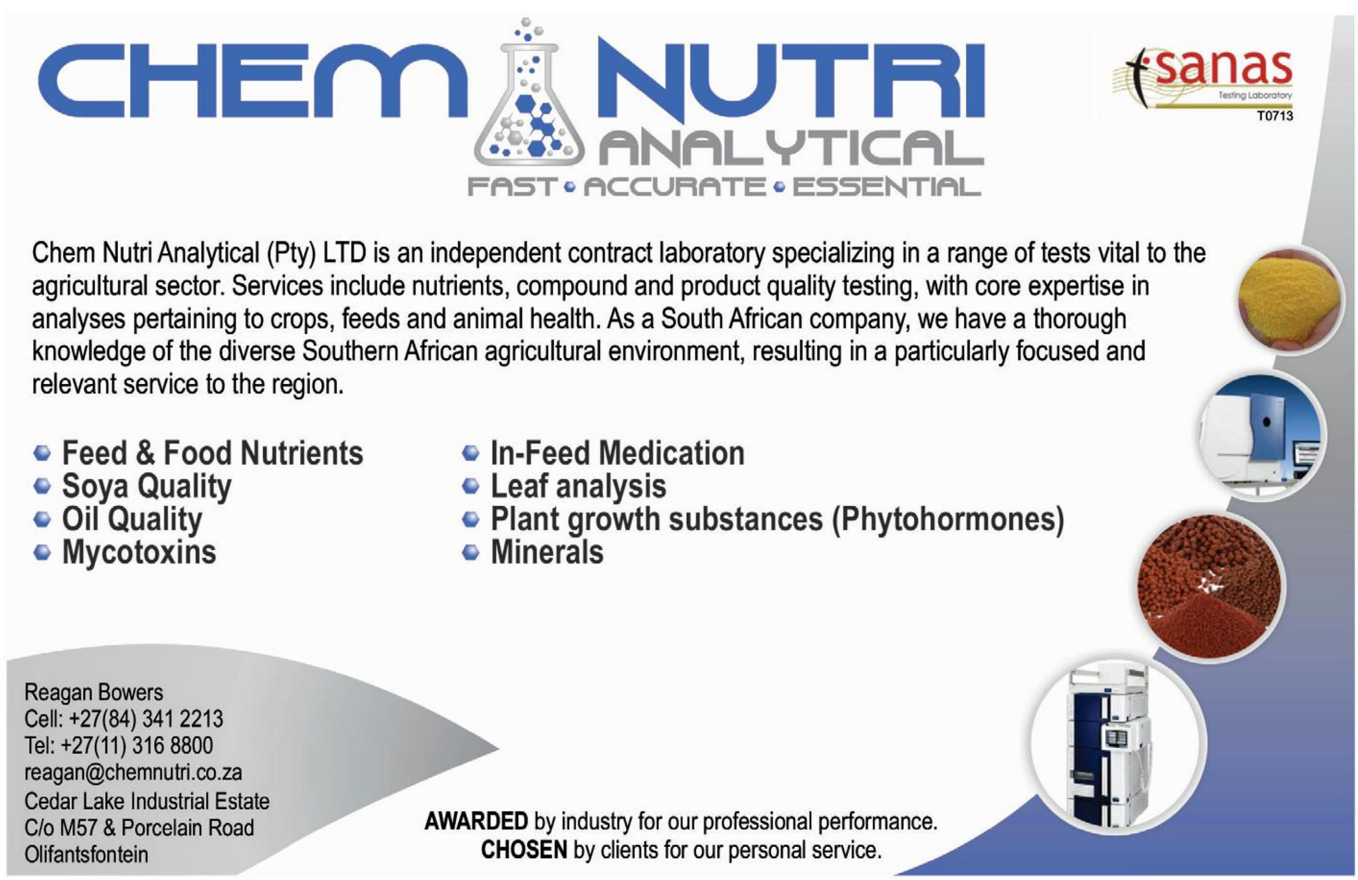

Foliar fertilisation of soya bean:
Is it useful to supplement primary fertilisation?

By Dr Antonio Mallarino, professor of soil fertility and nutrient management, extension specialist, Iowa State University

Many Iowa fields require phosphorus (P) and potassium (K) fertilisation for optimum soya bean production. Suggested application rates, when required and based on soil testing, are fairly large amounts. Fertiliser application methods and equipment commonly used to supply these nutrients, are adapted to apply these large fertiliser rates to the soil before planting.

Foliar fertilisation, on the other hand, can be used to apply only small amounts of nitrogen (N), phosphorus (P) and potassium (K), and also to apply sulphur (S) and micronutrients.

Nutrient use of the soya bean plant

Hundreds of field experiments during the 1970s and 1980s in Iowa and other regions of the United States (US) investigated foliar fertilisation of soya beans at late reproductive stages. The soya bean plant's nutrient use is characterised by a sharp decline of root activity during seed development stages, and increased translocation of nutrients from leaves and pods into the seeds. Researchers theorised that if nutrients were applied directly to the foliage at this time, grain yield might be increased.

A few Iowa experiments during the early to mid-1970s seemed to confirm this hypothesis by suggesting that spraying soya beans with a 10-1-3-0,5 N-P-K-S nutrient mixture between the R4 and R6 growth stages, could increase yield up to 0,54t/ha. However, numerous follow-up trials did not confirm these results.

Additional work in Kansas during the mid-1990s suggested significant yield response of high-yielding, irrigated soya beans to foliar application of N. However, more recent trials in Kansas, Iowa, and other Midwestern states, showed no consistent yield increases from spraying N at R2 to R6 growth stages, and sometimes yield decreases when rates were higher than 22,4 to 33,6kg N/ha.

Deficiencies during early growth

Field observations in Iowa during the early 1990s suggested that poor growth, perhaps due to nutrient deficiencies, may occur during early growth of soya beans. This was observed in fields where producers applied P and K before planting corn at the fertilisation rate for the two-year corn/soya bean rotation (as most producers do). Deficiencies were even observed in some fields where broadcast fertiliser was applied before the soya bean crop.

Deficiencies have been partly explained by inhibited activity of roots when the topsoil is dry, reduced nutrient uptake because of excessively wet and cold soil, and other factors resulting in slow early-root growth. In these conditions, small amounts of N, P, or K sprayed at early critical periods could be effective to supplement soil P and K fertilisation and symbiotic atmospheric N fixation. Therefore, approximately 100 replicated field trials were conducted in Iowa producers' fields since 1994 to evaluate this possibility.

Mixtures used in Iowa trials

The fields were managed with no-till, ridge-till, or chisel-plow tillage. Because the majority of Iowa fields test optimum or higher in soil test P or K, only a handful of fields tested below optimum levels. Treatments changed over time, and the mixtures used (N-P-K-S) included 3-18-18-0, 3-18-18-1, 10-10-10-0,10-10-10-1, 8-0-8-0. In some instances, mixtures included various micronutrients. Treatments involved single or double applications (spaced about ten days) of 18,7 to 56,1 litre/ha sprayed during the V5 to V7 growth stages.

This early-season foliar fertilisation resulted in statistically significant yield increases (usually more than 0,14t/ha) in about 15% of the fields, with frequency depending on the year. However, average yield increase across all sites was about 0,034t/ha. Application rates higher than 11,3 or 15,1 litre/ha of formulations with a higher proportion of N, reduced yield in a few fields (and at times leaf burn was observed).

Differences between treatments in increasing yield were not consistent across fields and could not be explained with certainty, but yield responses were more consistent for a rate of 11,3 litre/ha of 3-18-18. Addition of S or micronutrients to the mixtures or double applications seldom produced higher yield. It is important to remember that most fields tested optimum or higher in P and K, and that responses were observed in low-testing as well as in high-testing fields.

Yield responses and field characteristics

A study of relationships between yield response and various field or crop characteristics, indicated that the conditions in which foliar fertilisation would increase yield are difficult to predict. However, the research did indicate conditions in which a response might be more likely. In some years, responses were higher and more frequent in ridge-till and no-till fields compared with chisel-plow tillage, which is reasonable because foliar fertilisation could alleviate early nutrient deficiencies often occurring with these systems.

Yield responses also were higher and more frequent when early plant growth and P or K uptake were limited by a variety of conditions (such as nutrient deficiency, cool temperatures, and either too little or excessive rainfall).

Research conclusions

Although the research suggests that foliar fertilisation can sometimes be effective to supplement the primary fertilisation programme for soya beans, spraying across all production conditions will not be economically effective, because the expected probability of a positive yield response is only 15% and the average expected yield increase across all fields is 0,034t/ha or less.

For suspected problem fields, a single application of N-P-K fluid fertilisers having a low proportion of N and a low-salt K source should be safe (to minimise leaf burning and yield decrease) and may produce economical yield responses when these problem fields are targeted for application.

Addition of micronutrients will seldom increase yield unless early deficiency symptoms are observed (such as iron chlorosis in Iowa). The research on foliar fertilisation continues by evaluating several treatments, including combined application of foliar fertiliser and fungicides.

For the original article, visit Iowa State University Extension and Outreach's Integrated Crop Management page at *https://crops.extension.iastate.edu/encyclopedia/* or email the author at apmallar@iastate.edu.

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The use of soya protein in aquafeeds

By Yueming Dersjant-Li, ADM Specialty Ingredients Division

Fish meal is an excellent protein source in fish feed due to its balanced amino acid profile and high digestibility. Traditionally, fish meal is the main dietary protein source in fish feed formulation, especially for carnivorous fish species such as salmon and eel. In general, fish feed contains 5 to 50% of fish meal.

In commercially manufactured feeds for shrimp culture, marine animal protein sources such as fish, shrimp and squid meals are the primary protein sources being included in the feed, at a level between 30 to 50%.

Statistical data from the Food and Agriculture Organization (FAO) of the United Nations indicated that aquaculture is continuously increasing and the supplies from fisheries stabilised and even tend to decrease. However, the demand on fish production for human consumption is increasing and leading to reduced fish meal and fish oil production. For example, fish meal production was 6,83, 6,86, 6,70, 5,28 and 6,06 million metric tons in 1995, 1996, 1997, 1998 and 1999 respectively.

Fishmeal Information Network estimated that approximately 35% of fish meal is consumed by the fish feed industry, while 29% of fish meal is consumed by the pig feed industry. As for land farmed animals such as poultry and ruminants, up to 10% (maximum) of fish meal is included in the diets. In contrast, up to 55% of fish meal is included in fish feed. In fact, aquaculture has become the fastest growing food production sector of the world, with an average annual increase of about 10% since 1984 compared to a 3% increase for livestock meat and a 1,6% increase for capture fisheries (FAO, 1997).

The rapid development of aquaculture will result in a high demand and a shortage of supply of fish meal. Furthermore, the contamination of certain fish meal with dioxins has reduced the quality of fish meal as a raw material to be included in fish feed. Those factors are forcing feed industries and scientists to search for alternative protein sources in fish feed.

Table 1 shows the use of fish meal by species in 1994 and estimated fish meal use in 2010. It is predicted that, generally, aquaculture feeds will use lower levels of fish meal. To meet the high dietary protein requirement of fish, alternative protein sources will be used in fish feed as replacement of fish meal.

Alternative protein sources

Animal proteins such as poultry by-products, meat and bone meal have been used to replace fish meal in fish feed. Animal proteins are good protein sources with a low price, which can be used to partially replace fish meal. However, due to the occurrence of bovine spongiform encephalopathy (BSE), consumers are questioning feeding practices based on the use of animal proteins as raw materials in animal feed. In some countries, animal proteins are banned in animal feed.

Therefore, the future development of animal feed will head towards a vegetable-based formulation.

Plant ingredients which contain high protein content, such as oilseeds, are alternative protein sources for fish meal. These ingredients are readily available worldwide and at a low cost. However, plant proteins in general are low in some essential amino acids and contain anti-nutritional factors (*Table 2*). Therefore, the inclusion levels of raw or under-processed plant materials are limited in fish feed.

On the other hand, proper processed plant ingredients with high-protein content and with high digestibility of crude protein and low anti-nutritional components, are potential alternative protein sources for replacement of fish meal in fish and shrimp diets.

Among oilseeds produced, soya bean meal contributes more than 50% of the production.

Nutritional value of soya bean meal

Soya bean meal (SBM) is considered as the most nutritive plant ingredient widely used in pig, poultry and fish feed. Among plant

Table 1: Estimated production (thousand metric tons) of aquaculture feeds and the use of fish meal in aquaculture feed. (Source: Dudley-Cash, 1998)

Species	1994			2010		
	Feed produced	Fish meal used	%	Feed produced	Fish meal used	%
Salmon	685	351	51	1 600	480	30
Trout	446	171	38	560	140	25
Shrimp	922	241	26	2 940	588	20
Eels	186	93	50	155	47	30
Bream/bass	97	58	60	240	72	30
Carp	300	45	15	1 040	52	5
Yellow tail	70	42	60	90	27	30
Catfish	530	22	4	1 218	12	1
Others	337	61	18	820	88	11
Total	3 573	1 084	30	8 663	1 506	17

Table 2: Nutritional values of common protein ingredients in fish diets. (Data on as-fed basis, NRC, 1998)

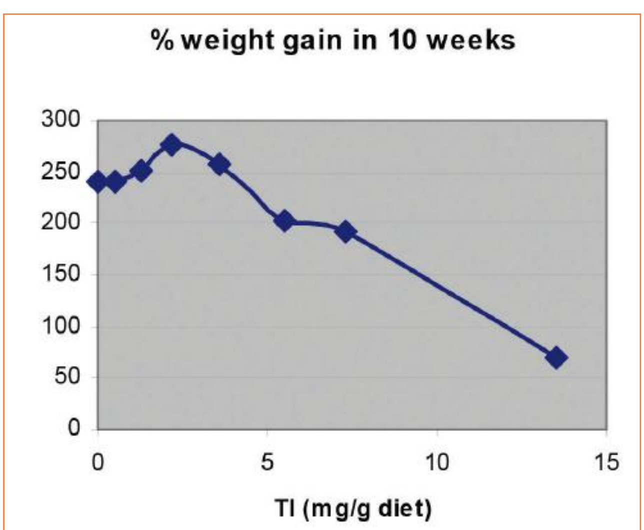
	Fish meal menhaden	Soya protein concentrate[1]	Soya bean meal	Potato protein	Sunflower meal	Corn gluten meal	Cottonseed meal
Composition %							
Dry matter	92	93	89	91	93	90	90
Crude protein	62,9	65	44	73,8	42,2	60,2	41,4
AA composition %							
Lysine	4,81	4,23	2,83	5,83	1,17	1,02	1,72
Methionine	1,77	0,91	0,61	1,68	0,66	1,43	0,67
Met & Cys	2,34	1,89	1,31	2,88	1,35	2,52	1,37
Threonine	2,64	2,73	1,73	4,3	1,28	2,08	1,36
Isoleucine	2,57	3,19	1,99	4,09	1,69	2,48	1,3
Tryptophan	0,66	0,78	0,61	1,02	0,54	0,31	0,48
Arginine	3,66	4,94	3,23	3,8	3,59	1,93	4,55
Phenylalanine	2,51	3,45	2,18	4,89	2	3,84	2,2
Valine	3,03	3,38	2,06	4,89	2,33	2,79	1,78
Histidine	1,78	1,82	1,17	1,71	1,07	1,28	1,17
Leucine	4,54	5,2	3,42	7,61	2,57	10,19	2,47
Antinutritional factors							
	Biogenic amine dioxin	Very low	Protease inhibitors, allergens, oligosacch arides, lectins, saponin	Solanidine glycol alkaloids (solanine, chaconin), sulfite	Chlorogenic acid, fibre	Mycotoxins (high xanthophylls)	Gossypol, cyclopropenoid fatty acids, tannins

[1] *Using Soycomil FG as an example, a soya protein concentrate produced by ADM Europoort B,V, Rotterdam, The Netherlands.*

protein ingredients, SBM has a well-balanced amino acid profile. Furthermore, SBM has the advantage of being resistant to oxidation and spoilage, and is naturally clean from organisms such as fungi, viruses and bacteria that are harmful to shrimp and fish (Swick *et al.*, 1995).

