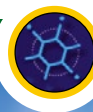


OILSEEDS

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Armyworm species

Nematodes and glyphosate



Sunflower seed set

Zero till and weed dominance



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The importance of oils and fats

By Kellie Becker, managing director, SOILL

For the past forty years, fat has been vilified based on evidence from skewed studies and recommendations from major health and nutrition organisations around the world. However, the negative perception of fat is changing due to new scientific evidence from contemporary studies and consumers' growing interest in nutrition.

The South African oil processing industry has grown by leaps and bounds amid this nutritional revolution and, on top of the growth in local demand, has become a dominant player in supplying Southern African Development Community (SADC) countries.

The supply has been met by impressive growth in the soya bean industry, which is expected to contribute more than 200 000 tons of oil to the balance in the current season. Adding to the equation, the very young canola industry contributes approximately 45 000

tons of oil. Despite the growth in local supply, we have seen 100% growth in imports of soft oils. On top of that, roughly

half a million tons of tropical oils are imported.

Another side to the story

But there is another side to Africa's relationship with processed oils. In the last two decades, the average consumption of oils and fats in South Africa has increased from nearly 15kg/head/annum to around 25kg/head/annum. According to studies, young working-class adults in the developing world take in high levels of 'bad' fatty acids. It accounts for more than 10% of their daily energy intake, which is similar to the rate in western countries. In Southern Africa, this is due to lack of knowledge of fatty acids as well as costs. Diet-related chronic diseases have also been on the rise, especially in developing nations.

The challenge is to help people reduce their risk of developing such diseases by improving dietary options, so that fatty acid intakes are within recommended parameters. Saturated and trans-fatty acids are considered bad. They increase the risk of several chronic diseases, such as type 2 diabetes, strokes, inflammatory response, heart disease and cancer, and have been clinically linked to increases in cholesterol levels.

Trans-fatty acids have become less of a problem, since the traditional process of hydrogenation of oils and fats has been replaced by the inclusion of various saturated fractions of palm oils and the process of interesterification. High levels of saturated fatty acids stem from increased dietary proportions of foods prepared using palm oil products. There is a significant increase in the consumption of these foods by resource-poor individuals, and fast food and ready-to-eat food consumers.

Food companies are further motivated to reduce the inclusion of palm oil in manufactured products due to the prevailing negative sentiment, a result of a lack of sustainable sources.

However, to replace these products can be a challenge. Mono-unsaturated oil offers the best options to achieve comparable stability. So-called high oleic oils trade at a significant premium when compared to general soft oils, and even more so to palm oil. Further processing of soft oils is required to achieve the desired melting point, which also adds to the cost.

The omegas

Omega-6 (linoleic acid) and omega-3 (linolenic acid) are essential fatty acids (i.e. not manufactured by the body). Omega-6 is the predominant fatty acid in sunflower and soya bean oil and is also present in maize, while omega-3 is found in fish, linseed and canola oil.

Our bodies require omega-6 and omega-3 in the ratio of 2:1. According to the *Journal of Nutrition and Metabolism*, the ratio in which omega-6 is typically consumed relative to omega-3 is 45:1. There are numerous health benefits linked to omega-3, and these fatty acids are now more widely available to the general public due to the introduction of canola as a crop in South Africa, which also offers a degree of support in restoring the balance between omega-6 and omega-3.

Market opportunity

Dietary trends such as banting and keto have made oils and fats significantly more acceptable as part of a healthy eating plan, and in larger quantities than previously consumed. The market opportunity for South African producers to produce more oilseed crops to meet the growing and changing demand of oils in the region is vast. The requirements for speciality oils will only grow, creating more opportunity for local production and processing. 🌱

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Agriculture and the Fourth Industrial Revolution

The Fourth Industrial Revolution affects us every day and changes the way we communicate with one another, the way we live and the way we work. It affects virtually all aspects of life, including business, education, transportation and health.

Agriculture is no exception. The digital revolution has been building since halfway through the last century and aspects such as improved information flow, lower transaction costs and faster communication have played a pivotal role in the economic growth of most countries.

It is extremely important that agriculture in South Africa continues to keep pace with the rapidly changing world to maximise advantages, and that smallholder farmers in remote rural areas are not left behind. They are the people who perhaps stand to gain the most from the advancing technology of our times.

Education and banking are prime examples of sectors in which there could be rapid advances and benefits; intelligence tools, digital finance and mobile-based training are but a few of the technologies that can be adopted.

The Fourth Industrial Revolution can greatly benefit agriculture in South Africa.

African swine fever a global threat

African swine fever (ASF) is affecting pig farmers globally and ultimately exerting an impact on the world supply of pork. Asia – specifically China, which has the largest swine herd in the world – has been the primary area affected. ASF has, however, also spread through Cambodia, Romania, Vietnam and South Africa.

Zeerust in the North West recently had an outbreak of ASF. The disease is endemic in warthogs in the area, which means that the movement of pigs from the area is restricted. The outbreak has been described as an isolated incident and is not expected to pose any risk to South African commercial pig production.

Since the outbreak in China, which was first reported in August 2018, that country has culled more than one million pigs and sow numbers in March were down 21% year-on-year. There is no cure and no vaccine for ASF, which is highly contagious and fatal to pigs, but fortunately has no effect on humans.

The disease is such a threat that, as a precaution, the US National Pork Producers Council cancelled the 2019 World Pork Expo, which would have hosted 20 000 international visitors from across the globe in Iowa this year.

Considering that the main application of soya beans is in animal feed, ASF has dragged down soya bean demand. The United States and China continue to negotiate a trade deal, with soya beans possibly being the major bargaining chip. Tariffs that were imposed on US soya beans during the trade dispute coupled with the impact of ASF is likely to reduce China's ability to import the quantities of soya beans initially expected. Earlier this year, soya bean imports to China from the US fell to its lowest level in four years.

There is currently no indication of when ASF could be controlled.

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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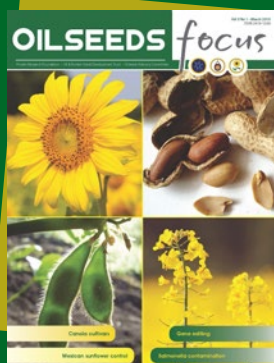
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Update on HB4® soya bean technology

Verdeca, which develops and deregulates soybean varieties with next-generation agricultural technologies, believes its Drought Tolerance (HB4®) technology has the potential to moderate the impact of drought and stabilise crop yields under a broad range of production conditions.

Based on field experiment results in Argentina and the US, it has been concluded that HB4® could be a biotechnological tool incorporated to manage water stress in a wide range of situations, conferring significant yield increases in rainfed low yielding areas, with no yield penalties in high yielding ones.

Verdeca's objective is to submit the dossier for this technology in South Africa and start the regulated field trial requirements later this year.

– Martin Mariani Ventura, Verdeca

Technology gets youth interested in farming

It is increasingly important for farmers to access up-to-date information and African governments are using technology to get young people interested in farming. Africa has the world's youngest population; 60% of its 1,2 billion people are under 25, but only 3 million jobs are created for the roughly 12 million young people who enter the workforce each year.

While developed nations turn to robots, blockchain, artificial intelligence and machine learning to solve agricultural challenges, simple, mobile phone-based offerings could produce great results in Africa. For example, a free app created by the Food and Agriculture Organization (FAO) of the United Nations provides information on weather, market prices for crops, and producing and conserving nutritious foods.

Experts say it is becoming more critical for farmers to access up-to-date information as weather patterns become more erratic with climate change and traditional knowledge on planting seasons becomes less reliable. – *World Economic Forum*

Australia rejects Roundup court finding

Australia's National Farmers' Federation (NFF) has rejected the findings of a US court that the weed killer, Roundup, causes cancer, saying it set a "reckless precedent" that could harm agriculture. Greenpeace urged the Australian government to start restricting the sale of Roundup after a Californian court found it caused the cancer of a terminally ill man.

The jury ruled that Dewayne Johnson, a school groundskeeper, developed Non-Hodgkin's lymphoma due to regularly using Roundup. It also found that the manufacturer, Monsanto, knew of the product's potential health risks and acted "with malice or oppression" by failing to warn users of the dangers.

The active chemical in Roundup, glyphosate, has been classified as "probably carcinogenic" by the World Health Organization, but is still approved for use in Australia and the US.

The NFF said that the US court decision was "in blatant ignorance" of science. "No other herbicide has been tested to the lengths that glyphosate has," says NFF president, Fiona Simson. "After four decades of evaluations, no regulatory agency in the world considers glyphosate to be carcinogenic." – *The Guardian*

Monsanto puts halt on Bt soya beans in US

Monsanto has shelved a longstanding project to bring Bt soya beans to the US. The company cited low grower demand, but US insect resistance to the proteins in its Bt soya bean product is more likely the culprit.

"We found that there was a lack of product demand from our growers in the region," says Monsanto spokesperson Kyel Richard. "Therefore, at this time we do not intend to launch this particular technology in the US."

Mississippi State University extension entomologist Angus Catchot says the southern US would benefit from a Bt soya bean product. Southern soya bean growers are facing high populations of soya bean loopers and soya bean podworm (also known as the cotton bollworm and corn earworm), along with growing insecticide resistance.

"Both pests are resistant to pyrethroid insecticides, and soya bean loopers are starting to show resistance to diamide insecticides," he explains. "We're putting tremendous pressure on the diamide class of chemistry in all crops. If we lose them, the demand for Bt soya beans, in the absence of new chemistry, would be extremely high."

– *DTN Progressive Farmer*



Grain storage platform to support food security

AFGRI Group Holdings (AGH) announced the creation of a strategic grain storage platform vehicle to enable the growth of grain storage capacity in South Africa.

As background to the transaction, Chris Venter, CEO of AGH, explains that in 2011 the AFGRI Group sold its debtors' book to the Land and Agricultural Bank of South Africa (Land Bank) with a clear vision of gaining access to a stronger balance sheet and the ability to expand its lending capabilities to offer a broader base of financial support to farmers.

Venter says that, using a similar approach, the AFGRI Group is now pleased to announce the creation of a strategic storage platform vehicle, AFGRI Grain Silo Company Proprietary Limited (AFGRI Grain Silo Company), which has the clear objective of expanding its current storage capacity of some 4,7 million tons to six million tons in the near future. "This will allow us to cater for grain storage, and to expand into the storage of other types of commodities," says Venter. – *Press release*

Astral's results mirror challenging market conditions

Astral Foods Limited (Astral) recently reported its results for the six months ending 31 March, which reflected the tough macro-economic and challenging trading conditions faced by the group.

"During our final results presentation in November 2018, we indicated that one of the key factors that would negatively influence our results would be an increase in raw material prices," says Chris Schutte, CEO of Astral. "The increase in feed prices could not be recovered in the selling price of chicken in the consumer marketplace. I have on numerous occasions expressed a concern about the financial health of the South African consumer given the dire economic environment."

Group revenue for the reporting period increased from R6,6 billion (March 2018) to R6,8 billion. Operating profit decreased by 51,4% from R1 036 million (March 2018) to R503 million, mainly due to the significant decline in the poultry division's profitability, which was down 68,9%. The group's operating profit margin decreased considerably from 15,7% (March 2018) to 7,4%. – *Press release*

Fall armyworm threatens China's oilseed production

The fall armyworm (FAW) was detected in China and is spreading rapidly. This could hurt production of key crops critical to the populous nation's food supply, according to the US Department of Agriculture. The insect is now found in at least six provinces in China and the risk of it spreading is seen as high.

Damage from FAW, which feeds on maize, soya beans, cotton, rice, and many other crops, could force China to import more maize, rice or soya to make up for the shortfall. Before the

EU neonicotinoid ban and the future of canola

The EU ban on neonicotinoid seed treatments for flowering crops is five years old. Ironically, the regulation that was imposed in part to protect the biodiversity that oilseed rape supports, could be the cause of the crop's decline.

Oilseed rape crops support vast populations of bees, butterflies and other insect pollinators, as well as a food chain involving the predators and natural enemies of these species and insect-eating birds. Together with the fact that oilseed rape is a key early-season source of pollen, the loss of this crop from the seasonal rotation would have far-reaching effects on biodiversity.

As cabbage stem flea beetle numbers explode, EU farmers are faced with making decisions on the viability of their worst-affected areas and are looking into planting strategies that may mitigate damage in the future, as over-exposure to pyrethroids is producing resistant adults. – www.oilseedandgrain.com

US demand for organic livestock feed climbs

Demand for organic livestock and poultry feed continues to climb in the US. This is leading to higher production and higher import volumes of organic grains, according to Mercaris, a market data and trading platform focused on organic and non-GMO feed and food commodities.

A new report, generated to provide greater transparency on the US organic and non-GMO market, concludes that livestock is becoming the driving force behind organic grain demand. The report states that over the 2018/19 marketing year, demand for organic livestock feed grains will increase by 6%, while demand for high-protein feed ingredients will climb by 7%.

US production of organic corn is expected to grow by 2% this crop marketing year. Meanwhile, import of whole and cracked organic corn is expected to rise by 10% year-on-year. US production of organic soya beans grew by 13% in 2018/19, however, supplies are expected to shrink by 4% due to a decline in organic soybean imports. – *Feed Navigator*

US-China trade war, China was importing approximately 60% of all US soya bean exports.

The problem comes at a time when Chinese authorities have been trying to boost soya bean production to reduce the need for imports. China now ranks as the world's largest importer of soya beans. China produces about 16 million tons of soya beans annually, but it imports more than 80 million tons a year of the commodity, which is commonly used for animal feed and oils.

– *CNBC* 🌱

Terrestrial non-parasitic nematode assemblages associated with glyphosate-tolerant and conventional soya bean-based cropping systems

By Akhona Mbatyoti, Mieke Stefanie Daneel, Antoinette Swart, Dirk de Waele and Hendrika Fourie

Commercial production of genetically modified crops (GM), either herbicide or insect tolerant, commenced in the 1990s. Herbicide tolerance of GM crops to broad spectrum herbicides containing glyphosate (N-phosphonomethyl) as the active substance is the predominant trait of these crops. Among glyphosate tolerant crops grown globally, soya bean (*Glycine max* L.) dominates in terms of hectares planted (54,2 million ha), followed by maize (*Zea mays* L.) (13,2 million ha), cotton (*Gossypium hirsutum* L.) (5,1 million ha) and canola (*Brassica napus* L.) (2,3 million ha).

In South Africa, glyphosate became commercially available more than a decade ago and is now widely used in soya bean and maize-based cropping systems in particular. It is estimated that more than 90% of soya bean (630 000ha) and 16% of maize (284 000ha) grown in South Africa is glyphosate tolerant (Dlamini *et al.*, 2014; James 2015).

The driving force behind the rapid adoption of glyphosate is because producers prefer to use a single herbicide to control a broad spectrum of weeds and grasses, resulting in minimal crop injury and great economic benefits to producers.

Glyphosate and nematodes

Glyphosate is often regarded as an environmentally friendly pesticide due to its low mammalian toxicity, relatively short environmental half-life and very low activity in soil due to its binding to soil minerals. However, the increasing cultivation of glyphosate tolerant crops has raised a wide range of concerns such as its effects on non-target microorganisms, e.g. nematodes in the soil.

Nematodes play a crucial role in important ecosystem services such as nutrient recycling and decomposition, suppression of pathogenic microorganisms, and biodegradation of harmful compounds. As a result, changes in nematode community composition (assemblage) may have a substantial impact on the ecosystem functioning.

Information about the non-target effects of glyphosate on soil nematodes is scarce and not well documented. More important, often inconclusive and/or conflicting effects of glyphosate on nematode assemblages are reported. Only six scientific reports could be found that dealt with the effects of glyphosate on nematodes. The majority of these focused on the effects that glyphosate has on plant-parasitic nematodes. Liphadzi *et al.* (2005), however, reported that different glyphosate dosages had no effect on non-parasitic nematode densities in a growth chamber experiment.

No information on the effects of glyphosate on, or its association with, either plant-parasitic or terrestrial non-parasitic nematodes (generally referred to as beneficial or free-living), is available for South African agricultural production areas. Therefore, the main aims of this study were to identify terrestrial, non-parasitic nematode assemblages in commercial soya bean fields where glyphosate has been applied regularly versus not applied for at least five years prior to this study and examine whether glyphosate application affected such nematode assemblages in a two-year soya bean/maize cropping system.

Commercial soya bean field study

Thirty-two non-parasitic nematode genera were collectively identified from

soils of the three ecosystems, with 65% identified from soils of glyphosate-tolerant soya bean fields, 72% from conventional soya bean fields, and 88% from natural vegetation sites. The genera identified were represented by different feeding groups and functional guilds, and included bacterivores, fungivores, predators and omnivores.

The predominant non-parasitic nematodes from glyphosate-tolerant soya bean sites for the 2011/12 season were *Aphelenchus*, *Acrobeles*, and *Acrobeloides*. *Aphelenchus* occurred in soils from all of the glyphosate-tolerant soya bean sites while *Acrobeles* and *Acrobeloides* occurred in only 50%. For conventional soya beans, the predominant genera were *Panagrolaimus*, *Acrobeloides*, and *Aphelenchus*. *Panagrolaimus* occurred at 75% of the sites, with *Acrobeloides* and *Aphelenchus* occurring in 50%. In soils from natural vegetation sites, the predominant genera were *Acrobeles*, *Aphelenchus*, and *Acrobeloides*. *Acrobeles* occurred at all sites, while *Aphelenchus* and *Acrobeloides* were found at 75% of the sites.

For the 2012/13 season the predominant genera identified from soils of glyphosate-tolerant soya bean sites were *Aphelenchus*, *Acrobeles*, and *Eucephalobus*. *Aphelenchus* occurred at all sites and *Acrobeles* and *Eucephalobus* at 89% and 78%, respectively. For conventional soya bean, the predominant genera were *Aphelenchus*, *Eucephalobus*, and *Acrobeloides*. *Aphelenchus* occurred at all sites, with *Eucephalobus* and *Acrobeloides* occurring at 44% and 67%, respectively. In soils from natural vegetation sites the predominant genera were *Aphelenchus*, *Eucephalobus* and *Panagrolaimus*. *Aphelenchus* and *Panagrolaimus* occurred at all sites and *Eucephalobus* at 83%.



Although the abundance of the predominant genera (*Acrobeles*, *Acrobeloides*, *Aphelenchus*, *Eucephalobus*, and *Panagrolaimus*) varied substantially for the three ecosystems, it did not differ significantly between ecosystems according to t-test analyses.

Significant interactions

Mixed Models analysis showed significant ($P \leq 0,05$) interactions for fungivores, omnivores, and predators for season locality and for predators for season ecosystem locality. Due to relatively low F-ratios for this interaction for fungivores and the absence or very low numbers for predators and omnivores (ranging between two and seven for omnivores and two and four for predators), further discussion of the data is abstained from.

Season significantly ($P \leq 0,05$) affected the abundance of all four nematode trophic groups (bacteri-, fungi-, omnivores, and predators). The abundance of bacterivores (873 ± 426 vs 120 ± 430 nematodes/200g soil), fungivores (283 ± 150 vs 88 ± 152 nematodes/200g soil) and omnivores ($1,6 \pm 0,9$ vs $0,5 \pm 0,9$ nematodes/200g soil) was significantly higher in Season 2 compared with Season 1.

By contrast, predator abundance was significantly higher ($P \leq 0,05$) in Season 1 ($0,8 \pm 0,15$ nematodes/200g soil) than Season 2 ($0,38 \pm 0,12$ nematodes/200g soil). However, due to either the absence or very low numbers for predators and omnivores, discussion of the data for these two trophic groups is abstained from.

Ecosystem affected only predator abundance significantly ($P \leq 0,05$), with significantly higher population densities in glyphosate-tolerant ($1 \pm 0,2$ nematodes/200g soil) compared with conventional soya bean ($0,3 \pm 0,2$ nematodes/200g soil) and natural veld ($0,2 \pm 0,1$ nematodes/200g soil). However, the very low predator numbers recorded for all three ecosystems warrants no further discussion.

Locality significantly ($P \leq 0,05$) affected omnivore and predator abundance but warrants no further discussion due to very low population densities recorded for these to trophic groups.

According to CCA analyses, no differences were apparent for the nematode assemblages present in soils from the three ecosystems when data for the sites were combined. However, when the three ecosystems were plotted per site, distinct variations existed among the respective nematode

communities for the three ecosystems with the cumulative explained variation for the different locations for both seasons ranging from 22 to 82%.

An example is that of Edenville, with a cumulative explained variation of 48,9%. For the other localities, similar differences between the nematode communities for the three ecosystems were observed, although the nematode assemblages associated with each ecosystem differed among the localities.

Presence of fungivores

According to faunal analysis, soils from the majority of the sites (54%) of the three ecosystems due to their Enrichment Index (EI) and Structural Index (SI) being $<50\%$ for both seasons were dominated mainly by the presence of fungivores, especially Fu2. Of the sites, 46% plotted in Quadrant A due to their EI being $>50\%$ and SI being $<50\%$. These soils were dominated by bacterivores, mainly belonging to Ba1 and Ba2.

The metabolic footprints (data pooled for sites from each ecosystem for each season) for the three ecosystems were small. The EI for the three ecosystems was intermediate (38%) to moderately high

(68%) and the SI very low (<10%) for both seasons. Small differences were evident for both natural vegetation for the two respective seasons and glyphosate-tolerant for the two respective seasons' ecosystems.

However, for the conventional soya bean ecosystem the difference for the 2011/12 growing season and the 2012/13 growing season was more pronounced. This phenomenon was probably due to a higher percentage of Fu2 being present in soils during the 2013 season.

Soya bean/maize cropping experiment

All nematode genera identified from the experimental plot were present in soil samples taken before the study commenced. Their numbers were, however, low and ranged between two and seven per 200g soil.

Fourteen non-parasitic nematode genera were identified from rhizosphere soil samples. In general, higher numbers of non-parasitic nematodes were recorded during the 2014/15 season compared with the 2013/14 growing season. *Aphelenchus* was most abundant and always occurred in higher numbers in glyphosate-treated plots.

Aphelenchoides only occurred in

the glyphosate-treated half of the plot while *Tylenchus* only occurred in non-treated halves of both crops. *Acrobeloides*, *Cephalobus*, *Eucephalobus*, and *Panagrolaimus* always occurred in higher numbers in the glyphosate-treated compared with the non-treated half of the plots.

Faunal analysis

Substantial differences were apparent for non-parasitic nematode assemblages present in soils of the soya bean/maize cropping system for the glyphosate-treated compared with the non-treated plot halves. Data for the non-treated soil of all sampling dates plotted, with EI >45% due to domination by bacterivores (Ba2 in particular representing *Acrobeloides*, *Acrobeloides*, and *Eucephalobus*).

One sample from the non-treated maize plants plotted with a high SI (86%) due to the presence of predators (Pr5) belonging to the genera *Aporcelaimellus* and *Discolaimium*. By contrast, all samples from the glyphosate-treated plot half, except for one, plotted in Quadrants C and D with a low EI (<35%). This was substantiated by the presence of

fungivores, Fu2 in particular, belonging to *Aphelenchus* and *Aphelenchoides* while Fu4 was also present and was represented by *Tylencholaimus*.

Discussion

The 32 non-parasitic nematode genera identified from the commercial soya bean field study and adjacent vegetation, and an experimental site where a soya bean/maize rotation was done, represent novel information for South Africa. Previous studies in such agricultural areas only focused on plant-parasitic nematodes.

Various abiotic factors are known to impact on nematode development and survival, with season significantly shown to affect the abundance of the four non-parasitic nematode trophic groups recorded in our study. This scenario implies that prevailing environmental conditions played a pronounced role during the two seasons this study was conducted.

Although soils from the commercial glyphosate tolerant fields were dominated by the fungivore genus *Aphelenchus* during both seasons of the study, this genus also dominated in soils from conventional soya bean and natural vegetation ecosystems in the second season. In the soya bean/maize cropping experiment, it dominated in the second season in both plots.

These results agree with those by Neher *et al.* (2014) who recorded higher abundance of fungivores in soils from Bt maize compared with those from their near-isolines. Also, it is to a certain extent in agreement with those by Liphadzi *et al.* (2005) who stated that fungivores dominated in soils treated with various herbicides. These authors, however, did not refer to glyphosate-treated soils as was done in the present studies.

Variation across ecosystems

The abundance and dominance of the non-parasitic nematode genera, however, varied among the three ecosystems sampled during the extensive field study, and for the two-year experimental soya bean/maize cropping study. For the field study, the glyphosate tolerant soya bean ecosystems supported the least number of genera (21), while the natural vegetation supported the most (27), followed by the conventional soya bean ecosystem (23).



The increasing cultivation of glyphosate tolerant crops has raised a wide range of concerns such as its effects on non-target microorganisms. (ID 121201752 © Adisak Kongsawat | Dreamstime.com)

This trend is in agreement with reports by Bekker (2016) that natural vegetation ecosystems adjacent to maize fields in South Africa supported a higher diversity of non-parasitic nematodes than conventional and conservation maize ecosystems. Also, the general trend that nematode communities in soya bean fields and natural vegetation sites were dominated by bacterivore genera of the families *Acrobelidae*, *Cephalobidae*, and *Panagrolaimidae* and fungivores of the families *Aphelenchidae* and *Aphelenchoididae* is in agreement with results by Bekker (2016) who did a similar study for commercial maize fields.

The dominance of bacterivores in terms of the genera diversity in soils sampled during the present studies is also in agreement with reports by Djigal *et al.* (2004) and Xu *et al.* (2015). These authors suggested that bacterial feeding nematodes are the most abundant metazoans in soil substrates.

Prevalence of fungivores

Fungivores were the second most prevalent group in soils sampled in the present studies, which is in agreement with a recent study by Renčo and Čerevková (2017). These authors reported that fungivores are the second most abundant in soil after bacterivores nematodes. The lower abundance and occurrence of predators and omnivores in the commercial field study was not surprising since these two groups are regarded as being very sensitive to soil disturbances.

A similar trend was reported by Bekker (2016) for a commercial maize field study. Hence, despite that ecosystem significantly affecting predator abundance, the very low population densities and/or absence of this trophic group at various sites are suggested to have caused this effect and hence discussion of the data is abstained from. The absence of omnivores in soils of the two-year experimental soya bean/maize study is another interesting observation and cannot be explained at this stage.

Nematode communities generally differ and fluctuate substantially among different locations in terms of abundance, diversity, and occurrence.

This tendency, although not significant, was apparent for the three ecosystems sampled during the commercial field study. When the three ecosystems were, however, analysed per site using the nematode trophic groups, each generally had different nematode communities and was separated from each other according to CCA analyses. However, no trend existed where a specific nematode genus/ genera was exclusively associated with either of the three ecosystems.

Although it was not possible to deduct the impact of each ecosystem on the nematode communities, our study showed that glyphosate-tolerant soya bean had no deleterious effects on non-target beneficial nematodes. This is in agreement with those for other genetically modified crops, e.g. Al-Deeb *et al.* (2013) and Neher *et al.* (2014) demonstrating that genetically modified Bt maize had no significant adverse effects on non-target, beneficial, and plant-parasitic nematodes.

Also, Chen *et al.* (2017) concluded that Bt rice had no remarkable impact on beneficial soil nematode communities and was pest specific. However, Neher *et al.* (2014) suggested that rhizosphere soil from Bt maize may contain more complex and successfully mature nematode communities opposed to those from non-Bt near isolines, which may be applicable to our study where fungivores generally dominated in soil from glyphosate-treated soya bean crops. This phenomenon may be an indication that less disturbance in the glyphosate-treated soya bean fields probably can contribute to nematode communities being more matured.

Sub-optimal soil quality

According to faunal analysis, all soya bean sites sampled were disturbed and degraded, indicating that the quality of these soils is not optimal in terms of the presence of beneficial nematodes. This situation is often associated with management practices such as repeated tillage and pesticide application, which are typical practices in local soya bean production areas.

Contrary to annual crop fields, natural vegetation ecosystems are usually

regarded as stable and structured due to either no or minimal disturbances. However, in the current study all-natural vegetation sites were also degraded or disturbed. This might be explained by the vegetation type that was represented by mainly grasses. Often natural vegetation consists of woody, perennial plants that are mostly considered less disturbed than grassland vegetation. The latter vegetation probably experiences periods during which the organic content of the soil is high compared to periods when substantially less organic material is present.

Results from the soya bean/maize cropping experiment, however, showed that glyphosate applied as a leaf spray twice per season during two consecutive growing seasons generally affected the abundance and diversity of non-parasitic nematodes. This was substantiated by soil food web analysis of the different nematode sampling dates that showed that the majority of the glyphosate-treated plots for both seasons were degraded and depleted opposed to the non-treated plots that were disturbed but enriched.

These results are not in agreement with those of the commercial field study and also those reported by Liphadzi *et al.* (2005), who found that glyphosate application had no effect on the abundance and diversity of non-parasitic nematodes in glyphosate-treated plots during a three-year study.

It is worth mentioning that the non-treated plot was hoed, implying some disturbance in the upper soil, while organic material was also added to the soil. Both these activities might have had an effect on non-parasitic nematode communities and probably favouring bacterivore genera.

Ultimately, results from the two South African studies conducted showed similarity in terms of *Aphelenchus* domination. However, glyphosate application did not affect the general abundance of non-parasitic nematodes compared with those from conventional soya bean fields and natural vegetation sites where no glyphosate had been applied for at least five years prior to this study, or never before. 🌱

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How to distinguish between armyworm pests

By Dr Annemie Erasmus, ARC-Grain Crops Institute

Being an invasive insect species, the presence of the fall armyworm in Africa over the past few years has once again highlighted the importance of distinguishing between the different larval and worm species that attack maize. To make things a little easier, this article provides some useful information on these species.

The larval species all belong to the insect order *Lepidoptera*. This means that there is a larval/worm stage after the eggs have hatched. After that, the larva pupates and finally emerges as a moth or butterfly.

We are familiar with two armyworm species currently found in South Africa, namely the African armyworm (*Spodoptera exempta*) and the beet armyworm (*Spodoptera exigua*).



African armyworm (*Spodoptera exempta*). (Photo by A Erasmus)

African armyworm

The African armyworm is found throughout sub-Saharan Africa and is a serious pest in countries north of South Africa. Unexpected pest outbreaks are characteristic of the African armyworm. Large larval colonies rarely attack extensive grazing, lawns and grass crops (e.g. maize and sorghum) areas. Minor outbreaks

occur frequently, especially in areas with high rainfall, such as Mpumalanga and KwaZulu-Natal, but large-scale outbreaks occur only every five to ten years. The worst outbreaks in South Africa occur in seasons with late summer rainfall following drought conditions.

The moth of the African armyworm is brown with white hindwings and distinctive darker patterns on the forewings. Moths can migrate across thousands of kilometres, especially during years marked by pest outbreaks. They migrate in the early evening and can reach heights of between 300 and 1 000m above ground

level. Moths move downwind on air currents, usually from the warmer northern neighbouring states such as Zambia, Zimbabwe or Mozambique, to South Africa.

Moths lay eggs in groups of 100 to 400 and a single female can lay up to 1 000 eggs. Eggs hatch within three to six days, depending on temperature and humidity. Larvae grow in length to approximately 25mm. They have a black appearance with

green/yellow stripes along the length of the body and have a characteristic V-shaped mark on the head capsule. Mature larvae pupate in the soil.

To effectively control the armyworm larvae, the pest must be spotted well in advance. If larvae are only sighted when almost mature, it is usually too late to control them chemically as the damage

has already been done and there will not necessarily be a second generation. Where larvae are still moving from one field to another, a furrow can be ploughed to trap them. They can then either be buried in the soil or controlled chemically.



Beet armyworm (*Spodoptera exigua*).

(Photo by D Visser)

Beet armyworm

The beet armyworm occurs all over the world and the larvae can also migrate en masse. Whether this phenomenon has been observed in South Africa has not yet been confirmed. The species can occur in two phases: a migratory or swarming phase (during which they are dark coloured), or a single phase. The single larvae are usually found in a C-shaped, curled position in the calyxes of maize seedlings. The larvae are green with a green-brown head and only grow to about 15mm. Although the colour of older larvae varies considerably during the migratory phase, they are usually dark coloured.

The moth of the beet armyworm is pale grey with brown marks on the forewings. The hindwings are white with dark veins. The moths can lay up to 600 eggs in groups of 30 to 100 on other plants;



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Fall armyworm (*Spodoptera frugiperda*). (Photo by A Erasmus)



African bollworm (*Helicoverpa armigera*). (Photo by A Erasmus)

however, this is usually not the case on maize. The number of larvae found on maize is limited – single larvae usually occur. The larvae pupate in pupal cells in the soil and moths emerge roughly ten to twelve days later. This species rarely reaches pest status on maize.