SBM can be used to partially replace fish meal or animal protein in fish and shrimp diets. In general, however, at high replacement levels the growth rates of fish and shrimp are reduced. The growth depression effect of soya bean meal at high inclusion levels may be related to the antinutritional components presented in SBM, as illustrated in *Table 2*. It has been observed in many fish species that antinutritional components in SBM, such as trypsin inhibitor, antigens, lectins, saponins and oligosaccharides, can have a negative effect on digestibility of nutrients and performance of fish.

Figure 1: The relationship between trypsin inhibitor activity (TI) and growth performance of channel catfish. (Wilson & Poe, 1985)



Trypsin inhibitor

Literature studies showed that soya bean trypsin inhibitor activity is negatively correlated with digestibility of protein and lipid and growth rate in salmon (Olli *et al.*, 1989), rainbow trout (Sandholm *et al.*, 1976), carps (Viola *et al.*, 1983, Abel *et al.*, 1984), Nile tilapia (Wee & Shu, 1989) and channel catfish (Wilson & Poe, 1985). Alarcon *et al.* (1999) observed that sea bream alkaline digestive proteases was inhibited by 42,6% after incubation of an extract with a solution containing raw soya bean meal.

Wilson & Poe (1985) observed that the best growth of channel catfish occurred when 83% (e.g. 3,2g TI/g diet) of the trypsin inhibitor activity in the soya bean meal had been destroyed (see *Figure 1*).

Lectins

Lectins can cause morphology changes in the intestine and therefore reduce the absorption of nutrients. Hendriks *et al.*, (1990) demonstrated the high sensitivity of the distal small intestine to the toxic effect of soya bean lectin in Atlantic salmon.

Oligosaccharides

Soya bean meal contains approximately 15% of oligosaccharides (sucrose, raffinose and stachyose). Oligosaccharides can have a negative effect on nutrient utilisation in fish. It was reported that removal of oligosaccharides from SBM, significantly improved the utilisation efficiency of nutrients in salmon and rainbow trout (Murai *et al.*, 1987; 1989, cited by Krogdahl, 1989).

Arnesen *et al.* (1989) found that alcohol soluble carbohydrate from SBM had a negative influence on digestibility of protein and lipid in salmon and in trout (tendency). For both species, alcohol soluble carbohydrate showed a negative effect on faecal dry matter content.

Table 3: Essential amino acids composition of SPC and requirement of fish (% of diet).

	SPC[1] (cp 65%) % as is	SPC % at 30% protein level	Requirement[2] Channel catfish	Rainbow trout	Common carp	Tilapia
Arginine	4,94	2,3	1,2	1,5	1,31	1,18
Histidine	1,82	0,8	0,42	0,7	0,64	0,48
Isoleucine	3,19	1,5	0,73	0,9	0,76	0,87
Leucine	5,2	2,4	0,98	1,4	1	0,95
Lysine	4,23	2,0	1,43	1,8	1,74	1,43
Met + Cys	1,89	0,9	0,64	1,0	0,94	0,9
Phe + tyr	3,45*	1,6*	1,4	1,8	1,98	1,55
Threonine	2,73	1,3	0,56	0,8	1,19	1,05
Tryptophan	0,78	0,4	0,14	0,2	0,24	0,28
Valine	3,38	1,6	0,84	1,2	1,10	0,78

*[1]Soycomil FG, ADM Europoort bv, Rotterdam, The Netherlands; [2]NRC, 1993; *Only phenylalanine*

Soya antigens

Soya antigens can cause allergic responses in animals and lead to intestinal damage. Rumsey *et al.* (1994) found that trout fed a diet containing high levels of the globular antigenic proteins, glycinin and β-conglycinin from SBM, had inferior growth performance, impaired utilisation of dietary protein and intestinal pathology.

Fish fed a full-fat SBM based diet showed damaged epithelium, with an increased number of goblet cells and a marked decrease or even absence of absorptive vacuoles. The microvilli of the enterocytes were shortened, with increased microvillar vesicle formation (Van den Ingh *et al.*, 1991), whereas fish that received a soya protein concentrate based diet have a normal, healthy intestinal structure, which is comparable to the fish that received a fish meal diet. The authors suggested that these changes might be due to the presence of antinutritional factors in a full-fat soya bean meal diet.

It was observed that a soya bean meal based diet caused enteritis-like changes in the distal intestine in Atlantic salmon (Baeverfjord & Krogdahl, 1996; Krogdahl *et al.*, 2000; Refstie *et al.*, 2001) and in rainbow trout (Bureau *et al.*, 1998) and caused an altered immune response (Rumsey *et al.*, 1994; Bakke-McKellep *et al.*, 2000) and might lead to increased susceptibility to furunculosis (Krogdahl *et al.*, 2000).

The alcohol extract of SBM (soya bean molasses) has been found to cause the enteritis-like changes (Van den Ingh *et al.*, 1996; Krogdahl *et al.*, 2000) and correspondingly alcohol-extracted soya protein concentrate has been found to be of high nutritional value in salmonid diets (Olli & Krogdahl, 1994).

Saponins

Soya saponins can contribute an undesirable taste and may alter intestinal functions. The presence of soya saponins in soya products is highly dependent on the mode of preparation. Soya bean meal and soya flour contain between 0,43 and 0,67% soya saponins (Ireland *et al.*, 1986). Saponins can be carried over with the protein during extraction in water. Therefore, soya protein concentrate and isolate produced by extraction with water alone, may contain high levels of saponins.

It was found that a soya isolate (90% cp) contained 0,8% of saponins (Ireland *et al.*, 1986). Soya protein concentrates produced by alcohol extraction are devoid of saponins since alcohol is a 'bond-breaker' and helps to remove saponin from proteins (Bureau *et al.*, 1998). It was reported that purified alcohol extracts from soya bean meal and soya protein isolate (prepared by an extraction process aimed at the isolation of soya saponins) depressed feed intake and growth dramatically in Chinook salmon and depressed growth of rainbow trout (Bureau *et al.*, 1998). The authors suggested that soya saponins were responsible for the effect of the extract used in this study.

Saponins in water are highly toxic to fish because of the damage caused to the respiratory epithelium of the gills by the detergent action of the saponins (Francis *et al.*, 2001). It was observed that soya protein isolate, which is produced by aqueous solubilisation and iso-electric precipitation of protein from soya flakes, appears to depress feed intake in a similar manner as soya bean meal in Chinook salmon (Hajen *et al.*, 1993).

Since soya protein isolate contains very low levels of antitrypsin factors, lectins and oligosaccharides, it indicated that heat stable, alcohol-soluble factors appear to be responsible for the depression of feed intake in salmon and may be also in other fish.

Nutritional value of SPC

The amino acid profile in fish meal in general reflects dietary amino acids requirement of fish. Compared to fish meal, soya protein concentrate (SPC) has a balanced amino acids profile. *Table 3* presents an example of amino acids provided by SPC at a dietary protein level of 30%. Assuming SPC is used as the sole protein source in fish feed, the essential amino acids provided by SPC meet the dietary requirement of channel catfish, common carp and tilapia very well. For rainbow trout, methionine concentration in the diet may need to be balanced by other protein ingredients or synthetic amino acid.

This article was originally published on *www.researchgate.net* and has been shortened and edited for this publication. For the complete article and references, email the author at Ydersjantli@admworld.com.

EVONIK
Leading Beyond Chemistry

AMINORed®: Accurate and rapid assessment of processed soya bean quality

By Chantelle Fryer, Technical Service Manager, Evonik Nutrition and Care

Soya beans are an important ingredient in animal diets. Unfortunately, raw soya beans contain anti-nutritional factors that can severely depress the performance of these animals.

Common soya products used in animal feed are soya bean meal (a by-product of soya oil extraction) and full-fat soya (the roasting and extraction of the entire dehulled bean). Both processes require the application of adequate heat to destroy the anti-nutritional factors, the most well-known of which are trypsin inhibitors found in raw beans. Trypsin inhibitors block sites where the enzyme trypsin binds with proteins during the digestion process, thereby reducing the ability to liberate amino acids and small peptides. This leads to performance and health issues such as poor growth and diarrhoea.

Although underprocessing of soya beans is always a concern, the opposite is also true. Overprocessing, where too much heat causes damage to the tertiary structure of proteins and reduces enzymatic binding, and thus digestibility of the amino acids of soya beans, is often overlooked.

When formulating animal feed, nutritionists consider the amount of digestible lysine in the soya bean meal or full-fat soya. Overprocessing leads to an overestimation of the amount of digestible lysine, and indeed many other amino acids, in the processed end-product.

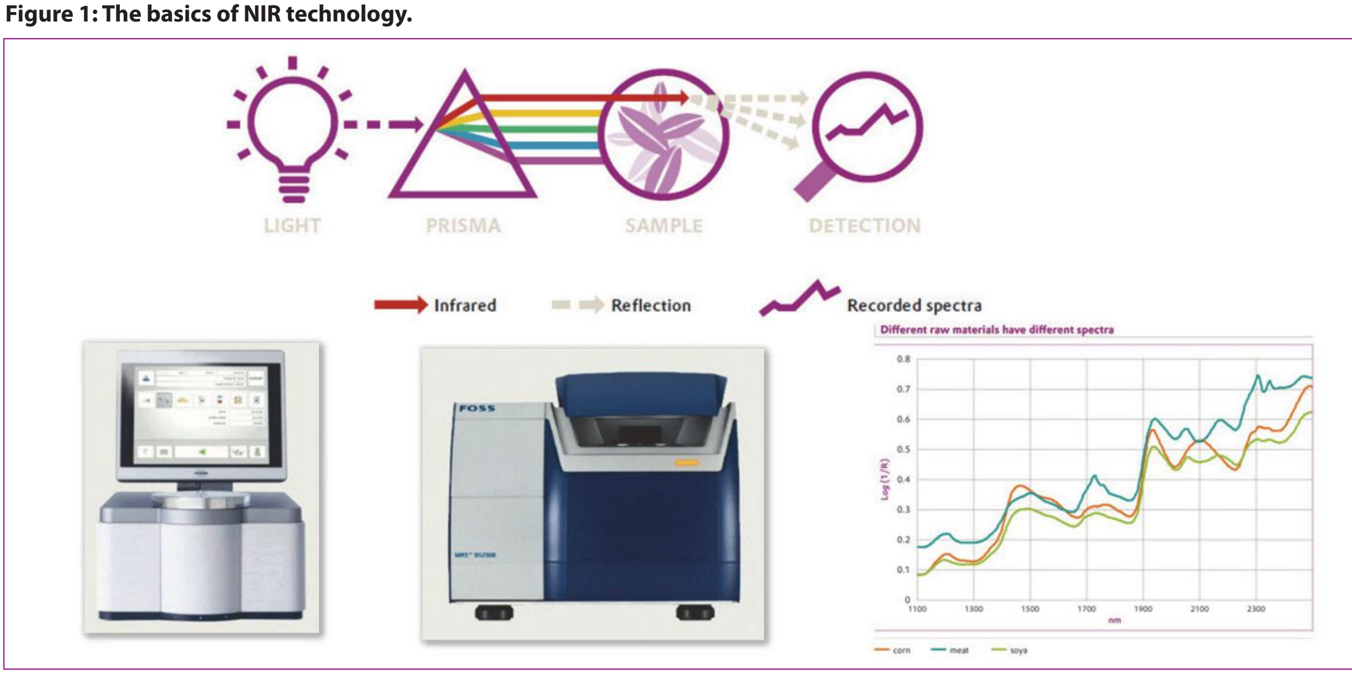
Table 1: Chemical analysis methods for processed soya beans.

	TIA	Urease activity	KOH	PDI	Reactive lysine: Total lysine
Underprocessing	+++	+++	+	++	No
Overprocessing	No	No	++	+	+++
Target values	<4mg/g	<0,3 pH rise <0,4mgN/g*min	73 to 85%	15 to 40%	>90%
Comment	Difficult	Most common		Simple method	Difficult

Methods for processing evaluation

There are multiple chemical analysis methods to evaluate processed soya beans, all with various advantages and disadvantages (*Table 1*). Trypsin inhibitor

Figure 1: The basics of NIR technology.