Fall armyworm

The invasive fall armyworm species is usually the one that creates confusion. This species was first observed in South Africa in early 2017. The fall armyworm occurs widely in North and South America. This pest feeds on a large variety of plants but prefers grasses and grass crops. However, the worms can also cause great damage to groundnuts, soya beans, cowpeas and wheat.

The larvae are fast growing and eat large holes in leaves, or even the whole leaf. The larvae are green and change colour to greenish brown as they mature. The larva has a characteristic

Y-shape on the head capsule. The larval stage can take between 16 and 30 days, depending on temperature and humidity. The mature larva pupates in a pupal cell in the soil. The moth hatches after about a week and lays eggs on vegetation around grasslands.

False bollworm

The false bollworm/false armyworm (*Leucania loreyi*) and the African bollworm (*Helicoverpa armigera*) are two other species that can occur in grasslands. These species can also cause confusion.

The false bollworm occurs sporadically, as opposed to the African bollworm. Moths lay up to 100 eggs in parcels between the leaf sheath and the stem; they hatch after about five days. Larvae also have the characteristic pale stripe on the sides like the African bollworm, but are usually dull in colour. Larvae may moult up to six times. There are a few generations a year.

Immature larvae can damage leaves to such an extent that only the veins remain, while mature larvae can consume the whole leaf. Damage can also be caused to maize cobs, which is similar to the damage caused by the African bollworm. Larvae usually feed at night. Larvae can occur in the calyx of younger maize plants as well as on maize cobs and suckers. This species can reach pest status on oats and wheat.



False bollworm or false armyworm (*Leucania loreyi*). (Photo by A Erasmus)

African bollworm

The African bollworm is considered to be one of the most important pests on agricultural crops in South Africa, as it attacks a wide variety of crops. Bollworm moths migrate at night and lay yellow-white eggs on maize cobs and leaves. The eggs take three to five days to hatch. Larvae moult five to six times, during which time they can change colour. A characteristic feature of the African bollworm is the pale white stripes on the sides of the larvae. The larval stage lasts about a month and occurs after flowering.

The larvae of the African bollworm that have infested maize fields will initially feed on the maize beard and later tunnel into the tips of the cobs. In maize fields where heavy infestation occurs on young cobs, the beard can be damaged to such an extent that it can lead to poor pollination. If young cob leaves are damaged during rainy periods and water penetrates the cobs, fungal growth may occur, which causes seeds to colour. In most cases, only the tips of maize cobs are damaged and crop losses are minimal.

Farmers should therefore be on the lookout for armyworm outbreaks. Places in a field or grazing where large flocks of birds gather is usually a good indication, as birds feed on the larvae. If there are any outbreaks, clear pictures can be taken and the ARC-GCI can be notified. During any outbreak, the species will be identified immediately. 📷

For more information or to report outbreaks, contact Dr Annemie Erasmus on 018 299 6113 or send an email to ErasmusA@arc.agric.za.

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On 1 June 2019, Corteva Agriscience finalised the separation from its parent holding company DowDuPont, to become a global agricultural company dedicated to seed, crop protection and digital solutions. Corteva Agriscience is headquartered in the United States with sites in Casablanca (Morocco), Cairo (Egypt), Pretoria (South Africa), and Nairobi (Kenya).

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As a focused, stand-alone agricultural company, Corteva Agriscience will be better positioned to offer a complete solution to help growers maximise yield and profitability. This includes a broad and balanced portfolio of seed products, including our flagship Pioneer® and Pannar Seed brands, as well as trusted crop protection solutions and agricultural software solutions.

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Factors influencing seed set and grain fill in sunflower production

By Corné van der Westhuizen, agronomist, Pannar Seed

Poor seed set and grain fill are two components in sunflower cultivation that can be problematic from time to time. This article focuses briefly on a few aspects that can affect seed set and grain fill.

This year, much the same as last year, there are regions in the sunflower production areas that may once again have lower than expected sunflower seed yields. This can be largely attributed to the difficult season and the occurrence of dull sunflower kernels with poor bushel weight. The late plantings, which appeared to be doing well, yielded a large percentage of seed with poor fill. During harvesting poorly filled seed blows out at the back of the combine harvester, causing lower than expected yields.

The period in the growth cycle of the sunflower plant during which the number of seeds per flower is determined, starts as early as flower initiation (R1) and continues to the first phase of seed



Lower than expected sunflower seed yields can be largely attributed to a difficult crop season and the occurrence of dull sunflower kernels with poor bushel weight.

fill (R7). This period runs from about 30 days before flowering, to about 20 days after flowering. It covers a significant portion of the sunflower plant's growth and development cycle and includes several shared and sequential processes of plant development, including leaf initiation, stem and root development, flower initiation, flowering, pollination, fertilisation, seed set and early seed fill.

Plant stand and pollination

There are several factors that may contribute to poor seed set and grain fill in sunflower seeds, including genetic, physiological, agronomic and environmental factors.

Plant stand, and its effect on plant development and flower size, plays a significant role in the number of individual flowers that occur per flower head. The sunflower usually consists of 1 000 to 4 000 small individual flowers that flower from the outside to the inside of the floral structure over a period of roughly five to ten days.

The stigma lobes of each flower lengthen, and insect-initiated cross-pollination usually occurs between different flowers. When insect numbers are too low for cross-pollination to occur, the stigma lobes curl backwards, the pollen comes into contact with the flower's own style and self-pollination takes place. Every flower is receptive to pollen for about 14 days. It is generally accepted that modern sunflower cultivars are about 95% self-pollinating. Low self-compatibility and poor self-pollination are among the genetic reasons for poor seed set and grain fill.

Physiological mechanisms

The physiological mechanisms that regulate seed set and grain fill in



The occurrence of broken neck in sunflowers due to a boron deficiency.

sunflowers are very complex. Insufficient photosynthate provision (source limitation) is mainly responsible for poor seed development and grain fill. The term 'source-sync' refers to the relationship between the source of photosynthate and the final point of use or, in this case, the relationship between the plant's leaf surface and the number of individual seeds on the flower head.

Studies show that the percentage of dull kernels per flower can be manipulated by changing the ratio of the amount of photosynthate to consumption or need by manipulating the leaf surface to flower surface. In general, it has been found that an increase or decrease in the leaf surface to flower ratio, has improved or impaired seed set and seed fill. The effect of this source-sync ratio is greatest in the centre of the flower and weakest on the outside of the flower. Seed mass is affected right across the floral surface.

Photosynthate deficiencies

Photosynthate deficiencies or so-called 'source limitation' is a major reason for poor seed set and grain fill in sunflower production under normal production conditions. A study conducted by Alkio *et al.* shows that

each leaf provides photosynthate to a specific 25 to 35% sector of the flower head, and that the top 10 to 15 leaves are mainly responsible for the photosynthate transported to the flower head. From these trials it can be seen that the leaf surface to flower ratio is very important for grain fill.

Deficiencies have little effect on vegetative growth, but cause problems with seed set due to early embryo death; severe deficits lead to broken stems.

If seed set does not occur, a shell with a dull seed forms (hollow sunflower seed). From these studies it can be seen that the occurrence of hollow seed (up to 20% of tubular flowers) is quite common, even under normal cultivation conditions with no significant yield loss, since flowers compensate by filling the gaps. The plant's photosynthate factory, the leaf surface, must be protected at all times. This means that leaf diseases such as *Alternaria*, which can cause a loss of leaf surface and photosynthetic efficacy, must be guarded against.

Agronomic factors

This relates to management decisions that have a direct impact on plant development and the final grain yield. Management decisions such as planting date, plant stand, field selection (soil pH), and fertiliser levels have a significant effect on plant development and final yield. During this season, planting date, as a single factor, may have exerted the greatest influence on sunflower production. Planting date trials conducted by the Agricultural Research Council (ARC) at Potchefstroom show that sunflower production is, for the most part, adversely affected by planting dates later than December.

Sunflower is very sensitive to aluminium toxicity. Optimal sunflower cultivation takes place at a soil pH (KCl)

between 5 and 5.5. Soil with a pH (KCl) of 4.7 and below should be avoided. Sunflowers are more sensitive to low pH and high acid saturation than maize. The effect of soil pH on the availability of nutrients to the plant is well known.

Effect of micro-elements

At a relatively low soil pH, important micro-elements such as boron and molybdenum are not necessarily available to the plant. Boron is one of the micro-elements needed for normal growth and development in plants. It plays an important role in cell division, and deficiencies lead to weak and abnormal cells. The occurrence of broken neck in sunflowers due to a boron deficiency has been described. Boron is also needed for pollen vitality, pollen germination, elongation of the pollen tube and seed development.

The flowering stage is the most sensitive growth stage to boron deficiency. Deficiencies have little effect on vegetative growth, but cause problems with seed set due to early embryo death; severe deficits lead to broken stems. Fertiliser trials show the positive impact of boron on pollen viability and seed set.

An imbalance in administered nutrients (N, P, K) can also have a negative effect on yield. Mulder's Chart shows the synergism and antagonism of different nutritional elements to one another. Excess nitrogen (N) has an antagonistic effect on the uptake of elements such as potassium, copper and boron. The suppression effect of excess nitrogen on the oil percentage of sunflower has been described.

Environmental conditions

During the crop's life cycle, environmental conditions can potentially have a major effect on the grain yield of the sunflower plant. Conditions involving high or low temperatures, heavy rains and persistent wet periods during flowering are beyond the control of the producer, but often have a significant effect on seed set and grain fill. Moisture stress is a highly significant environmental factor exerting a negative impact on sunflower production.



The sunflower usually consists of 1 000 to 4 000 small individual flowers that flower from the outside to the inside of the floral structure over a period of roughly five to ten days.

Mohan Reddy *et al.* (2003) showed that moisture stress that negatively affects the leaf surface index and dry matter accumulation during the flowering period, played the greatest role in lower yields. Moisture stress during the period from early flowering to early seed set leads to a decrease in the leaf surface index and consequently restricts the yield determining components.

The lower than expected yields associated with the 2017/18 season's sunflower plantings and the incidence of a high percentage of dull sunflower seeds, poor bushel weight and low oil percentage can be attributed to the cumulative effect of some of the factors mentioned here. The later than normal planting date may have contributed the most to lower yields, primarily due to a lower percentage of photosynthetically active radiation (PAR) available to be intercepted by the plant for photosynthesis. 🌱

Simple food colouring test to help spot root-knot

By PR Janse van Rensburg, Pioneer

Root-knot nematode (*Meloidogyne spp.*) is a pathogen that causes significant yield loss in soya bean production in South Africa.

The root-knot nematode's life cycle is approximately 30 days, which means a large number of eggs can be produced by the female, which lives for three months. She will penetrate the root and migrate in search of a favourable area to feed on the tissue, where she will remain for the rest of her life cycle and form an egg parcel of approximately 1 000 eggs. These egg parcels are known as galls.

Root-knot nematode populations in the soil can increase exponentially over a short period of time, because of the advanced ability of the female to produce

so many eggs. These nematodes can also change sex, depending on environmental conditions.

The hatching of eggs is not dependent on root secretions and it has been found that not all eggs will hatch under favourable environmental conditions. A percentage will therefore remain dormant in the soil and can live there for up to one year.

Cultivar choice is therefore a major determinant and plays a significant role in combating crop losses caused by root-knot nematodes.

The prevalence of this nematode is widespread across all soya bean production areas in South Africa and is increasingly reaching economic threshold values in more areas. The presence of root-knot nematodes can drastically decrease yields without any visible symptoms of infestation, and they spread very easily.

The root-knot test

Surface symptoms of nematode infestation on crops are easily confused with typical environmental stress symptoms such as drought, nutrient deficiency or chemical damage. Knots or galls will, however, be visible on the roots if root-knot nematode infestation is very high – hence the name 'root-knot'.

Underground symptoms of nematode infestation are noticeable in the root and the producer can thus be sure of the cause of crop losses. Root-knot nematodes tend to occur in patches, which makes it easier to identify infestation.

However, many farmers are still doubtful as to whether root-knot nematodes are present in their soya bean fields and whether nematodes are harmful to their crops. There is an easy way to test for nematodes. This test can be done as early as the second-leaf stage in soya beans. All that is needed is a shovel, the possibly infected soya bean plants, food colouring, water, a watch, a container, a measuring cup and a teaspoon.

Instructions

- Dig out the root with the shovel and shake off the soil around the roots (fine

Figure 1: A soya bean field infested with root-knot nematode; yellow spots are visible in the field with galls on the roots as underground symptoms.

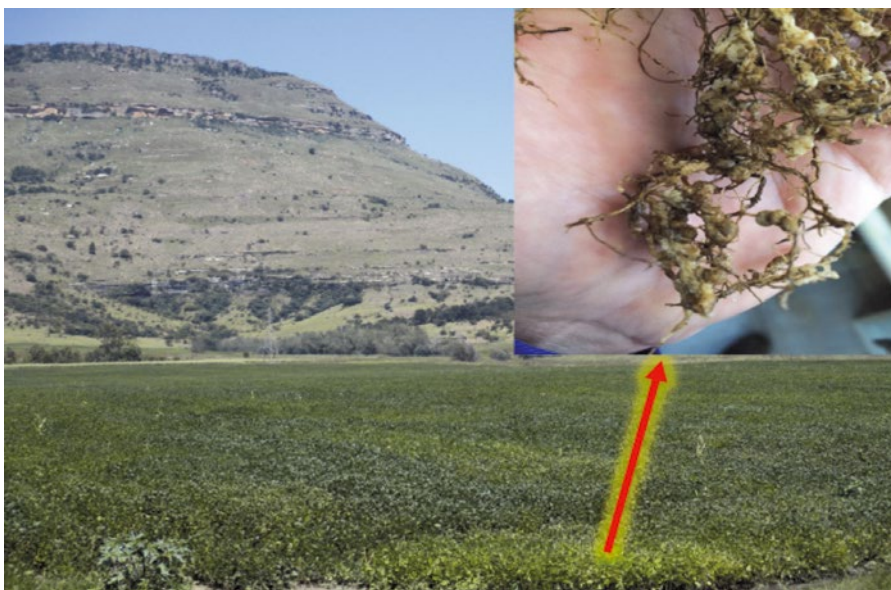
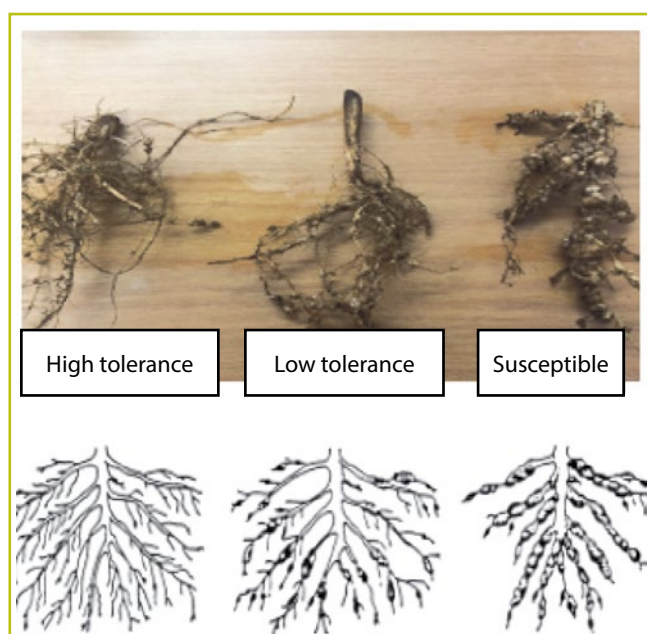


Figure 2: Roots coloured with red food colourant.



Figure 3: Visual representation of cultivars with high tolerance, low tolerance and high susceptibility.



roots easily remain in the soil when the soya bean plant is pulled out). Keep the leaves on the plant.

- Rinse all the soil from the roots with clean water.
- Mix a teaspoon of food colouring with 500ml water.
- Immerse the plant's root section in the coloured water and leave for 20 minutes.
- Remove the plant from the coloured water and rinse again with clean water.
- Place the soya bean root on a clean, white surface so you can clearly see if knots or galls are present.
- Use your smartphone's camera to zoom in if necessary.

is that a nodule can be broken off and crushed, while root knot nematode galls form part of the root and the whole root will split down the middle when the knots or galls are crushed.

Tolerant vs susceptible varieties

Root-knot nematodes are sedentary endo-parasitic nematodes which can increase rapidly and cause serious problems. There are, however, different control measurements that can be applied. Chemical control works if properly implemented, so that resistance does not develop. The implementation of crop rotation with the right crops and various biological

Figure 4: Field trial with high nematode numbers. Highly tolerant plants show good growth and no galls on the root. Susceptible plants show poor growth and galls on the root.