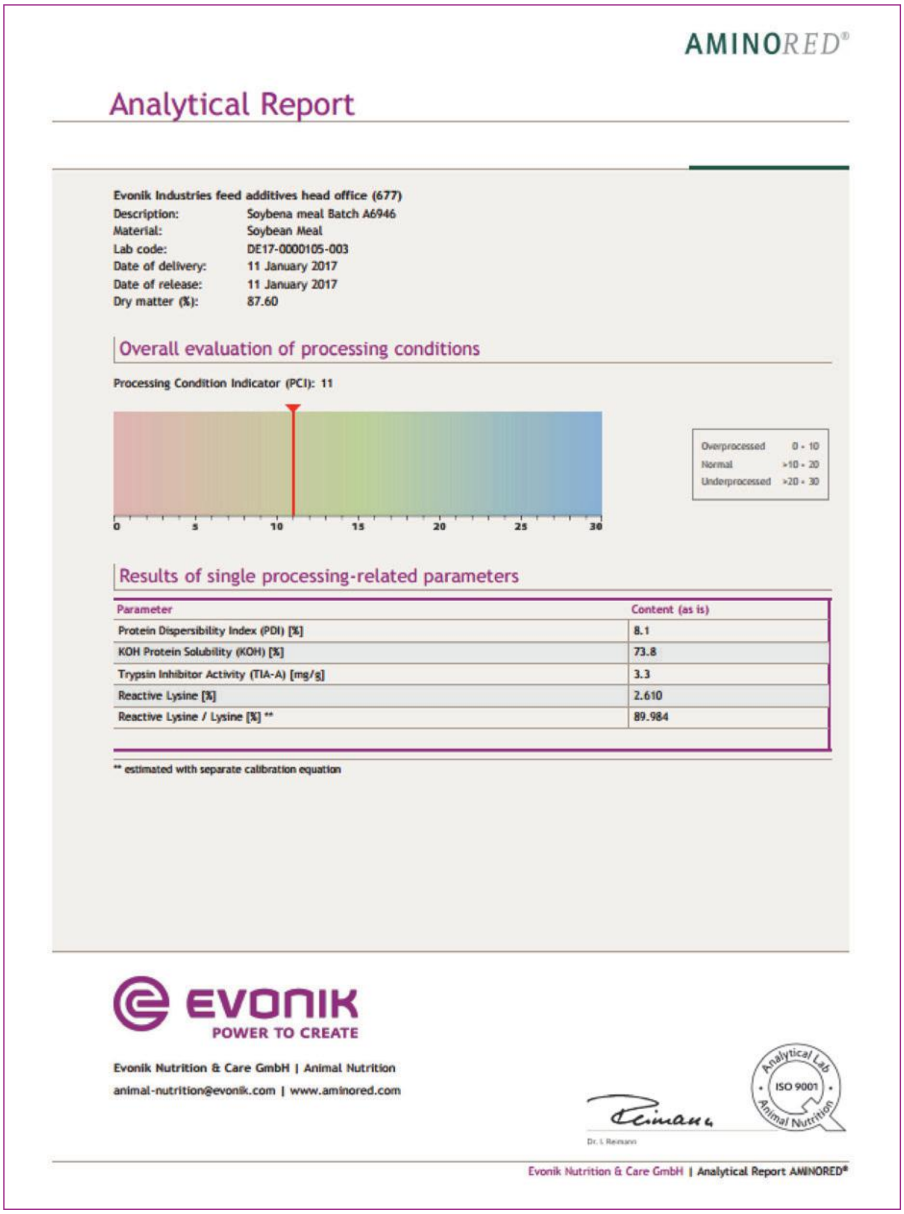


Different grades of processed soya bean meal used for the development of AMINORed® 2.0.

activity (TIA) is the most accurate test for determining underprocessing, but it is very difficult and costly to perform.

A urease test is simple and can be performed by most mills and processing factories, but results can vary depending on various factors, including particle size and even room temperature. TIA and urease cannot give any indication of overprocessing either, whereas methods such as potassium hydroxide (KOH) protein solubility can indicate overprocessing, but not underprocessing.

Figure 2: AMINORED® analytical report depicting the PCI and predictions for parameters such as TIA and KOH.



AMINORED®

Analytical Report

Evonik Industries feed additives head office (677)
Description: Soybena meal Batch A6946
Material: Soybean Meal
Lab code: DE17-0000105-003
Date of delivery: 11 January 2017
Date of release: 11 January 2017
Dry matter (%): 87.60

Overall evaluation of processing conditions

Processing Condition Indicator (PCI): 11

0 5 10 15 20 25 30

Overprocessed	0 - 10
Normal	>10 - 20
Underprocessed	>20 - 30

Results of single processing-related parameters

Parameter	Content (as is)
Protein Dispersibility Index (PDI) [%]	8.1
KOH Protein Solubility (KOH) [%]	73.8
Trypsin Inhibitor Activity (TIA-A) [mg/g]	3.3
Reactive Lysine [%]	2.610
Reactive Lysine / Lysine [%] **	89.984

** estimated with separate calibration equation

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Dr. L Reimann

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While lesser known, the reactive lysine assay is one of the most accurate ways to determine the effect of heat treatment on amino acid digestibility and availability.

Near-infrared technology

One of the biggest breakthroughs in ingredient analysis over the past few years has been the development of near-infrared (NIR) technology. NIR spectroscopy enables the rapid analysis of raw materials by the application of infrared light to a sample and measuring the spectra of that light.

NIR is an excellent tool for quality control as it enables the analysis of thousands of samples per year with precision, accuracy and minimal cost per sample. Evonik's expertise in this technology has enabled the development of a new calibration for the rapid assessment of soya bean processing quality – AMINORed®2.0.

This calibration was developed for the quality assessment of soya products and delivers predictions on well-established quality parameters used by the feed industry, such as TIA, KOH, and the Protein Dispersibility Index (PDI).

These parameters were combined with Evonik's leading position in amino acid analytics, especially the reactive lysine assay, to design a new parameter – the Processing Conditions Indicator (PCI). The PCI can classify all soya products according to the degree of processing, from raw beans to heavily overprocessed samples, within minutes. (*Figure 2*).

Processed soya bean quality is a vital consideration for animal feed producers and soya bean processors alike. Using the latest technology will deliver benefits to all role-players in the soya bean value chain.

For more information,
email Chantelle Fryer at
chantelle.fryer@evonik.com
or visit *www.evonik.com*.

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Implications of geographic soya bean production concentration: **Historical production, consumption and trade**

By Ikageng Maluleke, agricultural economist, Grain SA

The oilseeds market is considered a fast-growing crop segment in agriculture due to the growing demand for food amid a growing population. Soya beans are a crucial part of the global food chain, particularly as a source of protein for animal production. Global soya bean production has grown by over 100% in the past two decades, from 175 million tons in 2000 to 363 million tons in 2020 (*Figure 1*).

Although the 2019/20 season fell sharply, mainly on a sizeably reduced United States (US) harvest, there is an expected increase of about 7% in 2020/21. The forecast for 2021/22 seasons is expected to contain a much-improved global soya bean production with a 13% increase, to a record of 382 million tons. The predicted increase stems from expectations for a significant rebound in US output, tied to area gains and improved yields.

Over the past two decades, economic growth and restructuring of the feed industry intensified China's soya bean meal demands. Brazil, as well as Argentina and the US, stepped in to satisfy this increased demand. In the case of Brazil, rapid technical change coupled with an expansion in cultivated area, played a key role in meeting the increased soya bean demand in China, of which soya bean imports grew at 15% per year. In 2014, China's soya bean imports were about six times higher than its soya bean production, and China absorbed approximately 73% and 60% of Brazil's and the US's soya bean exports, respectively.

Figure 1: World production, demand, closing stocks and imports. (Source: US Department of Agriculture)

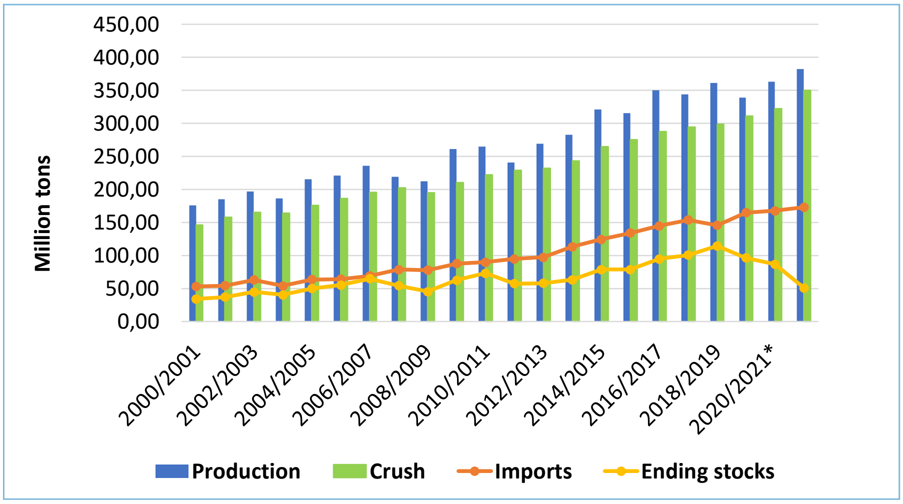
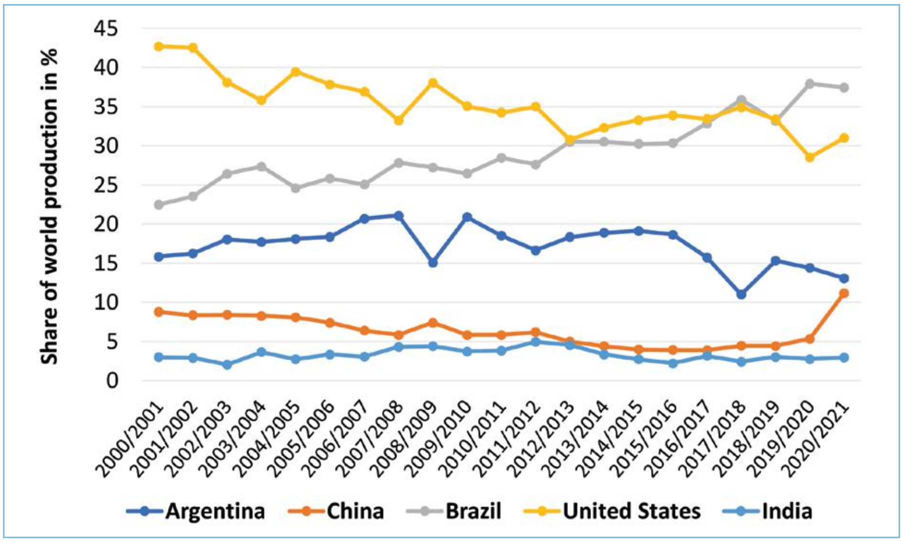


Figure 2: Share of world soya bean production by top five producing countries. (Source: International Grains Council)



Although global soya bean production is projected to be high for the current season, global usage is outstripping supply, with soya bean inventories expected to fall in the 2020/21 season, marking a third consecutive year of declining global soya bean inventories (*Figure 1*).

Geographic concentration of production and trade

Soya bean production is geographically concentrated between five countries that make up the top producing countries globally, with a total market share of 95,6%. Currently, South America continues to capture the largest soya bean market share with around 50%, with Brazil at 37,4% and Argentina at 13%, followed by the US at 30,98%, China with 11,14% and India at 2,9% (*Figure 2*).

For the 2020/21 season, just over 170 million tons of soya beans were imported globally. China is by far the leading importer of soya beans, with an annual import volume of approximately 100 million tons. The importance of China as a market for soya beans, is driven by an explosion in demand for meat as consumers switch from a diet dominated by rice to one where pork, poultry and beef play an important part. However, China is not able to produce enough animal feed itself, hence the need to import soya beans from the US and Brazil.

Back in 2017, it was good news for American farmers when US exports made up about a third of Chinese purchases. That made soya beans the US's second-most valuable export to China after aeroplanes. However, US exports to China decreased dramatically during the US-China trade war. From 2018/19 to 2019/20, China stopped purchasing any US soya beans in retaliation to the Trump administration having raised tariffs on Chinese goods. As a result of the trade war, US soya bean farmers were among the biggest losers.

The Trump administration softened the blow by offering approximately $28 billion in aid for producers. This led China to turn to Brazil, but with rising domestic usage and record sales to China, this drained supplies in 2019/20. The government ended up announcing the suspension of import duties in an attempt to encourage imports and suppress extensive domestic food inflation.

Figure 3: International soya bean prices. (Source: International Grains Council)

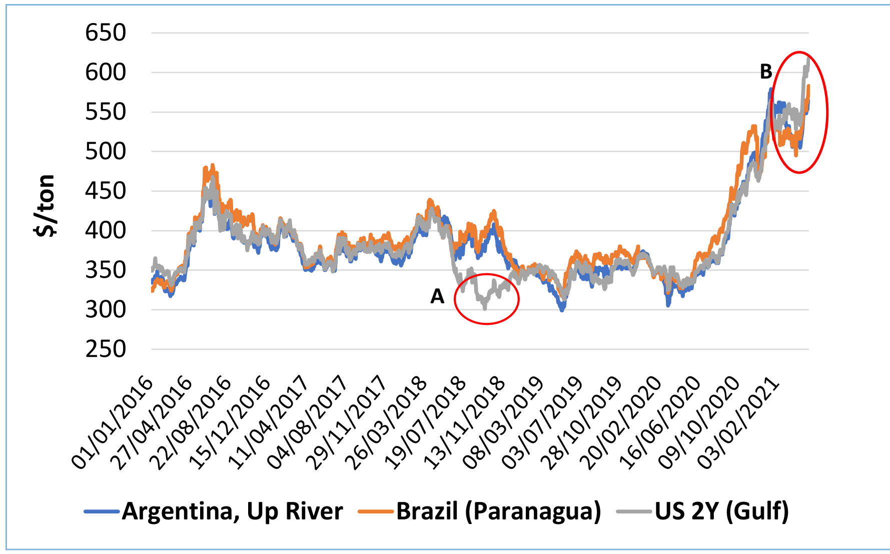
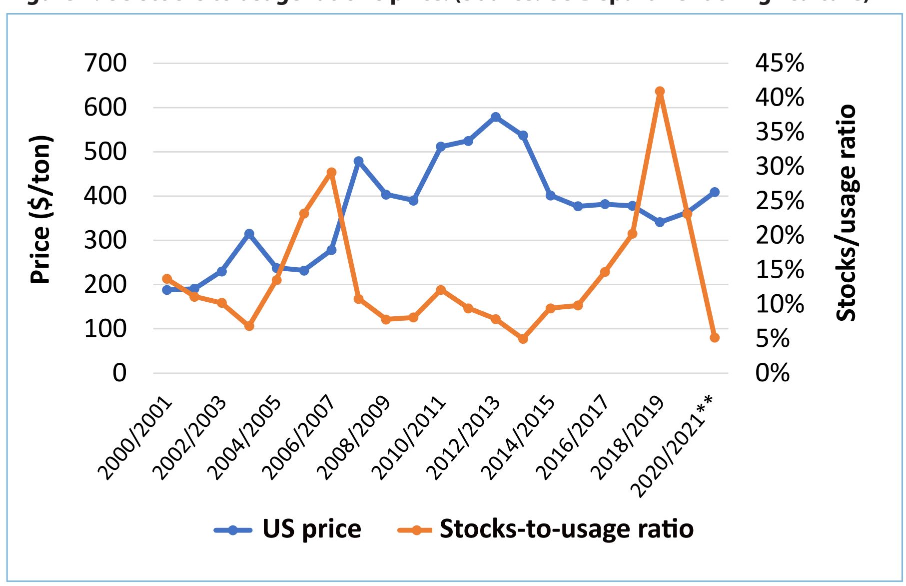


Figure 4: US stocks to usage ratio vs price. (Source: US Department of Agriculture)



Before the removal of import duties, the only countries from which Brazil could import soya beans without a tariff penalty, were the other members of the Mercosur regional trade agreement (Argentina, Paraguay and Uruguay). The US is the world's second-largest soya bean exporting country and the only major soya bean exporter outside of the Mercosur pact, which means the removal of import duties should allow imports from the US.

However, Brazil cannot import most genetically modified soya beans, which means it cannot easily turn to the US to fulfil its soya bean importing needs. Brazil found itself in a squeeze when it came to soya bean importing sources.

Unfavourable effects

The issue of geographically concentrated production and consumption of soya beans, has unfavourable effects on the rest of the world's supply (*Figure 1*) and prices (*Figure 3*). This can clearly be seen in the above-mentioned geopolitical issues between China and the US (point A, *Figure 3*) that took place in previous seasons, where US prices took a dip due to increased stocks.

The current situation with record prices can also be observed (point b, *Figure 3*) which can be attributed to the increased demand from China, where Brazil oversold their soya beans and China returned to buying US maize, thereby significantly reducing stock levels, not to mention unfavourable weather conditions in Latin America and the US.

Although Brazil generally produces soya beans for export, it should be noted that government regulations are sometimes a stumbling block when it comes to sourcing from there. Among international soya bean export prices (*Figure 3*), US prices increased the most by about 67% between April 2020 and April 2021, while Brazilian and Argentinian prices rose by 60% and 62% respectively.

Stocks-to-usage ratio

Another pertinent issue weighing on prices is the stocks-to-usage ratio for the US which are currently at a critical level, indicating that the level of carryover stock compared to the demand for soya bean, is extremely low. Current stocks-to-usage ratios in the US are at 5% compared to a norm of 13 to 15% or higher (*Figure 4*).

This is concerning as it means prices will continue at high levels. Historical trends indicate that when stock levels are low, prices move higher, causing a shift in both supply and prices for the rest of the world.

Implications for South Africa

The geographical concentration of soya bean production and trade is largely affected by geopolitical issues, government regulations as well as supply-side shifts in those regions, which causes instability for the rest of the world, especially the developing world. The situation of low stock levels and unfavourable weather conditions in the major producing countries, has pushed average soya bean prices in South Africa up by about 6% year-on-year, from about R6 700/ton in April 2020 to R7 100/ton in April 2021, despite the good production forecast and expected good yields.

According to the third production forecast by the Crop Estimates Committee (CEC), soya bean production is expected to reach approximately 1,794 million tons compared to 1,2 million tons in the past season, with an increase in area planted from 122 100ha to 827 100ha and an expected yield of 2,17 tons/ha. Although production potential is good, South Africa still imports a substantial amount of soya bean meal and oil into the country, making us vulnerable to international price movements.

Given the above implications, South Africa needs to continue stepping up its local soya bean production by riding the wave of both the Poultry Master Plan to increase production capacity, and the Soya Bean Strategy implemented in 2012 to increase local crushing capacity. Success can be achieved through improved production practices and technologies, as well as increasing research and development activities in the soya bean sector. This will cushion the country from negative sentiments and price movements internationally.

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

Quantifying the impact of reduced import tariffs on soya beans and soya bean meal in the South African soya value chain

By Prof Ferdi Meyer, Helga Ottermann and Dr Tracy Davids, Bureau for Food and Agricultural Policy (BFAP)
(Funded by the Oilseeds Advisory Committee)

Over the past ten years, from 2010 to 2020, the South African soya bean industry has been one of the country's biggest agricultural and agro-processing success stories. The area planted has more than doubled, production has nearly tripled and major investments in processing facilities have boosted total crushing capacity to 2,2 million tons (1,76 million tons at 80% utilisation) plus 450 000 tons full fat (360 000 tons at 80%). Consequently, local production of soya bean meal has rapidly increased, reaching 950 000 tons in the 2019/20 production season, driving down the volume of imported soya bean meal as the local feed industry shifts from imported to locally produced meal.

An all-time bumper crop of 1,78 million tons is expected to be harvested in the 2020/21 production season, with the national average yield estimated at 2,16 ton/ha. Consequently, in the current production season South Africa will move much closer to the level of soya beans required to meet local consumption.

Impact of duties

Although there is general consensus in the industry that soya bean production will keep on expanding (the latest BFAP projections indicate that South Africa will pass the 2 million ton mark in the next three to four seasons), the impact of duties on imported soya beans and soya bean meal on the integrated soya bean and livestock value chain point, is often tabled at value chain round-table discussions.

More specifically, stakeholders in the feed industry argue that a quota system could be introduced, allowing for crushers to import the shortfall of soya beans duty-free, and thereby boosting local crushing to replace all imported soya bean meal with local production until the local production of soya beans has expanded sufficiently to meet the local demand. The reduction in duties will, however, affect the profitability of producers, which could compromise the long-run expansion trajectory of soya bean production.

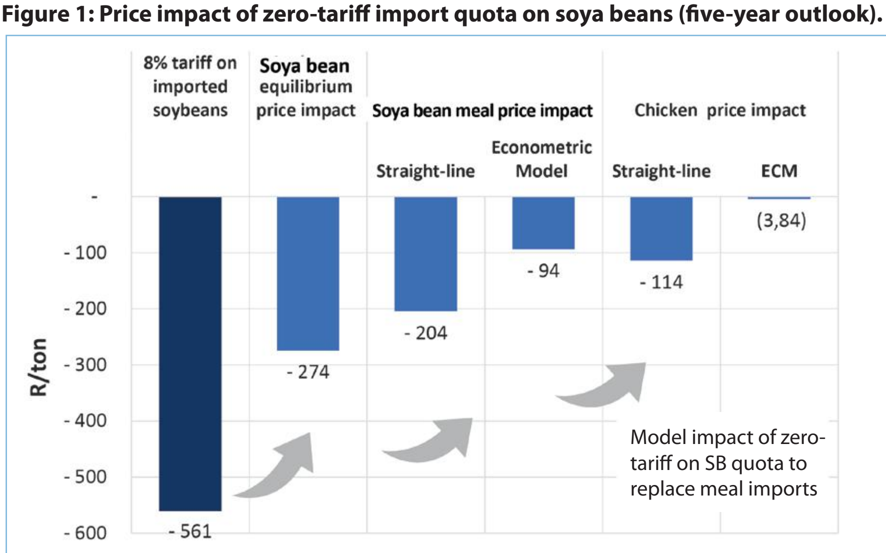
Two alternative scenarios were analysed to quantify the impact of reduced import tariffs on soya beans and soya bean meal on the soya bean value chain. Global soya bean markets are currently going through extreme price shifts, mainly due to a sharp rise in Chinese soya bean imports that are utilised for the rebuilding of the swine herd, following the outbreak of African swine fever. Therefore, a five-year outlook period is utilised for the purpose of this analyses to establish a longer-term market equilibrium.

Scenario 1: Zero-duty import quota

The first scenario analyses the impact of the introduction of a zero-duty import quota to cover the shortfall of soya beans required to meet the local consumption of soya meal. The 2019/20 marketing season is used to illustrate the introduction of this zero-tariff in practical terms.

With local production of soya bean meal reaching 950 000 tons, soya bean meal imports amounted to 474 000 tons to meet the shortfall in local production, which brings the total amount of marketable cake to approximately 1,42 million tons.

Figure 1: Price impact of zero-tariff import quota on soya beans (five-year outlook).



This implies that South Africa required an equivalent of just over 1,85 million tons of soya beans at a conversion rate of 75% to meet its domestic consumption of soya bean meal in the 2019/20 marketing season and with total production of soya beans at 1,17 million tons, a further 680 000 tons of soya beans would have been required for crushing to replace all imported soya bean meal.

Although small volumes of soya beans are entering the country duty-free from Zambia and Malawi under the SADC free-trade agreement, larger import requirements will have to be met by countries such as the United States (US), Argentina and Brazil, where an import tariff of 8% is applied.

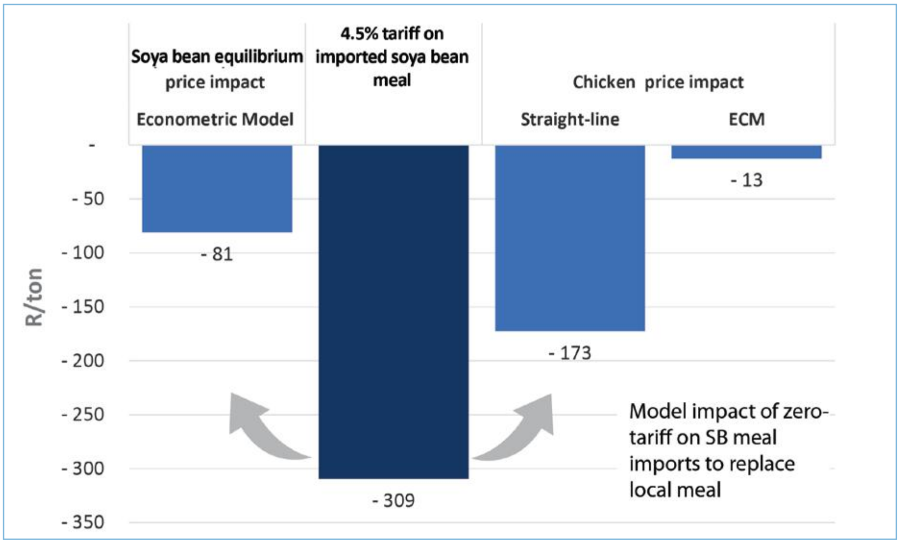
Figure 1 presents the average annual price impact over a five-year outlook period at various nodes in the soya bean value chain when this quota is introduced into the BFAP modelling platform.

The reduction of the 8% import duty on soya beans implies that soya bean crushers can import soya beans at R561/ton cheaper. However, this discount is only applicable to the quota of beans that can be imported to replace the imported soya bean meal and consequently, the BFAP econometric market model generates a net equilibrium price for soya beans that is R274/ton less, once all supply and demand responses have been taken into consideration.

Two approaches are utilised to transmit this reduction in soya bean prices through the value chain:

- First, the straight-line approach, where it is assumed that crushers transmit the full benefit of cheaper soya beans to soya bean meal prices. Soya bean meal prices consequently decline by R204/ton and if this cheaper meal is introduced in the feed rations of broilers, chicken prices decline by 11,4c/kg.
- In the second approach, the BFAP econometric market model is applied to estimate the actual price transmission elasticities between soya beans, soya bean meal and chicken prices based on historic pricing data. According to this approach, soya bean meal prices will only decline by R94/ton if an import quota with a zero-tariff is introduced and the decline in chicken prices will be negligible at 0,3c/kg.

Figure 2: Price impact of zero-tariff on soya bean meal imports.



Scenario 2: 4,5% to zero

The second scenario is more simplistic in the sense that it only takes a reduction in the current import tariff on soya bean meal from 4,5% to zero into consideration. Due to the domestic shortfall, local soya bean meal prices are mostly trading at or close to import parity prices. It is often argued that cheaper soya bean meal and consequently broiler feed, will boost the overall competitiveness of the South African chicken industry.

Figure 2 presents the net impact on prices for both the straight-line and econometric approach:

- In the straight-line approach, the full decline in the soya bean meal price of R309/ton is passed on to broiler feed rations, and consequently chicken prices decline by 17c/kg.
- In the econometric approach, the benefit of lower soya bean meal price is passed on only in part (not the full benefit), and chicken prices only decline by 1,3c/kg. As noted above, the econometric approach is based on long-run price relationships – in this case between chicken and soya bean meal prices – that are estimated using historic price data. In other words, this price transmission can be regarded as the more realistic estimate of actual market relationships.

Although both scenario 1 and 2 lead to lower soya bean meal and marginally

lower chicken prices, the economic impacts of these two scenarios on soya bean producers and processors, differ significantly. *Figure 3* presents the impact on gross margins of soya bean crushers.

Crushing margins

Under scenario 1, soya bean crushing margins are projected to increase by R277/ton under the straight-line approach and R359/ton under the econometric approach. The reason for higher crushing margins in both the straight line and econometric approach is twofold. Firstly, crushing margins increase because soya beans are sourced at lower prices (minus R274), which outweighs the loss in income of selling soya meal at lower prices (minus R204).

Secondly, due to improved margins, soya bean crushers will increase crushing volumes by approximately 55 000 tons per annum over the next five years, which offers an efficiency gain that drives down crushing costs per ton. Higher local production of soya bean meal will drive down soya bean meal imports by approximately 40 000 tons and slightly increase soya bean meal consumption due to lower prices.

Under scenario 2, soya bean crushing margins are projected to decline by R294/ton. As discussed in the section above, local soya bean meal prices will decline under this scenario because soya bean meal is imported without any tariff. Due to lower crushing margins, 41 000 tons less soya beans will be crushed, which will lead to efficiency losses that will drive up average costs of crushing. Total soya bean meal imports will rise annually by approximately 50 000 tons over the next five years to meet local shortfalls.

Local quality

The competitiveness of the local industry compared to imported soya bean meal, hinges on the quality of the soya bean meal that is produced and the price at which it can be marketed. Due to major investments in crushing facilities, local production of soya bean meal has rapidly increased, driving down the volume of imported soya bean meal. However, according to the latest BFAP Baseline projections, coastal areas will be relying partly on imported soya bean meal despite higher local production levels.

Under scenario 1, inland crushers (Randfontein) can supply soya bean meal to the market for R158/ton below import parity levels on average, while in the coastal region (Paarl) imported meal is R591/ton cheaper compared to local meal. When scenario 1 is introduced in the model, the cost of local soya bean meal reduces by R204/ton. This boosts the competitiveness of local meal in the inland regions further, yet when the meal has to be transported to the coastal areas (e.g. Paarl) at transport costs in excess of R800/ton, the cost of local meal remains higher than the parity price of imported soya bean meal.

Following extensive surveys with all local crushing facilities, it became apparent that despite this price differential, some of the larger crushes are prepared to discount their meal prices to such an extent that meal, which is produced in the inland region, is transported to the coastal areas during periods where ample stock is available inland and return freight from the coastal to inland regions is available to mitigate some of the transportation costs.