The difference between root knot nematode galls and bacterial nodules

control methods are other options.

It is important to understand that the implementation of any measure cannot be effective if it is not combined with a tolerant variety. Plants contain a genetically transferable ability to exhibit natural tolerance to nematode infestation, and if a susceptible cultivar is planted, the nematode population will continue to increase.

If a more tolerant variety is planted, infestation may be decreased or restricted to a minimum. Cultivar choice is therefore a major determinant and plays a significant role in combating crop losses caused by root-knot nematodes.

If the root-knot nematode infestation is very high, the plants will die before the producer can harvest if no control methods are applied and the plants are highly susceptible. 🌱

The development of novel risk reduction strategies for *Sclerotinia* head and stem rot of sunflower and soya beans

By LA Rothmann, MC Meiring and NW McLaren, University of the Free State

Sclerotinia sclerotiorum has an extensive host range of more than 500 plant species, including sunflower, soya beans and canola. These crops play an important role in the South African economy as protein and oilseed crops.

Vegetables that may serve as alternative hosts include (but are not limited to) cabbage, potatoes, squash, carrots and tomatoes. Many common South African weeds are also susceptible to infection and can harbour the pathogen within these crop production systems.

Disease symptoms and signs

Seedling wilt may occur, although *Sclerotinia* head and stem rot frequently develops at flowering and pod or seed fill stages. The initial symptoms are brown water-soaked lesions that become covered with white cotton-like mycelium on sunflower heads and soya bean pods, as well as in and on the stems of both sunflowers and soya beans.



Mycelium (A), sclerotia (B) and stipes (C), the apothecia initials of *Sclerotinia sclerotiorum*.

The white mycelium on the face of sunflowers eventually develops into a net of black sclerotia. As the disease matures, a shredded appearance, with sclerotia between plant fibres, can be observed, particularly in sunflowers. This fungus can also infect the subterranean crown and forms sclerotia within the lower stem of sunflowers and soya beans.

Although extensive literature is available regarding *Sclerotinia*, this disease remains problematic in economically important crops and the pathogen's local behaviour needs to be clarified.

The symptoms associated with a disease are a host response to the pathogen, whereas the signs are a physical reaction of the pathogen. These signs may also be seen morphologically in the laboratory. In the case of *Sclerotinia* diseases, mycelium and sclerotia are the primary signs of the pathogen's presence. Sclerotia, melanised masses of hyphae, are key to the life cycle of this fungus, as they are its primary survival structure.

Infection and spread

Infection by *Sclerotinia sclerotiorum* can occur through two means of germination to produce primary inoculum, namely myceliogenic and carpogenic germination. Carpogenic germination results in the formation of an initial

stipe, followed by the apothecia, which are mushroom-like structures.

The bird's nest fungus is commonly misidentified as apothecia. Apothecia release ascospores into the air under conditions of high relative humidity and changes in air pressure, favouring long distance dispersal and infection. *S. sclerotiorum* has the ability to remain dormant in the form of mycelium in infected plant residues when environmental conditions are unfavourable for germination and infection.

Environment and microclimate

Sclerotinia sclerotiorum is highly dependent on its environment, both weather and agronomic conditions, for disease initiation, development and survival. Cool, wet conditions favour disease development.

The disease is more prevalent in fields where there is a dense crop canopy and limited air circulation, which creates a favourable microclimate for disease development. This is directly related to plant population density and row spacing selected at planting, and to the selection of cultivars prior to planting. Cultivars vary in their physiological structure, i.e. they are determinate or indeterminate, with the latter tending to have a denser canopy.

The pathogen has a complex life cycle and interaction with its hosts and its environment, which makes the management of this disease complex.

Disease resistance and response

Currently, in an international context, there are no commercially available sunflower or soya bean cultivars with resistance to this disease.

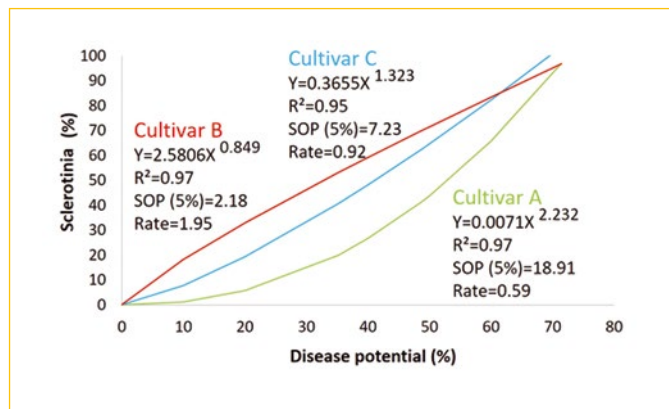


Apothecia (A) and the common bird's nest fungus (B).

However, the manner in which soya bean and sunflower cultivars differ in their response to the pathogen under conditions favourable to the disease, enables the selection of more 'tolerant' cultivars that can reduce the risk of infection and yield losses.

Marlese Meiring has conducted field trials to elucidate the response of soya bean and sunflower cultivars to disease potential, using regression analysis (*sensu* McLaren and Craven, 2008). This analysis determines the type of response and the relationship between *Sclerotinia* head and stem rot within a cultivar and changing disease potentials. Disease potential is defined as the expected mean disease incidence in a genetically diverse population under a specific set of environmental conditions.

Figure 1: Three potential disease scenarios associated with *Sclerotinia* head and stem rot of sunflower and soya beans.



Three response types can be observed between *Sclerotinia* incidence in a cultivar and *Sclerotinia* potential:

- Cultivar tolerant to increasing disease potential.
- Cultivar intolerance to increasing disease potential.
- Cultivar having linear relationship with increasing disease potential (Figure 1).

This regression methodology can be an effective and accurate tool to quantify the response of cultivars to different disease potentials, and to promote the selection process of cultivars for a specific disease potential. Further seasons will be added to this study to quantify the response of the cultivars across multiple localities.

Disease controls

There are a limited number of registered fungicides in South Africa. Currently, benomyl and procymidone are used on peas and sunflowers. The latter active ingredient is registered for use on soya beans. The exorbitant cost of the chemicals and their application and the potential requirement for multiple sprays is an economic risk for producers.

Disease forecast models serve as an early warning system that assists producers in optimising the timing of fungicide applications, ensuring optimal efficiency and healthy economic decisions. These risk assessments have been successful internationally for canola and soya beans. The systems range from simple checklists to more advanced

mathematical modelling, which is ultimately visualised as a risk percentage or proportion, followed by a recommendation to apply and the application timing, or by a recommendation to withhold fungicide treatments.

In Europe, canola field experiments conducted between 1981 and 2004

indicated that fungicide sprays were only 27 to 33% cost-effective against *Sclerotinia* stem rot (Koch *et al.*, 2007).

A risk analysis model

Professor Neal McLaren and Lisa Rothmann are currently in the initial stages of developing a risk analysis model to help producers identify the risk for *Sclerotinia* disease development at

critical growth stages during the cropping season. Ten-year disease and weather data were bulked to identify critical infection windows and estimate the length of infection and colonisation periods.

Rothmann is conducting further exploration and optimisation of data collected for the model development in collaboration with Prof Emerson Del Ponte from the Federal University of Viçosa in Brazil. To ensure that all regions of sunflower and soya bean production are covered and correct estimations of risk are distributed, Rothmann has requested producer involvement with surveys, which are currently being conducted. These will be made available via the South African *Sclerotinia* Research Network.

Prevalence and prevention

The change in agronomic decisions, environmental weather conditions, management practices and the susceptibility of germplasm has led to an increase in the importance of *Sclerotinia* diseases worldwide. The greater the prevalence and severity of the disease, the lower the yield and the greater the inoculum build-up.

In the 2017/18 season, sunflower and soya bean epidemics causing yield losses of up to 80% were reported in the Eastern Free State. In South Africa, in 2014, the effects of *Sclerotinia* stem rot of canola gained more attention due to the greater prevalence of the disease during that season, compared to previous years. Although extensive literature is available regarding *Sclerotinia*, this disease remains problematic in economically important crops and the pathogen's local behaviour needs to be clarified.

This investigation is a priority of the South African National *Sclerotinia* Research Network. The spread of *Sclerotinia sclerotiorum* into critical South African crop production areas and its associated yield losses highlights the importance of identifying and deploying effective management measures to safeguard agricultural land against the initial incursion of the pathogen. 🌱

For more information, contact Lisa Rothmann at coetzeeLA@ufs.ac.za or follow the South African *Sclerotinia* Research Network on Facebook, Instagram and Twitter.

Zero tillage promotes dominance of certain weed species

By Dr Charlie Reinhardt

In general terms, the many positive attributes of minimum and zero tillage for the achievement of sustainable and profitable crop production is beyond reproach. However, the saying 'for every human action in nature there are reactions' is very true in agriculture, where farmers deal with the convergence of human and natural factors in agro-ecosystems that may pose formidable management challenges. Ineffective weed management in zero tillage systems could spoil the advantages offered by the practice.

Effective weed management depends on the success of the application of three primary methods of weed control, either used singly or in an integrated approach. These methods are chemical control using herbicides, mechanical control using implements, and biological control (biocontrol) using crop litter or cover crops.

In zero tillage systems mechanical weed control is not an option, which may lead to a greater dependence on herbicides. Biocontrol is very popular in zero-till systems for weed suppression and can be a valuable tool to augment chemical weed control.

Eliminating mechanical weed control

With no mechanical weed control, there is a real risk that weeds may escape other means of control, such as herbicide use and/or biocontrol, to the extent that excessive weed numbers may cause unacceptable crop losses.

A delay in the use of herbicides can result in spraying the weeds too late, when they are beyond the optimum growth stage for effective control with post-emergence herbicides; generally, the optimum growth stage is considered to be the six-leaf stage or younger.

The very important class of pre-emergence grass herbicides – the acetanilide group with members such as acetochlor, alachlor and metolachlor – gives effective control of grass weeds only during the weed growth stage when the underground

plant parts that develop above the seed are emerging through the soil.

This is post seed germination, but prior to seedling emergence above ground. It is important to note that not a single herbicide (excluding soil fumigant products) on the market today inhibits seed germination, although several types of herbicides act on weed seedlings during the period between seed germination and seedling emergence.

Tillage knocks weeds back

Mechanical weed control with tractor-drawn implements allows the burying of weed seeds at soil depths where they encounter conditions that are unfavourable for germination. Alternatively, if they do germinate, especially the small-seeded seedlings lack the energy to reach the soil surface and die off.

Primary tillage actions can control weeds in the process of preparing the seedbed, which represents pre-planting weed control, and it can be specially employed for controlling deep-rooted weeds. Secondary tillage operations, with the specific purpose of controlling weeds physically by breaking contact between plant roots and soil and/or by covering plants with soil, can only provide weed control between crop rows and not on the rows. Weed-crop competition is fiercest on the crop row where the foliage above ground and the roots below the surface are most entangled, and the competition

for growth factors, i.e. light, water and nutrient elements, is strongest.

For a good 20 years after its introduction to the crop seed market in 1996, Roundup Ready™ (RR) biotechnology, which rendered crops tolerant to the non-selective herbicide glyphosate, led to the displacement of many other herbicides from major crops such as maize, soya beans and cotton. This technology slotted seamlessly into zero tillage systems based on RR maize, soya beans or cotton.

A non-selective herbicide, glyphosate, was rendered selective through genetic modification of the crop, which allowed the control of a broad spectrum of weeds, while not compromising crop safety. In effect, glyphosate use on RR-crops in zero tillage systems compensated for the 'loss' of mechanical weed control. Now, farmers could spray glyphosate only when the weed infestation warranted control, in-row weed control was possible, and wet soil need not thwart the spray operation because aerial application of glyphosate was possible.

Glyphosate and RR biotechnology

The hugely effective biotechnological tool which married glyphosate and glyphosate-tolerant crops, simplified weed control and boosted profitable crop production. Unfortunately, it has inadvertently been compromised by new challenges in the form of glyphosate-resistant weeds and dominant hard-to-control weeds. High dependence on glyphosate for weed

control, particularly in zero tillage systems, led to its overuse and non-compliance with instructions on the correct and responsible use of this herbicide.

Overuse implies 'creeping' dosages as the label-recommended rate is progressively increased to get the same level of control originally achieved. This is typical of one way in which weed resistance to any herbicide evolves. When injudicious use of a herbicide is combined with high frequency of use, e.g. three or more applications in a season, the risk of herbicide resistance developing in certain weed populations is increased.

Weed resistance and chemical dilution

The zero tillage crop system attracts certain weed species in the sense that the practice provides conditions conducive to their establishment and dominance. In the case of the abundant weed *Conyza bonariensis* (flaxleaf fleabane), and its cousin *Conyza sumatrensis* (tall fleabane), the prevalence especially in zero tillage systems is boosted by a key characteristic of seed germination.

Research in Australia has revealed that *C. bonariensis* seeds predominantly germinate on the soil surface or at a depth of 5mm. Very few seeds germinate at a depth of 10mm, and none at a depth of ≥ 20 mm. (H. Wu *et al.*, 2007, *Weed Biology and Management* 7: 192-199). The authors attributed the fleabane problem in minimum tillage systems in Australia to better emergence on or near the soil surface due to moist conditions provided by minimum tillage compared to conventional tillage.

Obviously, in zero tillage situations seed burial for weed control purposes is not possible. Other weeds that predominantly germinate at shallow depth are small-seeded broadleaf weeds, e.g. *Amaranthus* (pigweed) species, *Chenopodium album* (white goosefoot) and *Portulaca oleracea* (purslane), as well as the grass weeds.

The perennial grass *Cynodon dactylon* (couch grass) depends more on vegetative (plant segments) growth than on sexual (seed) reproduction, and lack of soil tillage as a control method aids the formation of a dense underground system of roots and rhizomes. This high underground biomass has a dilution effect on herbicides such as glyphosate when the chemical is applied to the foliage.

Consequently, treated couch grass tends



The pervasive weed *Conyza bonariensis* (flaxleaf fleabane) often dominates the weed spectrum of especially minimum tillage systems in summer and winter rainfall regions.

to regrow from rhizomes (underground stems). Such dilution of the herbicide, which is essentially inadvertent underdosing, is another risk for the evolution of herbicide resistance.

The same rationale applies in the case of weeds being sprayed only when the plants are beyond the effective growth stage for best control; spraying of mature (high biomass) weeds constitutes herbicide underdosing.

Varying approaches for best control

Glyphosate only has post-emergence activity on weeds and repeated application is required for weeds with staggered emergence throughout the growing season. For the control of broadleaf weeds that emerge during the growing season and have inherent tolerance to glyphosate, such as *Conyza* spp. (fleabane species), *Ipomoea purpurea* (morning glory) and *Commelina benghalensis* (wandering Jew), broadleaf herbicides that persist in soil are required.

The latter is a unique plant in that it produces aerial seed as well as subterranean seed on a single plant, and the temperature requirement for germination is different for the two types of seed. Hence the species shows staggered germination across the growing season (Ferreira and Reinhardt).

In the case of morning glory, M. Singh *et al.* reported that maximum germination of seed was 83% and 94% when sown 0mm and 20mm deep, respectively, but germination was significantly reduced to 76% for seed placed at a depth of 40mm and deeper.

For highly problematic weed species such as these, soil-persistent herbicides should be used. Seed burial done with soil tillage operations would likely assist with control.

Effective combinations

Fortunately, current herbicide recommendations are aimed at combining the use of glyphosate with different modes-of-action herbicides for the sake of avoiding herbicide resistance, as well as improving efficacy of weed control. An example of a popular herbicide mixture applied pre-planting in zero tillage systems, is glyphosate + 2,4-D which, in optimum dosages, improves weed control of certain weeds beyond that provided by glyphosate alone.

The 'double-knock' approach of applying glyphosate and paraquat separately in a sequential manner is another effective pre-planting treatment that can assist with the reduction of weed pressure later in the season.

Just as no single herbicide should ever be regarded as the panacea for all weed problems, zero tillage practice ought not to be mooted as a 'silver bullet' solution for sustainable crop production. 🌱

Dr Charlie Reinhardt is dean of Villa Academy, extraordinary professor in weed science at Stellenbosch University, and project leader in the SAHRI at the University of Pretoria. For enquiries, contact him on 083 442 3427 or dr.charlie.reinhardt@gmail.com.

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Argentina — global leader in no-till agriculture

Argentina is considered a world leader in no-till agriculture, or direct sowing, and has the largest percentage of land (92%) under no-till. At the same time, it is also the biggest per capita producer of grain in the world, producing 145 million tons of grain in the 2018/19 season.