Under the second scenario, a zero-tariff on imported soya bean meal implies that import parity prices are R309/ton lower than what the local industry can offer, even in the inland regions. In other words, whereas the introduction of a zero-tariff import quota on soya beans (scenario 1) boosts the relative competitiveness of local crushers in the inland and coastal regions, a reduction of the soya bean meal import tariff puts the local crushing industry on the backfoot, even in the inland regions (*Figure 4B*).

As can be expected, in both cases the gross margins of producers will be

Figure 3A: Scenario 1: Crusher gross margins (five-year outlook).

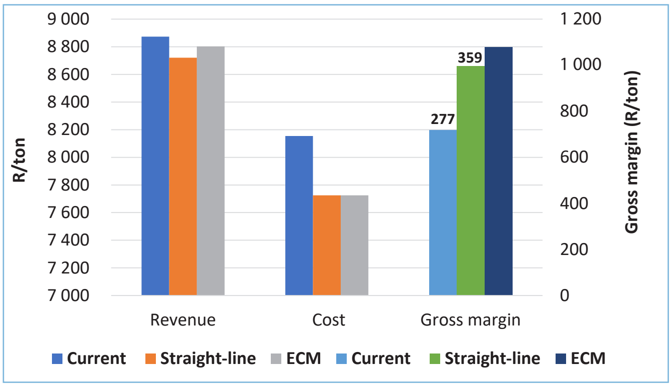
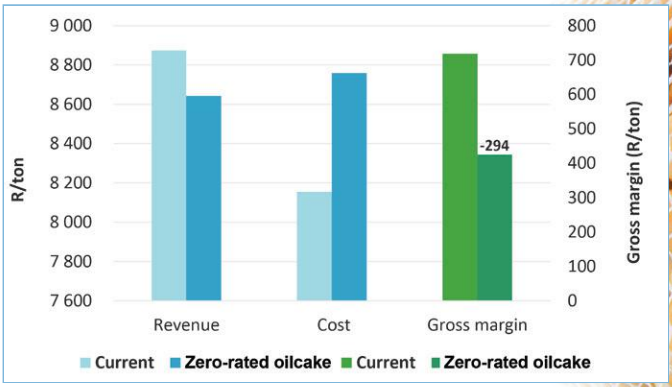


Figure 3B: Scenario 2: Crusher gross margins (five-year outlook).



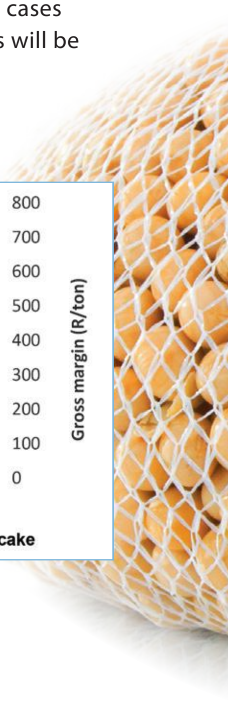


Figure 4A: Scenario 1: Local vs parity prices of soya bean meal.

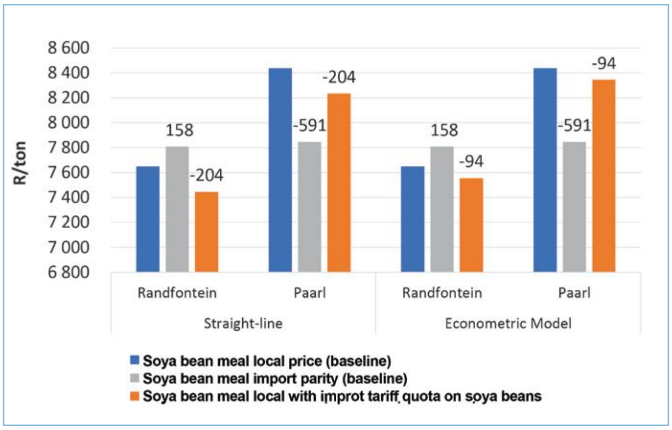
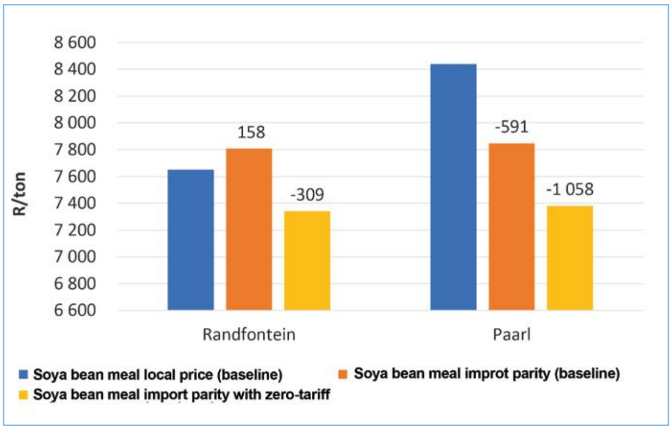
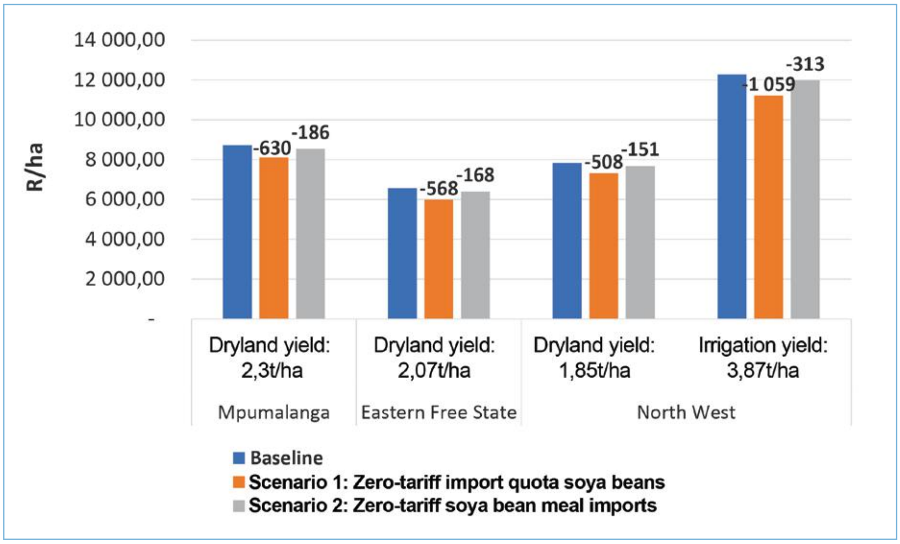


Figure 4B: Scenario 2: Local vs parity prices of soya bean meal.



impacted negatively. Under scenario 1, average soya bean prices are projected to decline by R274/ton, which implies that gross margins per hectare will decline by R1 059/ha in the typical irrigation areas of North West, and in the dryland areas of Mpumalanga, the Eastern Free State and North West, gross margins will decline by R630/ha, R568/ha and R508/ha, respectively. Under scenario 2, average soya bean prices are projected to decline by only R81/ton and consequently, the adverse impact on gross margins is significantly smaller, as illustrated in *Figure 5*.

Figure 5: Impact of reduced import tariffs on the gross margins of soya bean producer margins (five-year outlook).



Strategic perspective

To conclude, from a strategic perspective, the ideal position remains for South Africa to become competitive and economically sustainable in soya bean production closer to export parity levels. The overall competitiveness of the integrated soya bean and livestock value chain will be improved with the introduction of new seed technology and germplasm, and a constant drive in improved farming practices, together with an efficiency drive in the handling and processing of soya beans and investment in logistics, especially in the transport of soya bean meal to the coastal areas where almost one third of soya bean meal is consumed.

It is, however, a work in progress and the implementation of any short-term intervention, such as an adjustment in import duties, has to be carefully considered from a broader end-to-end value chain perspective.

Canola outlook for 2021 and beyond: Canada

By Jay Whetter, Canola Digest

Global demand for vegetable oil and plant-based protein sources remains strong. Meanwhile, global canola market share is declining, and potential for increased protectionism presents a risk for Canadian canola exports. This article will provide a brief glimpse into these topics.

Canadian canola yield

First, some facts on yield. Canadian canola yields averaged 2,25t/ha in 2020, which was the lowest for the past five years. The Canola Council of Canada's (CCC) goal of 2,91t/ha average yields by 2025, is getting farther away while the years click along. Yet CCC agronomy director Clint Jurke believes that yields could improve by 25% over the next five years.

That is because canola yields are showing healthy signs of growth. Despite flat results for the past five years, the average of 2,30t/ha for 2016 to 2020 represents a large jump from the average of 1,98t/ha for 2011 to 2015. Results for the past five years are also more consistent – the range of 2,25 to 2,37t/ha through that period compares favourably to the range of 1,56 to 2,25t/ha for 2011 to 2015.

This recent stretch of fairly consistent results, despite some poor growing conditions, suggests improved resiliency from genetics and agronomic practices. "This should prepare the crop for another threshold leap over the next five years," Jurke says.

An extensive canola grower survey conducted in Saskatchewan, Alberta and Manitoba in late 2020, will help identify those productivity challenges that are having the biggest effect on yield and profitability. Results from the survey should help Canadian canola growers identify pathways to improve on both counts, and help Canada reach its canola market potential.

Demand rising

The Canadian canola industry yield goal was launched in 2014 based on trends pointing to a potential market for 26 million tonnes of Canadian canola by 2025. Global demand for oilseeds still supports this market projection, helped along by increased interest in biofuels and plant-based proteins.

Global vegetable meal demand growth suffered a blip recently, but this is correcting. To specify, Thomas Mielke, executive director of ISTA Mielke and publisher of *Oil World*, says Chinese pork production is back on track after a major African swine fever outbreak in 2018/19. The result is a rebound in global demand for vegetable meal. Demand for vegetable oil also continues strong. This is why global productivity challenges for oil and meal crops in 2020 in many parts of the world, including Canada, resulted in tight supplies and a rise in prices over the past few months.

Looking more closely at supply and demand trends reveals a throwing-down-of-the-gauntlet for canola. Can Canada and other canola/rapeseed producing regions regain market share lost to soya beans? Mielke says the big picture shows that global dependence on soya bean oil and meal is increasing due to insufficient supplies of other oilseeds.

"During the past five years, soya beans accounted for 77% of the increase in world crushings of all oilseeds," he says. "In the years ahead, the prospective slowing down of the palm oil production growth will require more investments in increasing plantings and yields of soya beans, sunflower seed, canola and rapeseed."

That will require a reversal of trends. Canadian canola production peaked at 21,5 million tonnes in 2017 and has been declining since then. European Union (EU)rapeseed production is also down. Stephan Arens, managing director of the Union for the Promotion of Oil and Protein Plants (UFOP) in Germany, says challenges to rapeseed area and productivity in the EU include a recent drought as well as policies restricting genetically-modified plants, possible regulations on nitrogen use and expanded bans on pesticide products.

Neonicotinoid seed treatments are banned, making flea beetle management more difficult, and glyphosate is now up for discussion. "There are lots of challenges for Germany's crop production, not only for rapeseed," Arens says.

Biofuels policy

One EU policy that has helped Canadian canola exports is the biofuels mandate. The EU bought 2,1 million tonnes of Canadian canola seed in 2019/20, making it the fourth biggest export market for Canadian canola, after the United States (US), China and Japan.

Chris Vervaet, executive director of the Canadian Oilseed Processors Association, says a "biofuel renaissance" is underway in the US, led by California's Low Carbon Fuel Standard. Vervaet expects to see "explosive growth" in renewable diesel production capacity in the US in the near future, but notes that Canadian canola does not have competitive access to the US renewable diesel market at this time. "A priority is to work with the US government to approve a pathway so we can take advantage of this surge in demand for renewable diesel," he says.

Meanwhile, demand from the domestic Canadian biofuels market has potential to increase dramatically, and could demand another two million tonnes of canola oil per year by 2030. On 1 January 2021, Manitoba increased its biodiesel mandate to 3,5% of all diesel, up from 2%.

It will rise again to 5% on 1 January 2022. Canada's Clean Fuel Standard, which is not yet finalised, could further enhance the domestic market for canola-based biodiesel.

On the EU market front, Stephan Arens says EU usage of canola/rapeseed oil had stabilised, but following the EU Commission's decision to phase out the use of critical palm oil, "there is more market potential for canola/rapeseed oil in European biofuels".

Protectionism and compliance

While government policy has shaped the biofuels industry, government policy can also restrict market access and trade.

Jim Everson, president of the CCC, says increased protectionism around the world – where more regulations are being put in place to protect domestic consumers, plants and animals – could present big challenges for Canadian canola exports. "We're calling on the federal government to bolster support for market access activities, especially for the Asian market," Everson says.

Canada exports over 90% of its canola seed, oil and meal production, and Canada is the only major exporter of canola or rapeseed. According to US Department of Agriculture (USDA) statistics, Canada accounts for about two thirds of all canola meal, canola oil and canola seed exports each year. All others are lumped into 'other'.

Within this 'other' category, Australia and Ukraine are neck and neck for second place, but Australia's rather large 2020 crop was 3,7 million tonnes which is quite a bit less than Canada's 18,7 million tonnes. What this means is that Canadian farmers are more vulnerable than anyone when it comes to policies that restrict canola trade.

Brian Innes, vice president of public affairs for the CCC, says barriers to watch in 2021 are China's current blockages, a US decision on Canadian canola access to its renewable diesel market, and EU decisions on soil carbon sequestration requirements, pesticide residue limits and traits such as Optimum Gly, a new glyphosate-resistant option.

Kathleen Donohue, director general for Agriculture and Agri-Food Canada, says more countries are modernising their frameworks on how to regulate products of gene editing. In April 2021, the EU will release a study on the effect of current regulations on EU productivity. "I anticipate that the study will have a significant impact on the global landscape for gene-edited products," Donohue says.

Ultimately, Canadian canola growers need to know what their customers want and how policies are changing in these markets. "Canada must be able to demonstrate that our exports meet the requirements of importing countries," Donohue says. "We have to develop strategies to make sure we remain compliant."

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Key drivers of soya bean product quality for feed use in South Africa

By Dr Wiltrud Durand, Bureau for Food and Agricultural Policy

The Oilseeds Advisory Committee funded a study undertaken by the Bureau for Food and Agricultural Policy (BFAP) to investigate the drivers of soya bean product quality for feed use in South Africa.

The livestock industry in South Africa consumes an estimated 1,2 million tons of soya bean meal per annum. The soya bean meal is either procured locally or imported. Over the past few years, there has been a slow but steady trend within the local feed industry from using imported to domestically produced soya bean meal, as the domestic soya bean crushing industry matured.

To include locally produced soya bean meal in their formulations/rations, the feed industry requires a reliable and consistent supply of soya bean meal that has been properly processed to eliminate anti-nutritional factors, and which furthermore meets quality standards for oil and protein content. In addition, the locally produced soya bean meal should be competitively priced, especially for feed mills in coastal areas where deep-sea imports may be cheaper.

The feed industry requires a minimum of 46% protein in soya bean meal (with 12% moisture content).

Soya bean composition limits

The feed industry requires a minimum of 46% protein in soya bean meal (with 12% moisture content). Furthermore, feed must conform to the *Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act 36 of 1947*). Soya bean composition establishes the limits for soya bean meal composition – i.e. protein and oil content of the soya bean itself are the starting point for protein content bounds of the finished soya bean meal.

Thus, shifting the focus from increasing yield per hectare to increasing the oil and protein content, as well as preserving quality during processing, could benefit everyone in the soya bean supply chain, from the farmer, silo owner and crusher to the feed/food manufacturer.

Product quality at farm level

At farm level, it is known that several factors influence yield, protein and oil content of soya bean seed. Since factors such as longitude, altitude, environmental temperature (heat units) and rainfall play major roles in determining the quality of seeds produced, it is apparent that soya bean producers have only a limited capacity to influence the oil and protein contents of seeds.

Nevertheless, seed inoculation before planting, the judicious application of nitrogen and micro-elements, and the choice of variety and planting time can be managed by the farmer to contribute to the quality and yield of soya beans.

Although the national cultivar trials measure the oil and protein content of seed, most of the emphasis is on yield parameters. Furthermore, unlike some cultivars advertised in Brazil, soya bean seed cultivars advertised in South Africa are not accompanied by any information on oil or protein content parameters.

Breeding for soya bean seed composition traits is a complicated process and, to underline this, the major function of protein meal in nutrition is to supply sufficient amounts of essential amino acids – therefore, merely taking soya bean protein content into account is likely not sufficient. However, a combination of conventional breeding strategies and genomic approaches can aid breeding for improvement of seed composition traits.

Product quality at silo level

South Africa has only two grades for soya bean seed which are based on a few physical aspects. At silo level some silo owners have invested in NIR equipment that could potentially inform on quality aspects, such as oil and protein content of delivered seed.

However, based on the current grading regulations there is no requirement for these measurements. Furthermore, no reference to a quality-based incentive system (e.g. price premiums for higher oil and/or protein content) has been found in reference to the soya bean industry, locally or internationally.

Due to logistical challenges at silos, the different soya bean seed qualities cannot be kept separate in the downstream value chain. Thus, there is no sufficient quality-based (oil and protein content) grading system in place to take these aspects that are important to the feed industry further in the value chain.

Product quality at crushing level

In an ideal world, a sourcing strategy at crushing level would aspire to quality-based sourcing to increase efficiencies and profitability of crushing operations. However, South Africa's soya bean industry is not fully mature yet and occasionally experiences shortages. This renders a quality-driven sourcing strategy from a crushing perspective impractical in the current market environment.

> Full-fat soya, solvent extracted and extruded soya bean meal are three completely different products that are not interchangeable.

Some crushers have explored the methodology of buying soya beans directly from farms or regions known to have good quality soya beans. This way, they can implement quality control, and pay a premium for higher and more consistent oil and protein levels (e.g. irrigation soya beans). However, this can only be done during the harvest season, as any surplus soya beans are then stored in silos (where they lose their identity) until they are crushed.

Table 2: Solvent meal vs extruded meal vs full-fat soya. (Source: BFAP industry interviews)

	Protein content	Oil content	Fibre
Solvent soya bean meal	46,5%	2%	Max 4%
Extruded soya bean meal	42,5 to 43,5%	5 to 7%	Max 6%
Full-fat soya bean meal	36 to 37,5%	15 to 18%	Max 6,5%

Outside of the soya bean harvesting season, crushers' sourcing options are significantly constrained and 'crushing something' – even if the best-priced available soya bean is of suboptimal quality – is preferrable to 'not crushing'. *Table 1* provides a high-level summary of local and imported soya bean characteristics and pricing.

Soya bean seed destined for processing is inevitably of variable quality. Therefore, processors test for this variability, most using NIR technology, and they adjust their processing practices accordingly. Mostly the soya bean seed is tested for moisture, crude fibre, crude protein and oil content.

Processing of soya beans

Full-fat soya, as well as solvent extracted and extruded soya bean meal are three completely different products that are not interchangeable. Full-fat soya is an energy and protein source (containing all the oil originally in the bean), while solvent extracted soya bean meal is mainly a protein source (most of the oil has been extracted). Extruded soya bean meal is a midway where some of the oil has been extruded, but the result is less energy-dense than full-fat soya and lower in protein than solvent meal (*Table 2*).

In South Africa, the majority of soya bean seed is crushed and processed by solvent extraction to remove around 99% of the oil content. The majority of soya bean meal produced is consumed by poultry, followed by the swine, beef, dairy, pet-food and aquaculture industries.

Soya beans must be thermally processed to destroy anti-nutritional factors and increase oil availability while preserving the nutritional quality of the protein. The crusher greatly contributes to the nutritional value of the soya bean meal by reducing the bioactivity of anti-nutritional soya bean proteins through the proper use of heat during processing.

Processing challenges

The challenge with processing is that sufficient heat must be applied during processing to denature the anti-nutritional proteins thereby rendering them biologically inactive, but not to the extent that the soya beans are overheated, resulting in lower digestibility of the protein.

Table 1: Comparing local to imported soya beans. (Source: BFAP industry interviews)

	Local soya beans*	Imported soya beans
Protein content	34 to 38%	39 to 40%
Oil content	14 to 19%	>18% (usually >20%)
Other considerations	Consensus that yield and protein content have improved, but that there's space for improvement on consistency in protein content. Local seed has a high-quality variation regarding: • Growing regions. • Between seasons (e.g. drought vs normal climate). • Within seasons (increasing quality towards end of the season).	Some reports of lower protein and oil content levels and high free fatty acids in imported seed. Reports of soya beans that were dried resulting in a darker colour and negatively affected oil content.
Pricing (average 2019/20)	R 7 173,06/ton	R 7 828,51/ton

**Local processors report that beans are bought at a discount of R200 to R450 to import parity due to supply and demand dynamics.*

Table 3: Potential mitigations for soya meal. (Source: BFAP industry interviews)

Parameter	Crusher mitigation	Feed mill mitigation
Protein	• Dehull beans. • Blend meal. • Manipulated with the oil, fibre and moisture content of the beans. • Sometimes sell for discount.	• Adjust formulation. • Add other protein source. • Add amino acids. • Apply for discount.
Over-processed	• Decrease cooking time. • Dehull (limited for cold dehulling). • Blend (only small volumes). • Sometimes sell for discount.	• Downgrade digestibility, and apply for discount and add probiotics. • Only see effect later, calculate effect and talk to supplier.
Under-processed	• Increase cooking time. • Dehull (limited for cold dehulling). • Blend (only small volumes). • Re-process bit by bit.	• Downgrade digestibility, and apply for discount and add probiotics.
Meal size		• Mill again.

Several factors must be continuously managed to consistently achieve proper processing, including the combination of heating time and temperature. Therefore, feed manufacturers require reliable methods to differentiate between under- or overprocessed soya bean meal.

In South Africa, most feed manufacturers make use of in vitro analysis to assess soya bean meal quality before formulating. Some believe that the combination of the KOH and PDI test gives the best representation of soya bean processing quality. Stakeholders in the industry disagree on which test is the best indicator, but agree that a single test is not indicative by itself, and most prefer to conduct a combination of tests to achieve reliable results. However, this has cost and time implications. Many feed mills have a system where some of the basic tests are conducted on all soya bean meal loads delivered before off-loading, e.g. urease, KOH and PDI. More complex tests, such as TIA or reactive lysine, are determined as required for a broader continuous improvement process in collaboration with the suppliers who also test deliveries before selling.

Several factors must be continuously managed to consistently achieve proper processing, including the combination of heating time and temperature.

Product quality at feed mill level

At feed mill level processing consistency is the most important factor. It is even more important than protein content as there is no proper mitigation for incorrectly processed meal at feed mill level. Most South African feed mills prefer solvent soya bean meal and add oil (i.e. sunflower or soya bean oil), which is a major energy source, separately because this enables them to better control energy and protein levels and the associated costs when formulating feed.

> Soya beans must be thermally processed to destroy anti-nutritional factors and increase oil availability, while preserving the nutritional quality of the protein.

However, some feed mills cannot add oil separately during their milling process because they do not have a liquidating system. These feed mills often use full-fat soya bean meal. In general, the use of full-fat soya bean meal in feed formulations has not been as popular because feed mills had difficulties procuring sufficient, reliable, good quality sources at competitive rates. This can in part be ascribed to full-fat crushing plants being operated at smaller scales, namely 5 000 to 50 000 tons per annum in contrast to solvent plants with levels of 50 000 to 600 000 tons per annum.

Nevertheless, in recent years some feed mills have overcome these supply-chain challenges and include full-fat soya and extruded meal in their feed formulation. In addition, they have come to prefer it to regular soya bean meal due to its higher energy contribution.

Soya bean meal comparisons

International soya bean meal quality comparisons found that soya bean seed and soya bean meal composition varied depending on the country of origin and where they were processed. Most of the soya bean meal that has been imported to South Africa for the last 20 years, has been produced by Molinos in Argentina.

> Several trials evaluating and comparing imported soya bean meal to locally produced meal in recent years, have indicated that locally produced soya bean meal is not inferior to imported meal.

The soya bean meal is regarded as very high quality, delivering excellent animal performance and as such has been historically regarded to be the 'gold standard' in South Africa. Consequently, some stakeholders maintain that the imported meal from Argentina has better consistency, with set specifications, including processing quality indicators.

On the other hand, each South African crusher has different processing equipment and methodologies. This results in a wider product range. Furthermore, the products of newer plants are reportedly more consistent over product batches and are thus conceived to deliver better-quality products.

Quality of local soya bean meal

Several trials evaluating and comparing imported soya bean meal to locally produced meal in recent years, have indicated that locally produced soya bean meal is not inferior to imported meal, based on proximate analysis, quality tests and broiler performance. Some South African stakeholders even state that they believe that South African soya bean meal is even better than the Argentinean imports in terms of quality.

If the produced soya bean meal's protein content is below the specification, crushers can blend the meal with higher protein meal. However, this can only be done up to a point if the protein content is not too low. Often this blending process leads to inconsistent feed as the amalgamation process is never perfect. The protein content should rather be manipulated with the beans' oil, fibre and moisture content. For example, by removing more moisture and fibre in the beans, the protein level is increased.

From a feed formulation perspective, shortcomings in raw materials used in feed formulation such as soya bean meal can be corrected to some extent using additives. The most common is the addition of synthetic amino acids, enzymes, pro- and prebiotics. However, the cost of additives is high, and they cannot mitigate all the negative effects of poorly processed soya bean meal. *Table 3* presents potential mitigations for soya bean meal.

Quality standards for soya beans

Over the past few years, significant work has been done through close collaboration between crushers and feed manufacturers to improve the crushing process and its delivered product, especially to lower the trypsin inhibitors and deliver a 46,5% protein meal.

Soya bean meal has become the choice ingredient as protein source in poultry diets. Within the regulatory framework to date (February 2021), no official reference is made towards a required minimum protein and/or oil content of soya beans. Thus, the industry is, along with developing a soya bean meal futures contract to be listed on SAFEX, in the process of developing quality standards for soya bean meal.

Table 4 presents preliminary minimum quality standards for soya bean meal as proposed by the Animal Feed Manufacturers' Association (AFMA). To measure the standards, approved analytical methods must be used, i.e. AOCS, ISO or AOAC. Currently, there are no regulatory mechanisms that police these minimum standards. However, a recent study undertaken by BFAP has found multiple reports of self-regulation regarding soya bean product quality specifications, as well as close collaboration between large off-takers and suppliers towards improving the quality and consistency of soya bean products.

Table 4: Proposed quality measurements and minimum standard for soya bean meal. (Source: AFMA personal communication)

Quality parameter	Minimum standards
Minimum protein	46%
Maximum moisture content	12%
Maximum ash content	6,5%
Acid insoluble	1,5%
Maximum fibre content	5%
Fat basis content	2% (maximum 2,5%)
Particle size	10mm maximum with no lumps
Maximum urease activity	0,15%

For more information or references, send an email to Wiltrud Durand at wiltrud@bfap.co.za

Improving quality control systems in the oilseeds industry using proficiency schemes

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

The Oilseeds Advisory Committee (OAC) requested the Southern African Grain Laboratory NPC (SAGL) to co-ordinate a trust-funded proficiency testing scheme for soya beans and soya bean meal on their behalf. This year, four soya bean and soya bean meal proficiency tests will be conducted.

The test parameters were selected based on advice from the industry. The purpose of proficiency tests is to provide an independent assessment of the competency of participating laboratories. It will also add value to the quality control system of the participants.

Sample preparation and distribution

The soya bean meal test material used for the proficiency test, was provided to the SAGL by a commercial supplier. The homogeneity of this soya bean meal was confirmed by analysing five sub-samples that were taken at random.

For the grading proficiency test, the soya beans were cleaned of all defects. Known quantities of foreign matter, soya beans and parts of soya beans above the 1,8 mm sieve, defective soya beans above the 4,75 mm sieve and soiled soya beans, were added to each cleaned soya bean sample. Each of these prepared grading samples were graded in the laboratory to confirm that the composition of all samples was the same to enable comparison.

For the soya bean quality section of the proficiency test, the test material was prepared by milling soya beans after foreign material and defective kernels had been removed. Homogeneity was also confirmed by analysing five sub-samples taken at random.

Procedure for reporting results

Each participant received a result sheet along with their samples. Provision was made for the correct reporting unit as well as the moisture base for reporting (where applicable). The final reporting date for this first round of 2021 was 18 March.

Compliance with these dates is necessary to enable the SAGL to prepare and distribute the report as per the agreed times. Results received after the deadline were not included in the report. The SAGL is making use of international proficiency reporting guidelines where only one result per laboratory per analysis is included in the report.

In the instance where some of the laboratories reported both primary method and near-infrared (NIR) results, the primary method result was included in the report. Each participant received the proficiency test report with their specific confidential participant code. Three different reports were issued: one each for soya bean meal quality, soya bean grading and soya bean (milled) quality.