The country's grain crops include:

- Soya: 55 million tons at an average yield of 4 tons/ha.
- Maize: 46 million tons at an average yield of 9,76 tons/ha.
- Sunflower: 3,9 million tons at an average yield of 2,1 tons/ha.
- Sorghum: 730 000ha planted at an expected average yield of 3,4 tons/ha.

These production figures are not by chance, says Dr Valeria Faggioli, soil biologist at INTA, Argentina's National Institute of Agricultural Technology. "It is due to direct sowing (no-till), as well as a series of technological and socio-political factors that led to a profound change in the production system in our country, where the correct application of technology plays an important role."

No-till for sustainability

There has been a dramatic adoption of no-till by Argentinian farmers who trust that it is favourable for sustainability, which it is, says Dr Faggioli. The results of long-term experiments show that the conservation of organic matter is higher in no-till planting than it is in traditionally cultivated soil.

Long-term experiments also show that a lack of crop rotation can be as detrimental as conventional tillage in terms of soil carbon retention. The conservation of edaphic carbon, explains Dr Faggioli, is essential because organic compounds play key roles in soil function. Vital physical properties such as water infiltration, aggregate stability and aerial fluxes are determined by the level of organic matter. Moreover, organic compounds retain diverse communities

of soil biota that are crucial for mineral nutrition of crops, pathogenic suppression and plant growth promotion.

Building on a strong tradition

The move towards no-till in Argentina has been supported by the country's strong agricultural machinery manufacturing sector. Machinery adapted to no-till planting is now part of a country-wide industry, which supplies domestic and global market demand.

In 2017, the sector achieved record sales of US\$2,1 million. In the same year, Argentinian agricultural machinery exports to more than 30 countries, including South Africa, exceeded US\$149 million.

The sector, according to research by Dr Mario Bragachini of INTA, creates 100 000 jobs directly related to the industry. The industry is gradually adapting to global trends of automation and robotics and machines with artificial intelligence will soon be available, a factor that will revolutionise agronomic performance.

The country has more than 500 agricultural machine factories, and access to 32 million cultivated hectares on which to test machinery. This expands the ability of the Argentinian agricultural machinery manufacturing sector to test, apply and use the latest technologies, such as ISO standards BUS 3 and 4, CAMBUS, Big Data and AgTech. However, the sector still works at a scale that allows the farmer full access to the factory design to influence practical and specific designs. The motivation for this is to make implements that are practically adapted to work in difficult circumstances, such as those found in countries like Argentina and South Africa.

Despite access to technology, the average tractor in Argentina ranges from 135kW to 180kW since the only relevant implement used in the field is the no-till planter, which needs about 8kW per row. The emphasis is on sustainability and practicality – from an environmental and economic point of view.



A winter cover crop mix under irrigation on the farm of Hendrik Odendaal. Ten plant species can be identified.

A demonstration day of Argentinian agricultural technology and machinery for South African farmers will be held on 10 September on Hendrik Odendaal's farm, Holmdene, between Val and Villiers near Standerton. Various manufacturers of implements and related technologies will showcase their products. Watch the press and social media for more detail.



For more information, contact Hendrik Jordaan on +549 11 6274 5888 WhatsApp or cellphone, or consultancy@laurik.com.ar.



Quality control parameters for commercial full-fat soya beans: **Processed by two different methods and fed to broilers**

By N Ruiz, F de Belalcázar and GJ Díaz

Considerable knowledge has been accumulated over the years to quantify the need and the effects of heat treatment in soya bean meal (SBM) for animal feeding. Although full-fat soya beans (FFSB) as an animal feed ingredient may appear fairly related to SBM, in practice FFSB is a different ingredient with different nutritional composition and processing conditions than SBM.

Therefore, in the quality control (QC) of FFSB processing, the parameters are not necessarily the same as those used to estimate optimum SBM quality.

Matrai and co-workers, as well as Waaijenberg, have reported practical QC parameters for FFSB, which are specified according to the intended animal species and age of feeding. However, limited information is available correlating specific QC or *in vitro* estimators with actual performance of broiler chickens to market age. Therefore, the objective of this paper is to correlate *in vitro* determinations in representative samples of FFSB used in *in vivo* feeding trials with broiler chickens.

Two different experiments were conducted at the National University of Colombia to determine the optimum processing conditions to produce commercial FFSB by two different methods: wet extrusion and dry toasting. In both experiments, treatments consisted

of raw soya beans processed at different temperatures and lengths of time, formulated in a single broiler mash feed and fed to broiler chickens from 1 to 42 days of age.

Experiment 1 ***In vitro* data versus growth data**

The growth data from Perilla *et al.* show that body weight (BW) gain between 8 and 42 days was not significantly different for the 122, 126, and 140°C treatments. The BW obtained with these three treatments were not significantly different than for the soya bean meal treatment. However, feed conversion was more efficient in the SBM treatment. The raw soya beans treatment was significantly different than the 118 and 120°C treatments, confirming the improvement in animal performance due to heating of soya beans.

The BW and feed conversion data indicate that performance was maximised for treatments 122, 126, and 140°C.

Trypsin inhibitor activity dropped consistently from 50,800 (raw FFSB) to 4,700 TI units/g as temperature treatment increased to 140°C. The 17,700 to 4,700 range for treatments 122, 126, and 140°C appears consistent with the 14,000 to 7,000 TI units/g range considered typical in the US for adequately processed FFSB.

Urease activity as measured by the pH rise method is another *in vitro* test widely used by industry to assess the adequacy of heat treatment of SBM and FFSB. Raw soya beans and treatments 118 and 120°C had the highest UA values, which corresponded to suboptimal bird performance. In this experiment the range of pH values that corresponded

with maximum performance was 0,07 to 0,03 pH units for treatments 122, 126, and 140°, respectively.

Soy-Chek is a trademark for a ready-to-use colour test to evaluate UA. It was included as another *in vitro* test because it is fairly well correlated to pH rise and because it is a very quick and simple test to run. The data for Soy-Chek indicate that this quick method clearly differentiated the under-processed FFSB treatments from the adequate ones.

The Soy-Chek manufacturer indicates that the product is applicable to both SBM and FFSB; however, for FFSB the time to evaluate results is 10 minutes as opposed to SBM, for which the time is 5 minutes. It is possible that the fat content in FFSB slows the wetting of the sample by the reagent.

All of the above *in vitro* tests are valid to detect underprocessing, that is, insufficient heating of SBM or FFSB. The results for TI and UA follow similar trends as those reported by Perilla *et al.* on different samples of the same treatments and conducted in a different laboratory.

The KOH protein solubility (KOHPS) test has been suggested as a method to evaluate overprocessing, that is, excessive heat treatment of SBM and other oilseed meals. With the exception of the report by Perilla and co-workers, we are not aware of specific publications evaluating the value of the KOHPS test to predict overprocessing for FFSB.

The data for KOHPS show that solubility was above 90% for raw soya beans, which is in agreement with the data of Anderson-Hafermann *et al.* For the heat treatments, all values were in

the upper 80s with only the treatment of 140°C at 79%. The KOHPS data do not agree with the data reported by Perilla *et al.* on different samples of the same treatments since they reported solubilities as low as 72% and 67% for treatments 126 and 140°C, respectively.

However, it is important to emphasise that a major limitation of the solubility test is that it is very empirical with various factors, such as the particle size of SBM or FFSB, and agitation intensity among other factors affecting the interlaboratory variability for the test. For the FFSB samples used for this report, the average particle size expressed as the average geometric diameter ranged from 480 to 650 µm, whereas for the SBM sample it was 250 µm. The FFSB samples do not grind very well in laboratory mills because of its oil content.

In vivo amino acid digestibility versus growth data

Total amino acid (TAA) values standardised at 88% DM are presented. Although a single analysis was run for each sample, it should be noted that the FFSB treatments were all derived from

the same original lot of raw soya beans. Except when overprocessing conditions occur, TAA values are normally not affected by processing. Therefore, for practical purposes the TAA values for the different treatments are six replicated analyses.

As temperature increased during wet extrusion, the digestible amino acid (DAA) coefficients increased, indicating the gradual destruction of TI and other antinutritional factors that may affect amino acid absorption. The highest numerical values for DAA coefficients were obtained at 126°C.

However, because each DAA coefficient was determined with a single set of birds (three birds) per sample, and excreta were pooled together for one analysis, there is no variability data to statistically differentiate treatments 122, 126, and 140°C as far as DAA coefficients are concerned. Nevertheless, the performance data were not statistically different for these three treatments, and, consequently, it is possible to infer that the small variation among the DAA coefficients for these three treatments was not enough to change performance.

Although in general there was a small decrease in the DAA coefficients for the 140°C treatment relative to the 126°C treatment, performance data do not support the concept of overprocessing in the experiment of Perilla *et al.*

The effects of overprocessed SBM on broiler performance are well documented, digestible lysine being the single most damaged amino acid. However, an additional indication of overprocessing is the net destruction of total lysine, which could also be expected to occur in overprocessed FFSB, and it was not observed for treatment 140°C.

Experiment 2

In vitro data versus growth data

The growth data from Ordoñez and Palencia show that the BW at 42 days of age were not significantly different for the 120, 130, 135, and 150°C treatments. The BW for the raw soya bean and 113°C treatments were significantly different ($P < 0,05$). The highest numerical BW at 42 days was for the 130°C treatment, followed by the 120°C treatment.

The TI activity dropped dramatically from raw FFSB to the 113°C treatment, that is, from 56,300 to 8,850 TI units/g. Thereafter, additional heating (higher temperatures and longer residence times) resulted in a smooth decrease of the TI activity.

The UA also dropped dramatically from 2,01 to 0,03 pH units at the 113°C treatment, and Soy-Chek also reflected the large drop in UA at 113°C. Soy-Chek data were consistent with pH rise data. The KOHPS data show a consistent decrease in the protein solubility of FFSB as temperature and retention time increased.

All of the *in vitro* data changes corresponded with an improvement in the BW of broilers at 42 days up to the 130°C treatment. However, as discussed in the next paragraphs, the growth data for the 113°C treatment cannot be explained with the *in vitro* data obtained for the FFSB sample of that treatment.

In vivo amino acid digestibility versus growth data

As in the case of experiment 1, one TAA analysis was conducted per sample, but because the six samples of this experiment are derived from the same original lot of raw soya beans, the TAA



Table 1: Pearson correlation coefficients between *in vivo* parameters in broiler chickens (BW and feed conversion ratio) and *in vitro* quality control analyses in full-fat soya beans processed by two different methods.

	Experiment 1 Wet-extruded FFSB		Experiment 2 Toasted FFSB	
	BW gain day 8 to 42	Feed conversion ratio	BW at 42 days	Feed conversion ratio
Trypsin inhibitor activity (U/g)	-0,91*	0,93**	-0,98**	0,99**
Urease activity (pH U)	-0,85*	0,82*	-0,98**	0,99**
KOH solubility (%)	-0,73	0,81*	-0,61	0,57

*P < 0,05; **P < 0,0.

values are very similar, demonstrating that there was no damage to any of the nine analysed TAA as a consequence of dry toasting.

As temperature and retention time increased during dry toasting, the DAA coefficients of FFSB increased to reach a numerical maximum at the 130°C treatment with very slight changes for the 135 and 150°C treatments. As already indicated, the maximum performance in the experiment of Ordoñez and Palencia was obtained with the 130°C treatment. Therefore, the growth data ran parallel with the increased DAA coefficients as a consequence of toasting.

Did the *in vitro* data predict *in vivo* performance of broilers fed FFSB in the two experiments? We have to divide the answer to this question in two parts: underprocessing, or the detection of insufficient heating, and overprocessing, or excessive heat treatment.

Underprocessing

For both experiments the TI activity and the UA of the FFSB samples analysed were significantly correlated with the performance parameters evaluated. The TI and UA were negatively correlated with BW and positively correlated with feed conversion ratio. These high correlation values suggest that these parameters are accurate predictors of the quality of FFSB. In experiment 1, TI activity below 18,000 TI units/g coincided with a pH rise value below 0,10 pH units for the 122, 126, and 140°C treatments, which, in turn, were not significantly different among them and not significantly different than the SBM positive control.

In experiment 2, the only exception is for the *in vitro* data for the 113°C treatment, which do not predict the significantly lower BW of broilers at 42

days, since TI activity was only 8 850 TI units/g, and pH rise was not higher than 0,03 pH units. However, a review of the *in vivo* DAA coefficients suggests that indeed the FFSB dry toasted at 113°C showed a pattern of overall lower digestibility typical of underprocessed FFSB. In other words, the *in vivo* DAA coefficients data help to explain the suboptimal performance of broilers fed FFSB dry toasted at 113°C.

We do not have an explanation for this inconsistency. Otherwise, the concept of TI activity of less than 18,000 TI units/g and UA activity lower than 0,10 pH units also applies to dry toasting of FFSB to maximise performance.

Overprocessing

The only *in vitro* criteria used in the evaluation of the FFSB samples for the two experiments was the protein solubility in KOH. However, neither the growth data nor the *in vivo* DAA coefficients support the concept that overprocessing of FFSB occurred in either of the two experiments. Therefore, no significant correlations were found between KOH protein solubility and the performance parameters evaluated except for feed conversion ratio in experiment 1 (Table 1).

This is an unexpected finding because of the widespread use of KOHPS to assess the overprocessing status of SBM. Although the validity of KOHPS has been documented mostly in laboratory models, it also has been tested with commercial SBM having different solubilities. Kang and co-workers fed broilers to three weeks with commercial soya bean meals, which differed in 15 points (percentage units) of KOHPS values. The BW at 21 days showed a difference of 5,75% between the highest and the lowest solubilities.

A controlled experiment conducted by Lee and co-workers with a commercially overprocessed soya bean meal demonstrated that a ten-point drop in solubility resulted in a significant growth depression of about 170g in growing turkeys at nine weeks of age. Therefore, there is sufficient evidence on the value of KOHPS to detect overprocessed SBM, but the results of the two experiments with FFSB analysed here do not support that overprocessing was detected *in vivo*. Even though there was a drop in solubility of 19 points in experiment 1 (98% vs 79%) and 25 points in experiment 2 (94% vs 69%), these decreases did not reflect overprocessing of FFSB.

It is possible that the value of protein solubility at which it becomes correlated with overprocessing of FFSB is much lower than in SBM. Anderson-Hafermann *et al.* found that processing of canola seeds to generate canola meal may result in canola meals displaying a wide range of KOHPS values from 80 to 40%, but only solubilities below 40% are correlated with overprocessing. A similar effect was reported by Jensen *et al.* in rapeseed meals.

The relevance of the data from the two experiments with FFSB is that in both experiments each FFSB processor (the Anderson expander and the thermal processor) were used beyond their normal operating conditions to generate the highest temperature treatment in each experiment. Therefore, this is a suggestion that overprocessing of commercial FFSB may be a difficult task. 🌱

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Projected protein requirements for animal consumption in South Africa

By Dr Dirk Strydom and Dr Erhard Briedenhann

The Protein Research Foundation (PRF) has as its main objective the replacement of imported protein with domestically produced protein. After many years of investigating numerous alternatives, the focus has changed primarily to where the largest impact could be made, namely soya beans and canola.

Growth in the domestic availability of oilcake is a good measure the PRF uses to ascertain whether or not it is achieving its objectives by way of supporting the industry through research, new technology and technology transfer. The targets that will need to be met in

the future for the PRF to continue with the progress that has been made thus far, require projections of future oilcake demands and requirements that should be met to attain self-sufficiency, as well as when this goal is likely to be met.

Various models have been developed and used during past few years to accurately measure this progress. A new model has been developed.

New model methodology

Collaboration between the University of the Free State's agricultural economics department, the PRF and its existing APR model and BFAP, led to the creation of a successful new model that can accurately calculate current protein requirements, and project future protein requirements, in various scenarios.

The model considers changes in per capita consumption of meat, milk and eggs as projected by BFAP as well as population growth. The quantity of meat, milk and eggs predicted for import and export is also considered. Projected future prices of major raw materials are incorporated, as well as the availability of raw materials, mainly those that are derived as by-products from various agricultural processing industries.

The genetic improvement of animals has a substantial impact on productivity, therefore performance change in animals is an important factor that the model incorporates. The model calculates the quantity of feed required as well as the raw material breakdown for these feeds.

There are several animals that are not producers of meat, milk or eggs, that nevertheless consume a substantial amount of animal feed, including protein.

The feed consumption of these animals, including the protein materials, also needs to be considered.