Test methods

For the soya bean meal, eleven tests were included in the proficiency test, namely moisture, fat (crude), fibre (crude), protein (crude), ash, cystine, lysine, KOH protein solubility, protein dispersibility index (PDI), trypsin inhibitor activity (TIA) and urease activity. For the soya bean quality proficiency test, the five tests included were moisture, fat (crude), fibre (crude), protein (crude) and ash.

Results

Results for soya bean meal were received from 16 participants for moisture, fat, fibre and protein. Fifteen participants reported ash results, seven reported urease activity, and six KOH protein solubility results were submitted. Only four participants reported PDI values, two reported cystine and lysine, and only one participant reported a temperature humidity index (THI) value.

Nine participants reported results using primary analytical methods and three participants reported results by conducting both primary methods and NIR analyses. Four participants reported only NIR results. For the soya bean quality proficiency test, results were received from ten participants for all five tests.

Seven participants reported results using primary analytical methods, two participants reported results conducting both primary methods and NIR analyses, and one participant reported NIR results. For the soya bean grading proficiency test, only three participants submitted results.

Statistical evaluation of results

All the results were statistically analysed to determine the average value and standard deviation for each test and were summarised in table format. The average value and standard deviation were used to calculate a z-score for each result and these scores were also included in the table.

Since outliers in a set of data will influence the average and standard deviation of that data set, these were identified and marked with an asterisk (*) and excluded from further statistical analysis. A significance level of 5% (a confidence level of 95%) was used for the determination of outliers.

Interpretation of results

Each individual z-value represents the decimal number of standard deviations by which an analytical result differs from the 'true value', as represented by the average value. A 'perfect' z-value is 0. Z-values of less than 1 represent outstanding accuracy and precision.

Z-values of less than 2 are considered to represent satisfactory accuracy and precision, while z-values between 2 and 3 are considered questionable, and some attention to equipment and procedures may be required. Z-values greater than 3 are considered unsatisfactory and require examination of equipment and procedures used.

Summary of results

The soya bean meal proficiency test resulted in only two participants with z-scores between 2 and 3 for two of the parameters, and two participants with z-scores greater than 3 for one parameter each. For the soya bean quality proficiency test, one fibre and one ash result had a z-score between 2 and 3, and for the grading proficiency test, four of the grading parameters had z-scores between 2 and 3.

Distribution of next test samples

The SAGL soya bean proficiency test samples for May 2021 were dispatched at the end of April this year, and participants are encouraged to provide feedback regarding the proficiency tests and reports.

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

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Exploring soya within the National School Nutrition Programme

Dr Carmen Muller, Marcia van Deventer, Dr Beulah Pretorius and Prof Hettie C Schönfeldt,
Department of Animal Science, University of Pretoria, DSI/NRF/NDP SARChI Chair in Nutrition and Food Security

The South African National School Nutrition Programme (NSNP), implemented in 1994, is a government programme that provides one nutritious meal a day to learners in less-affluent primary and secondary schools throughout the country. This programme feeds approximately nine million learners in 19 393 quintile 1, 2 and 3 primary and secondary schools each day. For many of these children, this is their only meal of the day.

The goal of this programme is to improve the nutritional status of these children, thereby enhancing learning capacity and academic outcomes. Inadequate nutrition at a young age leads to underachievement in schools and is a major problem that is most prevalent in developing countries. Therefore, schools are an ideal focus area to start with basic good nutrition and improve academic outcomes.

Food parcels being handed out as part of the National School Nutrition Programme. Some nine million learners in South Africa are fed this way daily.

Meals that meet requirements

Ensuring that the meals provided are nutritionally adequate and acceptable is essential to the success of such a programme. In a survey conducted in 2016 at schools in Gauteng, it was found that there are various factors that influence the implementation of the NSNP as envisioned by the Department of Basic Education (DBE). Soya plays a key role in the NSNP as it is one of the protein options in the meals and is served up to twice a week, accompanied by various starchy staples.

The NSNP menus, as developed by the various provinces, consist of a protein, a starch and a vegetable/fruit portion per day. The protein portion can consist of various foods such as beans, soya, pilchards, peas, lentils, sour milk or chicken, which are alternated throughout the week. Menus in the different provinces are planned based on availability and preference.

In the study at hand, the goal was to investigate the implementation of the NSNP at grassroots levels and to determine if the problems reported in the 2016 NSNP review had been resolved. During this review it was also found that learners eat less on days that soya was served in the NSNP. As soya is shelf-stable, affordable and can contribute to a nutritionally adequate meal, the researchers also investigated soya as served in the NSNP, which will be further discussed in a follow-up article.

Semi-structured interviews were held with staff involved in the implementation of the NSNP at three secondary schools in the City of Tshwane, to ensure that different scenarios were investigated. These interviews shed light on some of the most pressing matters that hinder the successful implementation of the programme.

Findings

Each school participating in the programme, has an NSNP coordinator (manager) who oversees the programme and is also a teacher at the school. This co-ordinator is assisted by six or seven (ratio of 1:200 per learner) food handlers who are employed on a two-year contract on condition that they must have a child in the school during the time of employment.

These food handlers receive a monthly stipend from the Gauteng DBE and, theoretically, are supposed to receive training on how to prepare the meals according to the NSNP recipes. However, none of the food handlers interviewed received the stipulated training or the department issued *Mnandi 4 Sure* recipe book. This booklet is not very practical either, as it includes recipes such as dumplings, meatballs and burgers which are not feasible to prepare for over a thousand learners by six food handlers with limited equipment.

Equipment shortages

Although each of the NSNP schools were supplied with typical kitchen equipment such as utensils and pots, it was found that at most of the schools the original equipment was missing. However, even with these shortcomings, the food handlers made innovative plans to ensure food gets cooked and served. The Gauteng DBE installed three-burner gas stoves at each school in an area indicated by the school.

The areas in which these gas stoves where installed are different for each school, as the schools were not built with dedicated kitchens. One school uses an old home economics class. Only

Many kitchens are ill equipped and food handlers have to make do with few utensils to provide food for up to a thousand learners.

one oven in the home economics class works and this oven is used as a heater in winter. As this classroom was built with food preparation in mind, it is quite big and has two double basins and plenty of counter space to prep the food. Both of the other schools converted storerooms into kitchens with limited space. All three schools did, however, have a dedicated storeroom for the products they receive.

Fresh food deliveries are received once a week and non-perishable items, such as maize meal and soya, are delivered once a month. These foods are stored in a dedicated lockable storeroom with only a staff member other than the NSNP coordinator holding the key. Two of the schools unlocked the storerooms for the researchers and they were well kept and organised.

The NSNP co-ordinator has a great impact on the success of the project implementation at the school. One co-ordinator mentioned that she negotiates with the suppliers to swop some food items, for example, soya mince for soup powder to add flavour to otherwise bland meals. All NSNP co-ordinators also held fundraisers and asked for donations to buy spices to enhance the flavour of food.

Dining areas

A problem highlighted by all the schools was the lack of a formal dining area, and as a result food is served outside in a communal area. With all the original cutlery supplied by the department missing, the serving of food is handled differently by each school. In some cases, students bring their own plates or containers from home and at other schools, pupils had the option of buying a polystyrene container at R1 each.

Interestingly, all the schools allowed independent vendors to enter the school premises and sell food during breaks and lunchtime. In some cases, students would take the starch portion as provided by the NSNP (e.g. maize porridge, rice and bread) and purchased a protein portion (e.g. chicken feet or meat stew) from a vendor to complement the starch. Vendors are allowed on the premises under the condition that they are responsible for cleaning the schoolyard after lunchtime.

At schools where students ate from polystyrene containers, there was notably more waste at the end of lunch which needed to be cleaned by the vendors.

Pupils' interests come first

A sense of ubuntu was noted at all the schools, with initiatives to assist less-fortunate students who did not have food at home. These students were provided with leftovers at the end of the day, as well as non-perishable foods to take home over weekends and holidays. This was made possible due to careful planning by the NSNP co-ordinator.

There was a general feeling that the principals want the best for the students and go out of their way to ensure they are not only fed, but also emotionally cared for. Even with a lack of support, equipment and training, school food handlers make the best of what they have and provide more than a thousand pupils with meals each day, which is a commendable task. The NSNP is an essential service provided to the youth of South Africa and ensuring its effective implementation and sustainability is an investment in the future of tomorrow's leaders.

There is a lot of room for improvement regarding various aspects of the NSNP. This could warrant a study on its own. What was observed was that each school faces different problems, ranging from arrogance from the pupils to a lack of facilities to prepare the food. However, each school handles these problems in their own way and the people responsible for the implementation do have learners' best interest at heart and are willing to walk the extra mile.

4 SOYA MINCE STEW

Ingredients	Quantity 50	100	200	500	1 000
Soya mince	1,5kg	3kg	6kg	15kg	30kg
Onions	500g	1,5kg	3kg	6kg	12kg
Green peppers	2	4	8	16	30
Carrots	500g	1kg	2kg	5kg	10kg
Curry powder	60ml	100ml	200ml	400ml	800ml
Oil	100ml	200ml	500ml	1L	2L
Salt	20ml	40ml	80ml	150ml	300ml
Water	2,5L	5L	10L	25L	50L

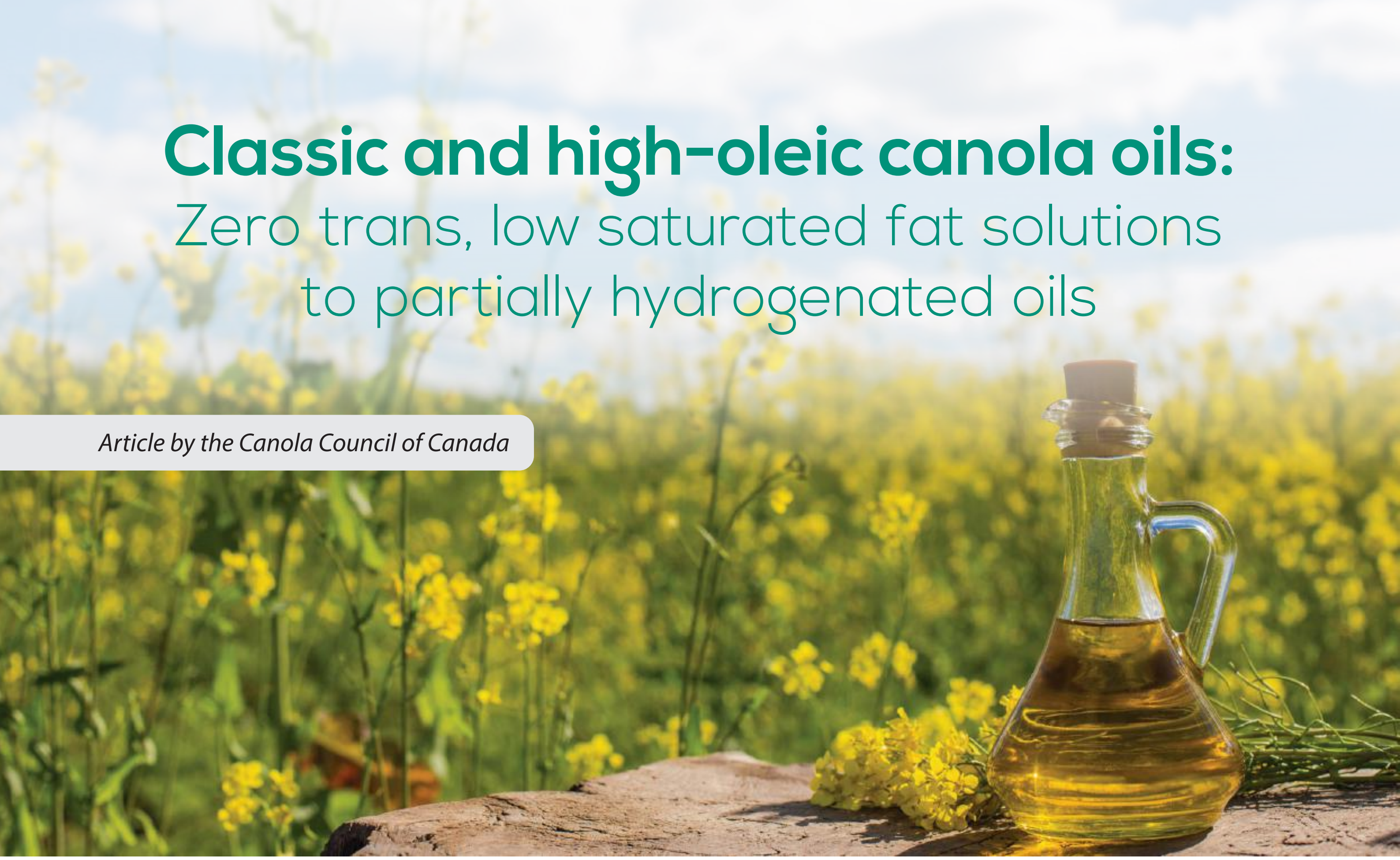
1. Soak soya in water for 30 minutes.
2. Chop onions and green peppers.
3. Top and tail carrots, scrape and slice carrots in 2cm rings.
4. Fry vegetables in oil until glossy, but still crisp.
5. Add soaked soya to vegetables and bring to boil.
6. Add more water or stock and simmer. The stew should resemble a thick stewed mince.
7. Serve 1/2 a serving spoon to primary school learners and 1 serving spoon to secondary school learners. Serve rice, bread, macaroni or pap and fresh vegetables.

A soya mince recipe from the Mnandi 4 Sure recipe book. Unfortunately some of the recipes are impractical and require too much preparation by too few handlers with limited equipment.

For more information, email Prof Hettie Schönfeldt at hettie.schonfeldt@up.ac.za.

Classic and high-oleic canola oils:

Zero trans, low saturated fat solutions to partially hydrogenated oils



Article by the Canola Council of Canada

Canola oil is one of the healthiest oils in the marketplace with zero trans fat and cholesterol, healthy monounsaturated and polyunsaturated fats, and the lowest amount of saturated fat of all common culinary oils. Today, there are two types of canola oil: commodity or classic, which is sold at retail, and high-oleic or high-stability, which is newer and sold almost exclusively to food companies and food service operations.

Both oils have the same low level of saturated fat and positive health attributes. The only difference between them is that high-oleic canola oil, as its name suggests, contains more oleic acid (a monounsaturated fat) and less polyunsaturated fats, namely alpha-linolenic acid (ALA) and linoleic acid (LA). This fat profile makes high-oleic canola oil more stable, allowing for greater heat tolerance and longer shelf life.

High-oleic canola oil, and in some culinary applications classic canola oil, is a great replacement for partially hydrogenated (PH) oils used in food products and food service, which account for about 80% of trans fat in North America. Trans fat is artificially formed when liquid vegetable oils are turned into solid fat using a process called partial hydrogenation, hence the term partially hydrogenated oils.

Why is trans fat bad?

Just like saturated fat, trans fat increases LDL levels or bad cholesterol in the blood. Unlike saturated fat, trans fat can also decrease the HDL levels or good cholesterol – both of which increase the risk of heart disease.

The 13 April 2006 issue of the *New England Journal of Medicine* included a review of the scientific evidence regarding trans fat in the American diet. The authors concluded that heart disease risk could be reduced if PH oils are replaced by trans-free oils with healthy profiles. They said that "complete or near avoidance of trans fats … would be prudent to minimise health risks" and "alternatives [to PH oils] should be low in both trans and saturated fats."

Table 1: Food oil smoke points. (Source: University of Lethbridge)

Oil	Smoke point	
	(° F)	(° C)
Sunflower high-oleic	478	248
Canola high-oleic	475	246
Peanut	471	244
Canola	468	242
Safflower high-oleic	468	242
Sunflower	464	240
Corn	453	234
Soya bean	453	234
Safflower	446	230
Grapeseed	435	224
Olive processed	428	220
Extra-virgin olive	331	166

Smoke points were determined according to AOCS Method Cc 9a-48. Results are averages of triplicate determinations, where error of estimation was within 3,5% of measured value.

[1]On 6 October 2006, the US Food and Drug Administration authorised a qualified health claim for canola oil due to its unsaturated fat content and ability to help reduce the risk of coronary heart disease. It states: Limited and not conclusive scientific evidence suggests that eating about 1½ tablespoons (19 grams) of canola oil daily may reduce the risk of coronary heart disease due to the unsaturated fat content in canola oil.

Table 2: Dietary fat comparison chart. (Source: POS Pilot Plant Corporation)

Oil	Saturated fat %	Mono-unsaturated fat %	Poly-unsaturated Omega-3 fat %	Poly-unsaturated Omega-6 fat %
Canola	7	61	11	21
Canola high-oleic*	7	70	3	20
Safflower	8	77	1	14
Flaxseed	9	16	57	18
Sunflower	12	16	1	71
Corn	13	29	1	57
Olive	15	75	7	9
Soya bean	15	23	8	54
Peanut	19	48	Trace	33
Cottonseed	27	19	Trace	54
Lard	43	47	1	9
Palm	51	39	Trace	10
Butter	68	28	1	3
Coconut	91	7	0	2

** The amounts of oleic and alpha-linolenic acids vary slightly among brands. This is an average representation.*

That said, canola oil is the ideal substitute for PH oils because it is both trans-fat free and low in saturated fat[1].

Classic canola oil

Classic canola oil is a multi-purpose oil that contains approximately 61% monounsaturated fat, 32% polyunsaturated fats (11% ALA and 21% LA) and 7% saturated fat. A less saturated substitute for other vegetable oils, canola oil can be used wherever liquid oil is desired, including cooking oils, salad dressings, snacks and pan-release spray.

In high-oleic canola oil, increased levels of the monounsaturated fat oleic acid displace a small percentage of polyunsaturated fats found in classic canola oil.

Classic canola oil delivers great performance and has a high smoke point, making it desirable for use in high temperature cooking (*Table 1*). The oil can be used for sautéing, stir- and deep-frying, baking, fondue, marinades and vinaigrettes. It is also a great base for making flavoured oils and can be substituted for solid fat in some baking recipes.

A study at the University of Lethbridge commissioned by the Canola Council of Canada (*www.canola-council.org/canola_pan.html*) looked at the effects of common cooking practices on the stability of classic canola oil. Results indicated that negligible, if any, amounts of trans fat were created during baking, stir-frying and deep-frying for long periods of time.

High-oleic canola oil

High-oleic canola oil is most commonly used in commercial food production and food service, as it has prolonged stability under high heat conditions. Unlike PH oils found in many processed foods, such as cookies and crackers, and in commercial frying applications, high-oleic canola oil does not contain any trans fat. It has an impressive nutrition profile with roughly 70% monounsaturated fat, 23% polyunsaturated fats (3% omega-3) and (20% omega-6) and 7% saturated fat. It has a high smoke point (475°F/246°C) – seven degrees higher than classic canola oil.

In high-oleic canola oil, increased levels of the monounsaturated fat oleic acid displace a small percentage of polyunsaturated fats found in classic canola oil (*Table 2*). Stability of an oil is directly related to its degree of unsaturation. Oils with higher levels of polyunsaturated fats, such as ALA and LA, are less stable than oils with higher levels of oleic acid. Thus, high-oleic canola oil is more heat-resistant and longer lasting than its classic counterpart.

When should high-oleic canola oil be used instead of classic canola oil? When greater performance and higher heat tolerance is desired in a commercial kitchen, high-oleic canola oil is a better choice. It allows for extended fry life and cost efficiencies. As a result, high-oleic canola oil is becoming a popular choice for United States and Canadian restaurants and food service operations, including universities, state fairs, resorts and supermarket delis, as they strive to eliminate artificial trans fat from their menus.

Acing the fry test

Frytest.com LLC, an organisation independent of the cooking oil industry, commissioned Texas A&M in 2006 to test ten oils in a zero trans-fat cooking oil contest, three of which were high-oleic canola oil. Each oil was used to fry 300 batches of French fries and compared against fries cooked in PH soya bean oil. Results released in early 2007 revealed that all of the zero trans-fat oils, including high-oleic canola oil, have excellent fry life and are functionally equivalent to or better than PH oil. None of the oils even came close to the end of their fry life after 300 uses.

In addition, the zero trans-fat oils were preferred by consumer evaluators over the PH oil. All ten oils maintained quality during repeated frying for 13 days. There were insignificant differences in French fry flavour, taste, texture or appearance compared to the PH oil. According to Frytest.com, this study "proves there is no need to partially hydrogenate oils to obtain superb fry life and confirms that zero trans-fat oils are preferred by consumers."

High-oleic and classic canola oils offer solutions to eliminate trans and lower saturated fats in food products prepared in the home and in food service operations. Not only are these canola oils good for everybody, but good for the food industry, too.

For the original article, visit *www.canolacouncil.org*.

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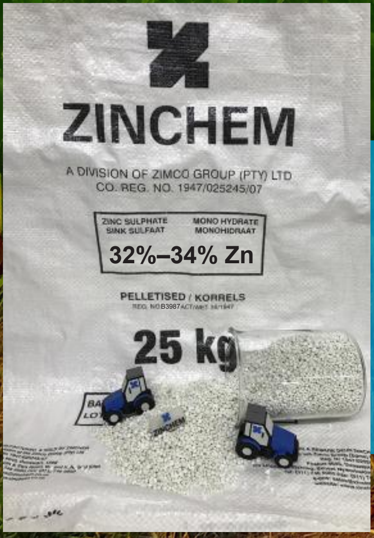

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Are evictions really the only way out?

By HJ Moolman, Moolman & Pienaar Incorporated

The law and outcomes contained in court orders may appear harsh at times, much like a sentence for an offence. This is the one instance in which government authority and power are mobilised to enforce a particular order of the court, once the court has been persuaded to grant a remedy in favour of one party.

Evictions are no exception. A residential eviction involves the physical removal of people and their belongings from the premises where they reside. This is perhaps also why the *Constitution of the Republic of South Africa, 1996 (Act 108 of 1996)* stipulates that evictions must remain a last resort and may only be granted once the court has taken all circumstances into account. In this regard, the legislation also provides for the rights of children, elderly people, and female-headed households to be considered.

Is this the only way out?

The question is whether evictions are the only option, specifically with regard to dispute resolution between landowners and occupiers of land within the regulated framework of the legal obligation and relationship between the parties involved in terms of the *Security of Tenure Act, 1997 (Act 62 of 1997)*, or the *ESTA*.

The answer to this question is contained in the wording of Section 10 of the *ESTA*, which links the relationship between landowners and occupiers of their land to two elements, namely:

- A contract with rights and obligations.
- A relationship between people, which can be measured by values such as respect, trust, communication, and co-operation.

This is also why the breach of an oral or written contract, or the irreparable breakdown of the relationship between landowners and occupiers, would be legal grounds for eviction under the provisions and requirements of the *ESTA*.

Relationship conflict on the farm

Outside of the framework of politics and rhetoric over tenure on farms, the reality is that landowners and farm dwellers, or farm dwellers and other farm dwellers, must share a geographical space. This is even more complicated on farms, as natural resources such as water are linked to availability.

There is no doubt that conflict is inevitable when people share a geographical space which they use to carve out their day-to-day existence. At the same time, suitable and effective legal mechanisms should be in place to serve as a proverbial outlet for conflict, and eviction should be a last resort.

However, the harsh reality is that the *ESTA*, and the way it is enforced in practice, does not provide for an alternative dispute resolution mechanism. Eviction, and the arduous, costly process involved, is currently the only 'outlet' for these disputes.

Fuel on the fire

The negative effect of this lack of alternative dispute resolution mechanisms is exacerbated by the fact that various unregulated organisations are becoming increasingly involved in disputes between landowners and farm dwellers, and that their motives are fuelling conflict instead of finding solutions to it.

Efforts by the Department of Agriculture, Land Reform and Rural Development to resolve disputes are ineffective, as the officials are often perceived as subjective and, almost without exception, lack the necessary knowledge of legislation, applicable case law and mediation skills.

In rural communities, good on-farm work relationships are crucial for commercial farming success, but even more so in a climate where these people are often the targets of violent crime.

Possible alternatives

An objective view of the nature and extent of the legal and human relationship between landowners and farm dwellers should justify a new approach to this issue. This approach will require a concerted effort to incorporate alternative ways of dispute resolution (for example mediation) into conflict management.

An alternative method of dispute resolution needs to have enforceable outcomes in order to eliminate legal uncertainty between the parties.

Lastly, it makes sense to start regulating people or organisations, other than admitted attorneys who provide legal advice, as in the case of employers' organisations and trade unions. This will ensure that people involved in these disputes are held accountable, and will prevent people or institutions with ulterior motives from becoming involved.

A better and more positive approach to repairing relationships through conflict management will mean that evictions become a last resort in all cases. It is a solution in which less activism and more humanity is the driving force.

For more information, contact HJ Moolman on 018 297 8799, 018 297 0397 or hj@mmlaw.co.za.

The COIDA: What to know

By Stephan Pietersen

Companies in South Africa are subject to several labour laws. One such piece of legislation is the *Compensation for Occupational Injuries and Diseases Act, 1993 (Act 130 of 1993)*, or the *COIDA*, which administers work accidents in South Africa.

The main objective of the *COIDA* is to provide compensation for injured workers or those who contracted an occupational disease. Covid-19 contracted in the workplace is also regarded as an occupational disease. Families of workers who died in the workplace may also qualify for a pension.

Compensation Fund regulations

All companies that employ one or more employees (part-time, full-time, contract) must register with the Compensation Fund within seven days after appointing its first employee. This includes seasonal workers in the agricultural industry.

Producers who are registered with the fund, are protected in such a way that farm workers cannot lodge civil claims against them. Employees who are injured on duty can qualify for compensation depending on the seriousness of the injury (for example, if a finger was cut off).

Companies must submit their annual return of earnings by 30 March every year and pay their accounts within 30 days to be in good standing with the Compensation Fund. The fund raised R9,3 billion during the 2018/19 financial year from companies in South Africa. If a company does not submit the return of earnings, the fund can do its own estimates and as a result, companies can be overcharged. Failure by companies to submit their annual return will result in a penalty of 10% being issued on the actual assessment, and a further 10% for the late payment.

The agricultural industry

Producers in the agricultural industry are charged some of the highest rates when calculating their assessments.

The agricultural industry is divided into four categories for the purposes of the *COIDA*, and the new rates that took effect on 1 March 2021, payable on every R100 paid out in wages, are as follows:

- Livestock farming: R2,15.
- Tillage and forestry: R2,13.
- Mixed farming: R2,65.
- Sugar and tea farming: R1,42.

This industry also had the highest number of work-related accidents, with more than 10 000 reported during the 2017/18 financial year. However, farm owners do not always claim back the salary they paid their injured workers and, in the process, lose thousands of rand. This is due to the inaccessibility of services from the Department of Labour. The Compensation Fund only paid out R3,9 billion for benefits in 2018/19, which included medical expenses, refund of salaries to companies, and pensions.

All employers must report work accident claims on the fund's new electronic system, CompEasy. In terms of the *COIDA*, a company must pay the injured employee his or her salary for the period booked off duty and claim this back from the fund. Doctors and hospitals must also send their invoices directly to the fund for payment.

COIDA amendments to be approved

The minister of employment and labour drafted new amendments which are awaiting approval. These amendments will have a huge effect on the administration of work accidents, and companies will face hefty fines if the right processes are not followed.

Some of the amendments include the following:

- *Failure to report an accident within seven days:* A 10% penalty of the declared annual earnings (these are the earnings which are used to calculate the assessment).
- *Failure to furnish all information:* A penalty equal to the full amount of compensation plus interest (if information is not completed on the forms when reporting the accident).
- *Failure to pay the employee's salary while he or she is off duty:* A penalty equal to double the full amount of three months' compensation plus interest (in terms of the *COIDA* a company must pay the worker up to three months while he or she is booked off duty).
- *Failure to provide conveyance of an injured employee:* A fine equal to the full cost of the conveyance (the company must transport the injured worker to the nearest doctor).
- *Failure to keep a record of earnings:* 10% of the actual or estimated annual earnings.

Companies must familiarise themselves with these amendments, and update their internal processes and educate their employees regarding the proper procedures to follow when reporting a work accident.

For enquiries, send an email to Stephan Pietersen at support@workaccident.co.za.

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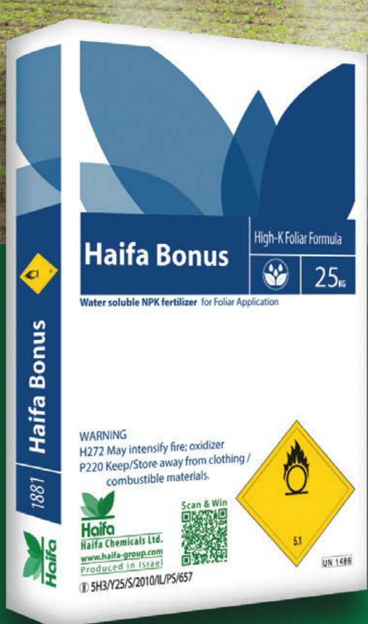

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