The new model has the ability to formulate the actual feed required by all animals in South Africa, given the quantity constraints of the raw materials that will be domestically available. It does this by making use of least cost linear programming while considering the transport costs of raw materials across various regions of the country. The result is an accurate prediction and projection of protein requirements, domestic and imported.

The APR model in collaboration with BFAP data is used to calculate the projections of future oilcake demands and future requirements for self-sufficiency. This will enable the PRF to stay on track with the progressive path it has laid down.

Current scenario

Based on the current per capita consumption of animal products, the estimated (using the APR Model) requirement for animal feed in South Africa is set out in *Table 1*.

In terms of oilcake consumption, soya oilcake remains the most

Table 1: National animal feed production 2018.

Feed type	National feed consumption (tons)
Dairy	2 421 756
Beef and sheep	3 433 951
Pigs	880 623
Layers	1 053 808
Broilers	3 258 449
Pets	343 952
Horses	138 303
Ostriches	112 117
Aquaculture	5 314
Total	11 648 273



consumed oilcake in the market, followed by sunflower oilcake.

On the local market, South Africa has progressed in terms of substituting imported soya oilcake with locally produced oilcake. In 2018, South Africa produced 69% of the country's total requirement; in 2008 only 20% of oilcake demands were met by local production. The projection for 2021 is that 89% of oilcake needs will be met by domestic production, rising to 95% in 2027.

In terms of total oilcake consumption, the local share has increased from 37% in 2007 to 82% in 2018. It is projected that the local share will increase to 82% in 2021, and 94% in 2027.

Growth in requirements

It is critical to determine demand to calculate the consumption figures of various livestock species. The demand was calculated in combination with the growth figures of animal feed conversion ratios using the following macro variables: Population growth, per capita consumption growth, imported animal products and exported animal products.

The genetic improvement of animals has a substantial impact on productivity, therefore performance change in animals is an important factor that the model incorporates.

As already explained, soya oilcake remains the dominant protein source in South Africa; a dominance that has increased over time and will continue to do so. In 2010, soya oilcake made up 40% of oilcake requirements; this increased to 70% in 2018 and is predicted to stabilise at 71% in 2021. Soya oilcake consumption in Table 2 shows a decrease between 2021 and 2027, mainly due to BFAP's projection that poultry imports will increase by 63% during that time.

Poultry feeds make up 39% of total feed consumed in South Africa, a market share of total feed which is predicated to remain constant until 2020. Most oilcake is used in the poultry sector,

Table 2: Projections of feed and oilcake requirements in 2021 and 2027.

	Feed (ton)	Oilcake (ton)	Soya oilcake (ton)
2018	11 628 789	1 649 498	1 150 521
2021	12 561 132	1 764 946	1 307 338
2027	13 372 018	1 826 894	1 287 638

Table 3: Local vs imported soya oilcake.

	Local soya oilcake (From local soya beans) ton	Local soya beans Production (required) ton	Total soya oilcake Requirements ton	Local soya Production (required) ton self-sufficiency	% local
2018	980 860	1 226 075	1 150 521	1 438 151	85
2021	1 172 228	1 465 285	1 307 338	1 634 173	89
2027	1 228 798	1 535 998	1 243 233	1 554 041	98

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

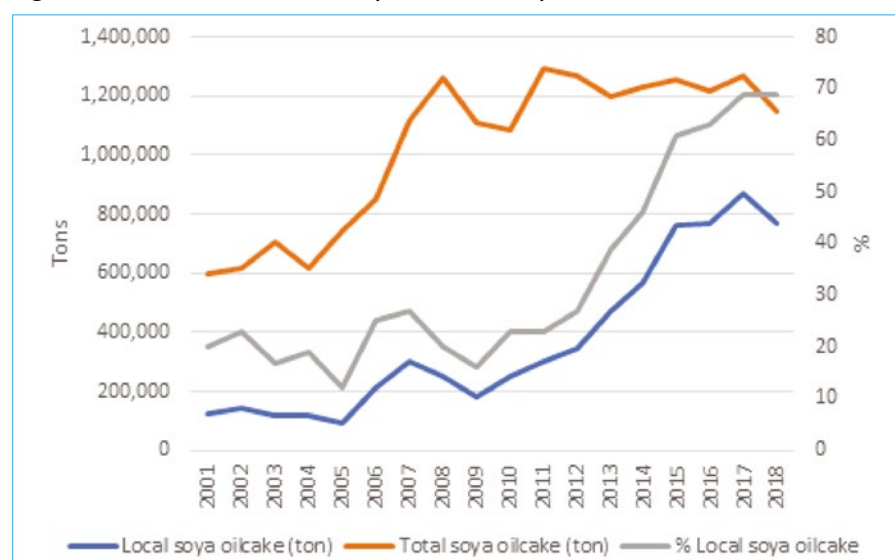
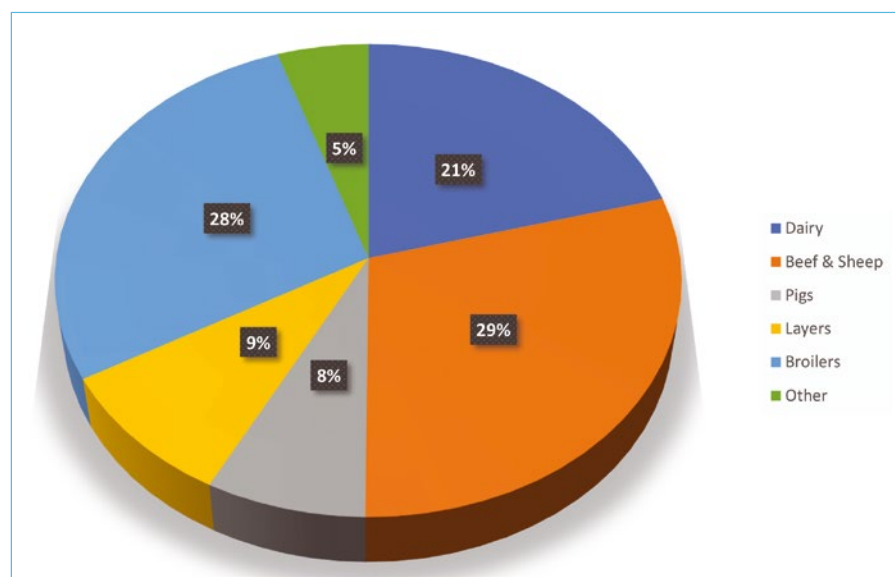


Figure 2: Species feed consumption.



with a share of 84%, which is expected to remain relatively stable until 2027.

Local oilcake production

The increase in local oilcake production from locally produced soya beans will make South Africa increasingly self-sufficient in meeting its protein requirements.

Oilcake requirements in South Africa were estimated at 1 649 498 tons in 2018 and local production was at 1 441 527 tons or 87% of requirements. The soya bean requirement of 1,2 million tons excludes the 238 000-ton full fat soya bean requirement, as well as the 30 000-ton requirement for human consumption. Soya oilcake produced in South Africa in 2018 provided 85% of the country's soya oilcake requirements (Table 3).

According to the model, feed requirements will increase to 13 372 018 tons in 2027 and 12 561 132 tons in 2021. Soya oilcake requirement will be 1 307 338 tons by 2021 and 1 243 233 by 2027 (Table 2). There is a decrease in

requirements that can be attributed to an increase in feed conversion ratios.

Estimates indicate 98% self-sufficiency by 2027 and 89% self-sufficiency by 2021 in terms of soya beans. This can be attributed to an increase in production of soya beans, estimated by BFAP.

Although the combined beef and sheep population is the largest consumer of animal feed, the poultry sector plays a major role in oilcake, and particularly in soya oilcake, utilisation. Growth and sustainability in the poultry industry will play a major role in oilcake requirements.

Conclusion

South African animal feed consumption decreased dramatically in 2017, mainly due to the lag effect of the drought, but also because of the bird flu outbreak in

Table 4: Oilcake usage projection in 2021 and 2027.

Oilcake	2021 (tons)	2027 (tons)
Soya oilcake	1 307 388	1 287 638
Sunflower oilcake	356 299	362 300
Canola oilcake	63 000	125 064
Palm kernel	37 710	42 993
Soya full fat	147 302	159 000
Cotton full fat	36 000	65 086
Canola full fat	3 246	5 345
Total	1 950 945	1 047 426

the country. However, in 2018 there was a slight recovery in feed consumption. Given the major increase in production of local soya beans, there was a significant increase in self-sufficiency. In terms of total oilcake consumption, at a level of 87%, South Africa is self-sufficient. This figure is expected to increase towards 2027, indicating the progress South Africa is making in substituting imports. 🌱

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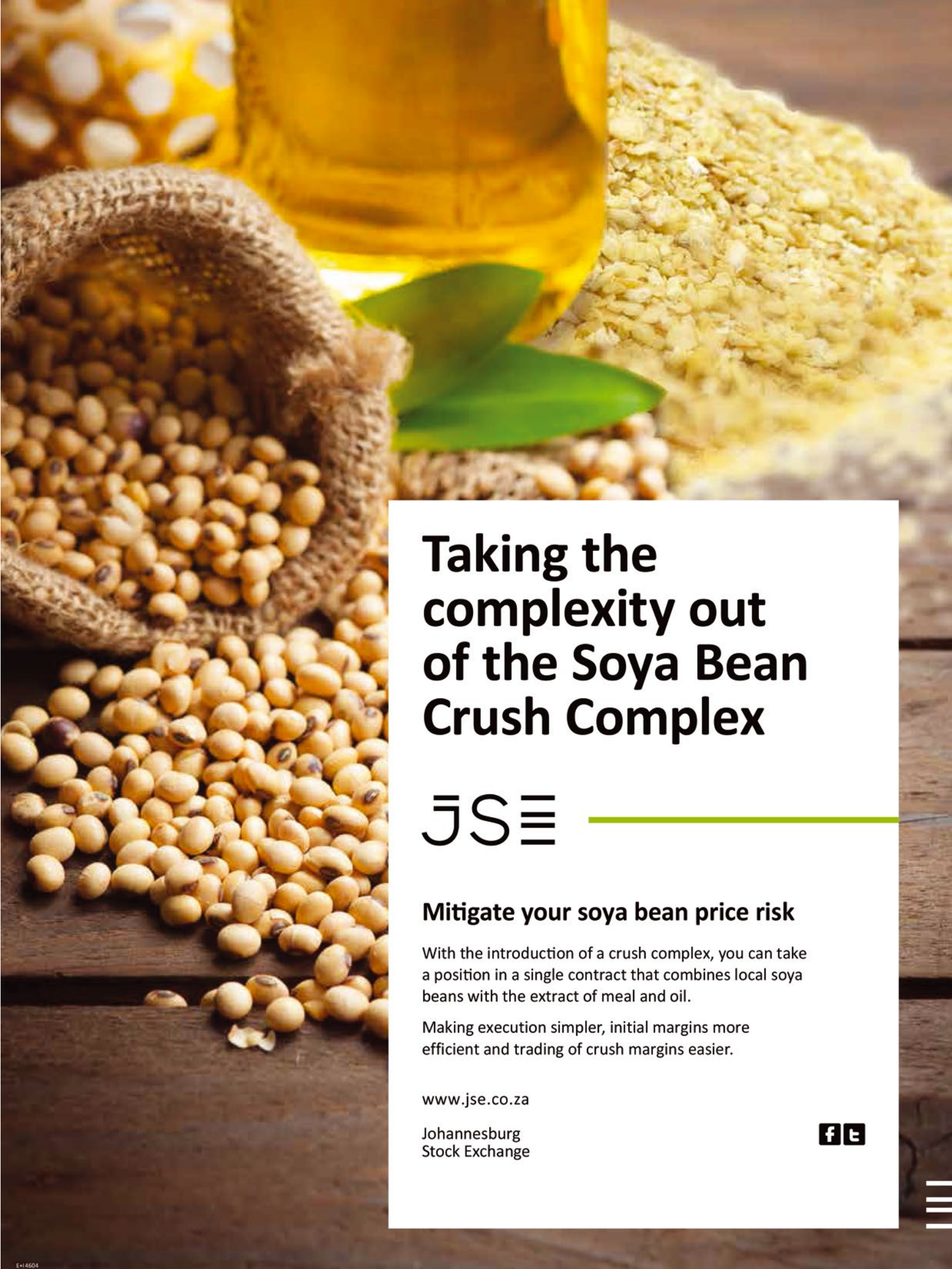
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Role of the JSE in the South African soya bean market

The JSE provides a commodities market in the form of a derivative trading platform for the South and Southern African region. The market allows for price discovery for fair value and price risk management with the use of derivative instruments.

These instruments enable hedgers, typically producers and processors who have an inherent interest in the underlying commodity, to protect themselves against adverse price movements. Speculators, or participants with no link to the underlying commodity, also play a crucial role in the market as they provide liquidity.

Among other commodity derivatives, the JSE has a 50-ton soya bean future and option contract listed for trading. The underlying commodity is Soya Bean Class SB as defined in the South African grading regulation. The soya bean future contract is physically deliverable, which means when the futures expire the seller delivers 50 tons of soya beans and the buyer takes delivery thereof. Only 2% of the traded volume is physically delivered, which is in line with international standards.

Trading activity on the JSE

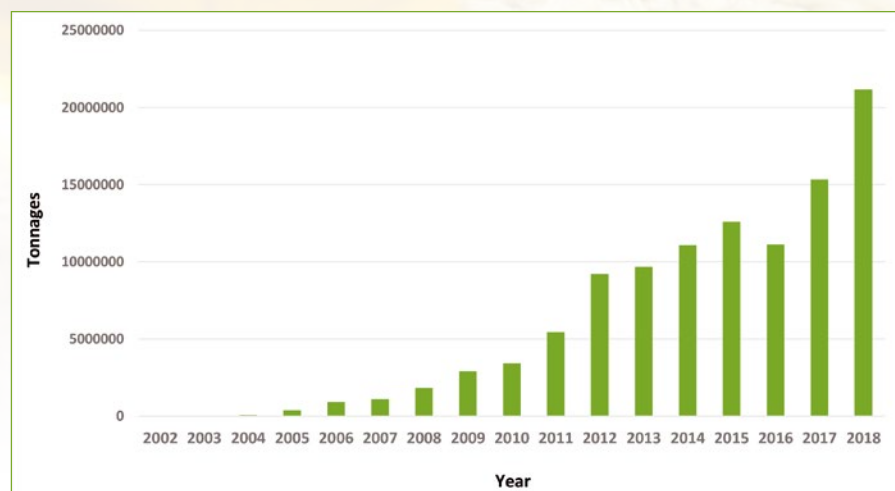
Trading in soya beans derivative instruments was introduced on the JSE in 2002. The JSE has seen exponential growth in trading activity since inception. The exponential growth could be partially attributed to the existence of a transparent, accessible and reliable derivatives market.

Tonnages traded on the exchange have grown hundredfold over the past decade. Also worth mentioning is the astonishing 38% growth between 2017 and 2018, which was driven by the growth of the local production of soya beans and increased international demand.

Local production and demand

Since the JSE began trading the derivatives contract in 2002, the South African soya bean market has developed rapidly, from

Figure 1: Annual tonnages traded (in metric tons) for the soya beans futures contract on the JSE since 2002.



producing just above 100 000 tons a year to producing a record-breaking 1,54 million tons in the 2018/19 production season. However, the Crop Estimates Committee has estimated a 7% decrease in the area planted and a 16% decline in production for the 2019/20 season in its third production forecast. The 16% decline brings the total estimated production to 1,29 million tons.

The National Agricultural Marketing Council reported local demand at approximately 1,35 million tons for the 2018/19 season. Moreover, the marketing council projected demand to be 1,47 million tons for the 2019/20 season in its April 2019 report, up 8,8% from the previous season. The biggest growth in demand is estimated to come specifically from crush (oil and cake), with demand projected to grow by 13%.

Soya bean prices

The past decade has been marked by volatility in the soya bean spot price. In 2009, the price of soya beans was as low as R3 200/ton. Prices shot up to levels as high as R8 010/ton in June 2016; this was at the height of the worst drought recorded in South Africa. Prices dipped in 2017/18, mainly influenced by increased production (oversupply) of soya beans both locally

and internationally. By April 2019 the soya bean spot price was trading around R4 700/ton and R4 500/ton in early May.

So, what are the factors influencing local soya bean prices? There is a vast number of factors, ranging from weather, local production and the cost thereof to international production. Local demand also plays a big role in local prices. As already mentioned, projections show an increase in total soya bean demand and a decrease in production, which would naturally put upward pressure on prices if all other things remain the same.

On the international front, China, the world's biggest importer of soya beans, is in the middle of a trade war with the US, the largest producer of soya beans. In the past few months, China has looked to South American countries such as Brazil to source soya beans. With trade negotiations still ongoing between China and the US, the international market remains uncertain.

It is evident that the global demand for soya beans is surging. This surge will continue since soya beans serve as a key source of protein and vegetable oils.

For more information, send an email to commodities@jse.co.za, phone 011 520 7039, or visit www.jse.co.za.



Price volatility expected in global oilseeds market

By Dr Dirk Strydom

The oilseeds world stock is still on the rise. According to an analysis by Oil World, the expected ending stocks for 2018/19 will be 127,4 million tons, which represents an increase of 15,6 million tons or 14%. This should result in a 3% increase in the stock to usage ratio, from 20% in 2017/18 to 23% in the 2018/19 forecast.

Soya bean stock levels

In terms of soya beans, which is the largest oilseeds crop, the ending stock

Table 1: World supply and demand of seven major oilseeds.

(Source: Oilworld)

	2018/19 F	2017/18	2016/17	% YOY
Opening stock	111,8	109,4	91,8	2%
Production	573,4	556,1	548,6	3%
Demand	557,8	553,7	531,1	1%
Ending stock	127,4	111,8	109,4	14%
Stock to usage	23%	20%	21%	13%

increased from 94,3 million tons to 110,1 million tons; a 4,4% increase in the stock to usage ratio. Although market stocks were high, there were various uncertainties at the end of May 2019.

Trade negotiations did not progress

as expected, which resulted in a decrease in demand in China, rising stock levels in the United States (US), and more trade taking place in South America. The expectation in the market is that the US soya bean ending stock will be 28,5 million tons at the end of August – a record high.

This expectation resulted in an overall bearish market, with prices at a ten-year low in the middle of May. The reduction of exports from the US to China contributed towards price pressure.

The low prices in the market created an environment for an increase in long positions to benefit from the prices. However, the increase in buying was also

supported by concerns regarding the planting progress of crops in the US.

US crop uncertainty

At the end of May, the US was still struggling to plant due to wet conditions. The United States Department of Agriculture (USDA) released its crop progress report on 19 May 2019, which showed that only 19% of soya beans had been planted – the five-year average is 47%. According to the report, there was a possibility that some of the corn hectares could shift to soya bean hectares. As such a shift can only take place within a two-week window, depending on the geographical area, there was a risk of reduced soya bean plantings after mid-June.

This uncertainty created volatility in the market. However, the majority

Figure 1: Final planting dates for corn in the US.

(Source: Farmdocdaily)

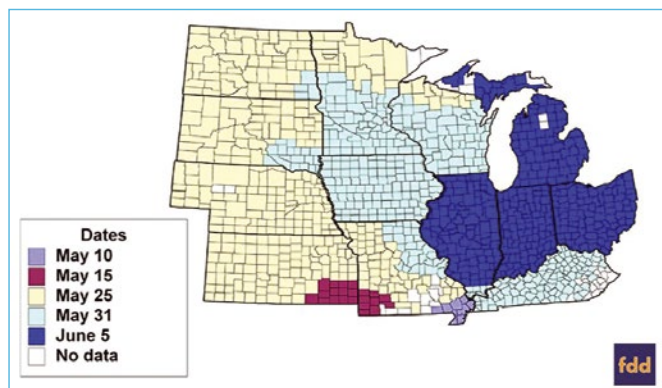
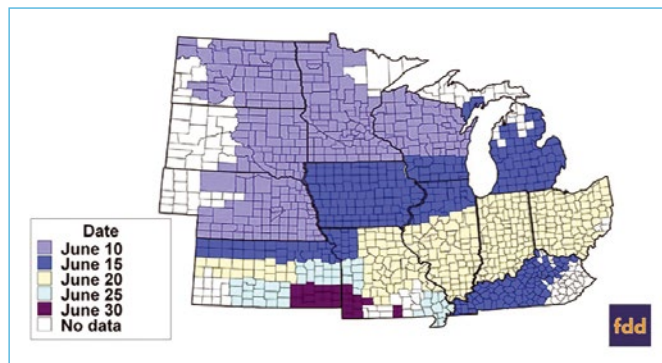


Figure 2: Final planting dates for soya beans in the US.
(Source: Farmdocdaily)



of international traders still believe that the carryover stock and the slowdown in trade, will facilitate a bearish outlook. There will be a close review of the market in June, especially in terms of weather conditions.

Sunflower seed

Global sunflower seed processing is expected to continue to grow from April to September 2019, exceeding that of the previous season. The large amount of sunflower seed available internationally, together with the large import demand for sunflower oil, contributes to the processing of sunflower seed in especially the Black Sea countries.

The biggest processing is expected in Ukraine and Russia this season. In Argentina, sunflower seed processing was lower than expected, despite good sunflower seed production for the season. It was, however, expected to improve.

Canola

In Canada, the canola ending stock for the season is expected to reach a new record level of at least 4,2 million tons, which is 1,7 million tons more than last season's closing stock. The sharp increase in Canadian stocks is due to trade restrictions between China and Canada, which means that Canadian exports for the season have been much lower. In the EU, the production outlook for the season does not look too good and production is expected to be lower for the season.

Groundnuts

The groundnut plantings in the US are progressing fairly well and are more in line

point in the season is 36%.

Local market

In terms of local production, it was a very difficult season. The planting season was very late and in some areas

with the previous season's plantings than most of the other crops. The groundnut plantings are reported at 40% complete, compared to the previous season's 42% for the same period. The five-year average peanut planting completion rate at this

the follow-up rain was insufficient. Several of the production areas also struggled with hail damage. However, as processing figures improved since October last year, the soya bean industry expected a very large carryover stock level, which provided relief.

According to the Supply and Demand Estimates Committee (S&DEC) the opening stock for the current marketing season was 502 241 tons, with the Crop Estimates Committee (CEC) estimating the local production at 1 295 845 tons. The S&DEC estimated an increase in demand of 11,2%, predominantly in crushing, due to local production displacing some imports of meal. This means that the expected carryover stock for the season is at 314 036 tons, which is a stock to usage ratio of 21%.

Record processing figures for soya beans were achieved in the previous marketing season – monthly processing was more than 100 000 tons per month since September 2018, with the highest processing rate ever for soya beans in November at 137 633 tons. The three-year average is 88 000 tons per month.

According to South African Grain Information Service (SAGIS) figures, 1 308 441 tons were processed in the 2018/19 marketing season, which is a new record. This is remarkable when compared to the 260 300 tons processed in 2008/09.

Given this increase in processing figures and the difficult crop experienced, there is space for price movement within the local market. However, this is subject to local processing figures and is highly dependent on the international market. It is going to be important to monitor the planting conditions in the US as well as the trade war between China and the US.

South Africa is still competing in the US market and will therefore follow market movements similar to the US. In order to receive the premiums obtained by South America, South Africa must be able to export soya beans to China. There are talks between South Africa and China to open new market possibilities, but this will take time. 🌱

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



Not a good year for local peanut production

By Wandile Sihlobo, chief economist of the Agricultural Business Chamber of SA (Agbiz)

Although I use peanut butter almost daily, for some reason I had not looked at its production pipeline in a few months. That is, until I received a call in February from a Zambian trader who wanted to export peanuts (groundnuts) to South Africa. This prompted me to do some back of the envelope calculations on South African supplies for the 2019/20 marketing year, which started on 1 March.

In the process, I realised that South African farmers planted 20 050 hectares in the 2018/19 production season, which is the smallest area on record in a dataset covering the past 83 seasons. The reduction in plantings is mainly underpinned by drier weather conditions experienced at the start of the planting season, a period between October and December 2018.

South Africa consumes roughly 81 496 tons of peanuts a year, mainly in two forms – as edible nuts and as processed peanut butter.

If we take an average yield over the past ten years and apply it to the aforementioned area planting, then South Africa's peanut production would possibly be around 22 272 tons. An average yield could be attainable, given the recent improvements in weather conditions in February and March in some parts of the country. But this won't help much, as the expected harvest is well below

South Africa's average long-term peanut production of 65 992 tons per annum.

Consumption and yields

To put things into perspective, South Africa consumes roughly 81 496 tons of peanuts a year, mainly in two forms – as edible nuts and as processed peanut butter. Now, if production is likely to be as low as 22 272 tons and we add into this the carryover stock of 17 200 tons (according to data from Grain SA), then overall supplies could be roughly 39 472 tons.

If consumption is maintained at levels of around 81 496 tons a year, then South Africa would have to import over 40 000 tons of peanuts to satisfy its annual consumption. Such a number would not be extraordinary. In the 2016/17 marketing year, when South Africa's peanut production had declined significantly due to the drought, the country imported 52 112 tons of peanuts.

The leading suppliers were Argentina, India, Brazil, Malawi, Mozambique, Turkey, the United States and Zambia, among others. These countries are likely to be among the leading suppliers this year again, as they have remained consistent suppliers since the drought, albeit with marginal volumes.

Market supply

Moreover, there are decent supplies in the world market. The United States Department of Agriculture forecasts 2018/19 global peanut production at 41,87 million tons, down by 7% from the previous season.

A decline in production, coupled with an uptick in consumption, could lead to a 30% year-on-year decline in global peanut stocks to 2,72 million tons. This essentially means that global peanut prices could increase in the coming months.



Wandile Sihlobo.

Fortunately, at this point, the impact of all this has not yet fully reached the consumer. The prices of peanut products, such as 800g of peanut butter, was roughly R52,88 in February, up by 3% year-on-year according to data from Statistics South Africa.

In the 2016/17 season, when South Africa imported over 52 112 tons of peanuts, the price of 800g of peanut butter did not rise above R55, partly because of the lower global peanut prices on the back of a large harvest.

This year is different. While there are decent supplies in the global market, the harvest will be lower than the 2017/18 season. This will present upward pressure, which will subsequently be passed on to the South African consumer. So, this is not a good year for peanut consumers or producers. 🟡

For more information, email the author at wandile@agbiz.co.za.

UPDATE: Trade dispute between China and Canada

Compiled by Ursula Human

China extended its ban on Canadian canola seed imports in March this year to include shipments from Viterra Inc. This is the latest development in a wider trade dispute between the two countries, according to reports from Reuters. Viterra is the second canola exporter to have its registration cancelled, after Beijing halted shipments from top exporter Richardson International in the same month. An industry group said that Chinese importers have stopped buying oilseed from Canada, although China continues to import Canadian canola oil and meal.

Safety concerns

Chinese customs officials said in a statement that several pests had been detected in samples taken from cargo shipped by Viterra to the ports of Dalian and Nanning. To prevent the introduction of harmful organisms, Chinese customs cancelled the firm's export registration and would continue to strengthen inspections on all canola imports, Reuters reported.

Canadian Prime Minister Justin Trudeau said his government was trying to resolve the issue and was considering sending a high-level delegation to China to address the country's safety concerns. Viterra was working with the Canadian government and the Canola Council to gather more information. Export products are tested to ensure they meet specific import standards.

A spokesman for the Canola Council of Canada said the industry group is confident about the quality of Canadian canola seed exports, noting that no other global customers had expressed concerns.

China accounts for approximately 40% of Canada's canola seed, oil and meal exports, according to the Canola Council, with seed exports to China worth about US\$2 billion a year.

Effect on exports

The United States Department of Agriculture (USDA) also reported that Canada's rapeseed exports decreased, following the trade dispute with China in a World Markets and Trade report for oilseeds that was published in April. Canada's rapeseed export forecast for 2018/19 was reduced by a million tons this April in response to a slowing pace of trade and the recent trade dispute with China.

Exports are now forecast to reach 10,6 million tons, down slightly from the previous year. However, the export pace will need to accelerate relative to last year to reach the current forecast, as exports for the twelve months ending in January 2019 have fallen to below 10 million tons.

The report stated that to achieve this, Canada may need a quick resolution to the current trade dispute that has cut access to China's market for Canada's two largest exporters. This was in response to China's contention that

shipments have failed to meet quality standards regarding prohibited pests.

While Canada can potentially locate other markets to cover the shortfall, it may not be that easy. Since twelve-month exports peaked in late 2017 at nearly 11,7 million tons, exports to markets outside China have remained flat or have declined. Part of the issue is competition with soya beans, particularly from the US, that has probably contributed to lower demand for rapeseed in the US, Mexico and South Asia. With limited potential to expand trade with Japan, Canada's second largest market, exporters will face significant challenges in the coming year.

Exports of meal and oil

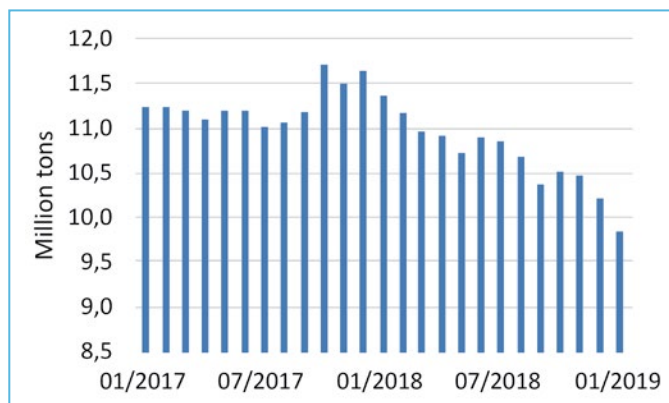
On a more positive note, despite the current restrictions on rapeseed exports to China, exports of products, meal and oil are currently unaffected and exports of rapeseed meal and oil to China are increasing.

Since the end of 2016, China's share of Canada's rapeseed meal exports has risen from 15 to 30%. However, overall export growth has been steady at 6% due to limited crush capacity. Consequently, the rising share of the

Chinese trade has come at the expense of trade with other markets, particularly the US.

For rapeseed oil, a similar pattern exists with a rising share of exports to China, from 21 to 36% since 2016, but this has been at the expense of exports to other markets. Unlike rapeseed meal, oil exports have grown more rapidly since 2016 at 12%, but the prospect of limited supply growth remains a factor due to restrictions on expanding crush volume. ●

Figure 1: Trends in Canada's total rapeseed trade (twelve-month totals). (Source: USDA)



The amazing benefits of sunflower oil

by John Staughton (BASc, BFA)

The health benefits of sunflower oil include its ability to improve heart health, boost energy, strengthen the immune system, improve skin health, prevent cancer, lower cholesterol, protect against asthma and reduce inflammation.

What is sunflower oil?

Sunflower oil is a non-volatile oil that can be easily extracted from sunflowers. Although most people are already familiar with sunflowers, they don't immediately think of sunflowers as a source of an extremely healthy vegetable oil that can replace some of the less healthy cooking oils available on the market. Sunflower oil is also used in certain cosmetic applications.

The main producers of sunflower oil are Russia, Ukraine and Argentina, but the oil is used throughout the world in the preparation of various cuisines.

Sunflower oil is used in cooking and frying, in cosmetics such as lip balms and skin creams, and as a medicine for the heart, as it is low in cholesterol.

Sunflower oil nutrition

According to the USDA, sunflower oil is rich in vitamin E, vitamin K, phytosterols, and monosaturated fatty acids.

One of the primary reasons for the growing popularity of sunflower oil is its impressive fatty acid content, which includes palmitic acid, stearic acid, oleic acid, lecithin, carotenoids, selenium, and linoleic acid. The combination of fatty acids in the body is extremely important to maintain various elements of human health, and sunflower oil can help maintain that balance.

Some of those fatty acids, as well as vitamin E (tocopherols) and other organic compounds, act as antioxidants in

sunflower oil, which means they can have a positive effect on a range of conditions from which people regularly suffer. Sunflower oil contains more polyunsaturated fats than any other commonly used vegetable oil, and with the recent trend towards healthy eating and searching for alternative options, sunflower oil is becoming sought after on the international market.

Sunflower oil also has fascinating health benefits for everyone. Let's explore them in detail.

Lowers cholesterol levels

The fatty acids found in sunflower oil, including a substantial amount of linoleic acid (an omega-6 fatty acid) are very well balanced, according to a study published in *The American Journal of Clinical Nutrition*. Finding a healthy balance between HDL or good cholesterol (omega-3s) and LDL or bad cholesterol is very important. Sunflower oil does not contain any saturated fats, which means that it can actually reduce overall cholesterol content in the body.

Relieves athlete's foot

Sunflower oil is an effective remedy for providing relief from athlete's foot (*Tinea pedis*), a fungal infection that starts between the toes. The topical application of sunflower oil to the affected area helps to fight and cure the infection.

Boosts heart health

Sunflower oil, taken in moderation, is a good choice for people who want to keep an eye on their heart health and prevent atherosclerosis. Atherosclerosis can clog arteries, raise blood pressure and increase the chances of suffering a heart attack or stroke. The presence of choline, phenolic acid, monounsaturated fats,

and polyunsaturated fats in sunflower oil boosts energy and reduces the risk of incurring cardiovascular disease.

Improves immune system

In a study published in the *Food Chemistry Journal*, Spanish researchers confirmed that sunflower oil is rich in vitamin E, which acts as an antioxidant in the body. Vitamin E has been directly connected to preventing heart disease and boosting the immune system.

Skin care

Sunflower oil, rich in vitamin E, is specifically related to improving skin health and regenerating cells. This means the skin is better protected against damage from the sun, as well as the natural degradation of age that occurs when free radicals are present in the body. Antioxidants such as vitamin E neutralise free radicals and prevent them from destroying or damaging healthy cells.

Using sunflower oil reduces the visibility of scars, helps to heal wounds and gives a healthy, natural glow to the skin. This is a major reason why sunflower oil is commonly used in cosmetic applications. Some people use sunflower oil to massage premature infants with low birth weight or other complications. It has been claimed that this effectively lowers the chances of the infant developing skin infections. Since the infant's organs (including the skin) are underdeveloped, the oil acts as a protective barrier. However, there is insufficient scientific evidence in the literature to substantiate this benefit of sunflower oil.

Boosts energy levels

The fatty acid content in sunflower oil is connected to energy levels in the body. Saturated fats can make one



feel sluggish, while unsaturated fats, many of which are present in sunflower oil, can keep energy levels up.

Anti-cancer potential

As mentioned above, sunflower oil is rich in antioxidants and substances that act as antioxidants. Vitamin E, which has a group of compounds known as tocopherols, is a powerful antioxidant that can eliminate free radicals before they mutate healthy cells into cancerous cells. There are a number of ongoing research studies to verify the effects of sunflower oil on a wider variety of cancers.

Reduces inflammation

Asthma, a respiratory condition that ranges from mild to life-threatening, affects millions of people worldwide. Sunflower oil has been positively correlated to fewer and less intense asthma attacks. This is because of its anti-inflammatory qualities, derived from the vitamin content of sunflower oil and its beneficial fatty acids. This has been confirmed by Dr Michael James of the University of Adelaide in a study published in *The American Journal of Clinical Nutrition*.

Reduces the severity of arthritis

Along with asthma, sunflower oil has also been linked to a reduction in the severity of arthritis.

Protects the body

Fatty acids have a significant effect on the general immune system and increase the body's ability to resist attacks by infection, says Dr Parveen Yaqoob of the University of Reading. Sunflower oil is a rich source of fatty acids, which protects the skin by strengthening the membrane barriers, making it more difficult for bacteria and viruses to enter the body.

Prevents infections

Sunflower oil is highly recommended for infants because it can protect them from infections, particularly prematurely delivered babies who are highly susceptible to infections. Adults who use sunflower oil enjoy the same benefits, although the effects are not as dramatic in adults.

In today's fast-paced lifestyle with its chronic levels of stress there is hardly time to check and consume nutritious foods, but by using sunflower oil in the kitchen, the quality of the cooking can be improved.

A fatty diet, fast food and a lack of exercise may lead to obesity. There is a fast-moving generational trend to choose foods and meals containing unhealthy ingredients that may have a lasting impact on health. Many of these foods provide no protein, vitamins or essential nutrients. The incorporation of sunflower oil into the diet offers consumers a chance of leading a healthy life by reaping the benefits it offers.

A word of caution

Although the fatty acids in sunflower oil are important and essential in the diet, sunflower oil does have a higher omega-6 content than most other vegetable oils. There has been some concern about this, particularly for people who have problems with obesity or cholesterol.

If sunflower oil is eaten in excess without the intention of boosting omega-3 intake, it can result in an imbalance of fatty acids in the body, which is dangerous. A 2018 study also shows its adverse effects on the liver.

As long as certain health factors are monitored, sunflower oil can be a beneficial addition to the diet. 🌻

This article was first published on www.organicfacts.net.

Systems thinking to reduce groundnut aflatoxin exposure

By Dr Willeke de Bruin, Department of Plant and Soil Sciences, University of Pretoria (Photos by Amy Byrne)

*To many African people, the groundnut (*Arachis hypogaea* L.) is the most important legume providing them with much needed dietary nutrients and income. Groundnuts, also known as peanuts, are consumed in a variety of snacks and are a major ingredient in ready-to-use therapeutic food (RUTF), one of the most effective home-based nutritional therapies for children and HIV/AIDS patients, particularly in the developing world (Magamba et al., 2017).*

The quality and safety of groundnuts is however often compromised by aflatoxin contamination. Aflatoxin is produced by *Aspergillus flavus* and *A. parasiticus* and represents a group of structurally related mycotoxins that are among the most potent naturally occurring substances known to mankind (Kendra, 2007).

The toxin is generally heat stable and is not destroyed during most processing stages (Matumba, 2017). Aside from causing acute poisoning at high doses, chronic exposure to lower-level doses can cause liver cancer and stunted growth in children (Gong et al. 2002; Meisssonier et al., 2008; Turner et al. 2003).

Aflatoxin contamination may also lead to a significant reduction in crop yield and is a cause of economic losses. According to the Partnership for Aflatoxin Control in Africa (PACA), the continent is reported to lose more than \$670 million per year in export earnings due to the presence of aflatoxins on food.

For developing countries that produce over 60% of the world's groundnuts (Magamba et al., 2017), this may impede their progress towards attaining food security and a reputable standing. Moreover, contaminated foods that do not meet export standards are often sold in the domestic market or used for household consumption, increasing the health risks associated with aflatoxin exposure in local communities (Njoroge et al., 2017).

Strict limits imposed

The Food and Agriculture Organization (FAO) of the United Nations estimates that 25% of food produced worldwide is contaminated with aflatoxins. To limit

exposure, countries across the world have set and enforced maximum tolerated levels (MTLs) of aflatoxin in traded groundnuts.

Limits for individual countries range from 4 to 20 parts per billion (ppb) for total aflatoxin content. A stringent limit of 4ppb for total aflatoxins in foods is enforced in the European Union (EU). During 2015 and 2016, five groundnut consignments from South Africa were rejected at the EU border. The total aflatoxin content in one of these consignments was 330ppb.

Since its discovery in the 1960s, researchers, governments, investors and the like have looked into factors that contribute to aflatoxin production, use of preventative measures and upscaling regulatory enforcement. In the last



The quality and safety of groundnuts is often compromised by aflatoxin contamination.

decade alone, 38 800 peer reviewed scientific papers have addressed this topic. As significant as the research is, it has rarely examined how complex and interconnected groundnut food systems really are. A different kind of analysis that requires various forms of knowledge to identify which parts of the food system are at the root cause of the problem have hence become a necessity.

Mapping the groundnut system

The food system is not only comprised of the sum of activities of the groundnut value chain, but also has an outcome on and is influenced by socio-economic and environmental factors (Van Berkum *et al.*, 2018). In order to find sustainable solutions for a safe supply of groundnuts, one should start by mapping the food system, showing its constituent parts and how they interrelate.

The groundnut system is made up of a number of activities that leads to a supply of peanuts that are safe to consume. These activities include the value chain (production, processing, trade and consumption), as well as things such as business services and an enabling environment. Business services include providers of agricultural inputs (fertilisers, pesticides, biological control agents, etc.), technical advice, extension services, availability of analytical facilities and financial support.

An enabling environment again would typically relate to food safety regulations and legislation in other countries with which trade contacts exist (Van Berkum *et al.*, 2018). The set of activities mentioned here are aimed at preventing the growth of the aflatoxin producing *Aspergillus* species. These strategies are based on good agricultural practices (GAP), which represent the primary line of defence against aflatoxin contamination in the field, followed by the implementation of good manufacturing practices (GMP) during the handling, storage and distribution of mature groundnuts.

Contamination drivers and controls

Equally important is the influence of socio-economic factors on the



To many African people, groundnut is the most important legume providing them with much needed dietary nutrients and income.

groundnut food system. These include income, employment and level of education, to name a few. An emerging farmer may, for instance, not have the financial means to pay to test aflatoxin contamination levels. *The Agricultural Products Standards Act, 1990* (Act 119 of 1990) controls and promotes specific product quality standards for the local market and for export purposes.

With respect to aflatoxin contamination (Regulation R1145 governing tolerance for fungus produced toxins in foodstuffs), the Perishable Products Export Control Board (PPECB) has been appointed and authorised to test groundnuts. Based on 2018 figures, laboratory fees for analysing 10kg groundnuts amount to R1 130.

Environmental factors such as climate and rainfall are also critical drivers for fungal colonisation and aflatoxin contamination. Climate change will certainly have a significant impact on this. The late 2015 drought could, for example, account for the increased number of European market rejections of South African produced groundnuts.

Lastly, the food system itself has

an outcome on socio-economic and environmental factors. The activities related to the groundnut value chain provide employment to farm workers, raising their incomes. This could, in effect, lead to higher education levels and an enhanced awareness of food safety, which benefits the farmer in the long run. However, excessive and irresponsible use of agrochemicals may also be harmful to the environment. All these factors affect the functioning of the food system.

Future aflatoxin control and mitigation efforts, in addition to GAP and GMP, should also take other interrelated factors into account. This may be useful for improving our understanding of the various routes of aflatoxin contamination, of the critical factors causing aflatoxin contamination, and of the interactions governing the specific behaviour of the groundnut value chain, to design context-specific interventions. One solution will not suffice. 🌱

References available from the author on request. For more information, email Dr Willeke de Bruin at willeke.debruin@up.ac.za.

Tackling the problem of elevated acrylamide levels

By Serena Lim, editor: *Oils & Fats International (OFI)*

New European Union (EU) legislation that came into force on 11 April last year has meant that all businesses that manufacture food, or prepare and serve it to customers, must understand the potential risk of the carcinogen acrylamide, and take steps to reduce it.

Acrylamide is a chemical substance formed when starchy foods with higher levels of the amino acid asparagine are cooked at temperatures above 120°C in processes such as frying, roasting, baking, grilling and toasting. Acrylamide is potentially carcinogenic and is found in a wide range of foods including roast potatoes and root vegetables, chips, crisps, toast, cakes, biscuits, cereals and instant coffee.

Acrylamide develops as a natural by-product in food through the Maillard reaction, in which a chemical reaction occurs between reducing sugars and amino acids to create a food's characteristic flavour, colour and smell.

Temperature is the most important factor in acrylamide formation. Long frying times at low temperatures causes less acrylamide than short frying times at high temperatures. It is not possible to eliminate acrylamide from foods, but action can be taken to reduce its levels.

Legislation and benchmarks

EU legislation sets benchmark levels for acrylamide and describes practical measures to mitigate its formation. Businesses that manufacture food, or prepare and serve it to customers, must be aware of the potential risk of acrylamide and take steps to reduce its formation. They must sample to monitor levels and record mitigation measures according to the AAK Food Service.

Legislation sets benchmark levels for acrylamide in different products. Examples of this are 40 microgrammes

(µg)/kg in baby foods, 350µg/kg in biscuits and cookies, 750µg/kg in potato crisps, 850µg/kg in instant soluble coffee and 300µg/kg in most breakfast cereals, except for maize, oats, spelt, barley and rice-based products, where the benchmark level is 50% lower. The European Commission (EC) will review the levels every three years, gradually setting lower levels.

Cancer risk

The presence of elevated levels of acrylamide in food was first reported in April 2002, when the Swedish National Food Administration announced that acrylamide had been found at higher levels in starch-containing foods, such as potato products and bread, cooked at high temperatures.

The UK Committee on Mutagenicity (CoM) suggested in 2006 that acrylamide could damage DNA, stating: "There is no level of exposure to this genotoxic carcinogen that is without some risk".

In 2013, the EC introduced 'indicative values' as a guide for food groups most associated with acrylamide. In 2014, the European Food Safety Authority (EFSA) supported the CoM's views and EFSA's Scientific Panel on Contaminants in the Food Chain confirmed that acrylamide in food potentially increased the risk of developing cancer, in people of all ages.

As it is not possible to establish a safe level of exposure for acrylamide to quantify the risk, the EFSA has used a 'margin of exposure' approach, indicating the level of health concern posed by a substance's presence in food. Acrylamide has a margin of exposure of 100, compared with a value of 100 000 for aflatoxins and nitrosamines, which are therefore 100 times less dangerous.

Acrylamide in oil

Acrylamide is not found in cooking oil but if starchy food, such as potatoes, is fried

in oil and that oil is re-used, acrylamide levels can build up. According to the AAK Food Service, it is the crumbs and fine particles of food left in the frying oil after cooking that may contain, and continue to create, acrylamide in the hot oil. "If the frying oil is not skimmed or filtered out, the fine particles may stick to the next batch of food, raising acrylamide levels."

According to food chemist Dr Christian Gertz, of Germany's Maxfry GmbH, acrylamide levels are not influenced by the use life of frying oils. "You can produce fried products in fresh oil with a high level of acrylamide and vice versa. The main factor is the applied temperature and frying time," Gertz says.

UK food safety firm, Klipspringer, recommends replacing cooking oil when it reaches a 25% total polar compound (TPC) level. "There is no direct correlation between acrylamide and TPC levels, but it is widely acknowledged that oils with a high TPC level also contain higher levels of acrylamide," says the food safety firm. The 25% TPC level is a rough guide as the limits in Europe are different, according to Gertz.

"The problem is really much more complex," he adds. "TPCs give only limited information on the real status of an oil. In industrial practice, for example, it can be found that production with oils that have less than 25% leads to products of low quality and off-flavours. Levels of 12% to 18% can already be a problem depending on the application and product."

Klipspringer outlines some advice for any food business that cooks with oil, or cooks food containing acrylamide:

- Abide by the new standards.
- Cook food at lower temperatures for less time and fry at a maximum temperature of 175°C.
- Cook food to a maximum light golden brown colour.
- Check the levels of TPC in oil and discard at 25%.



Formation in frying

The most important condition affecting acrylamide formation during frying is temperature. "In chemistry, a rule of thumb is that the speed of a reaction doubles in steps of 10°C. A critical temperature for deep frying is 175°C. From that point on, the formation of acrylamide increases exponentially," says Gertz.

According to Gertz, S Klostermann and Parkash Kochar in their study, *Deep frying – the role of water from food being fried and acrylamide formation*, frying is basically a dehydration process. After food is immersed in oil, a sharp superficial crust region is immediately formed. The thickness of the crust increases with the frying time from about 0,3mm to 2mm.

Heat is transferred from the frying oil to the core centre of the food via the crust. Water evaporates at the moving boundary. After the boundary zone is dehydrated, water migrates from the food outwards to the walls to replace what is lost during heating. Behind this front, the temperature within the food is about 100°C to 104°C, representing the temperature change from water to steam. The temperature in the crust remains at the boiling point of water.

When frying potato crisps, the crust region enlarges quickly and the core zone disappears. The lack of water to be evaporated causes pressure to drop, and heat transfer rapidly raises the temperature of the material to above 100°C. When no more water can escape through the crust, the temperature increases to above 120°C, when acrylamide starts to form.

Comparing different oils and fats

Different oils and fats have different abilities to transfer heat to food as they contain different quantities of substances such as mono- and diglycerides, or short- or middle-chain fatty acids.

In Gertz's 2014 paper *Fundamentals of the frying process*, palm olein and beef tallow were found to contain more polar components than oils such as rapeseed oil, sunflower oil or groundnut oil. It is possible that more polar compounds reduce the surface tension between the oil and food surface.

The surfactant theory of frying suggests that as oil degrades, more surfactant materials are formed, causing increased contact between oil and food. These materials lead to better heat transfer, the water in the food evaporates faster and the time the temperature takes to exceed 100°C to 104°C is shorter. This suggests that frying with palm olein and tallow can cause higher acrylamide levels in comparison to vegetable oils such as sunflower or rapeseed, if no attention is paid to the frying time.

Mechanism of formation

According to Gertz, a number of theories have been proposed to account for the mechanism by which acrylamide is formed in fried food. "In experiments with asparagine, it has been confirmed that asparagine is the nitrogen source for acrylamide."

Asparagine is found abundantly in wheat, corn, potatoes, green beans and peanuts. Heating of asparagine alone does

not efficiently produce acrylamide but, combined with reducing sugars and some fat degradation (oxidation) products, the formation of acrylamide is accelerated. Other factors which may influence the reaction include the potato variety, the temperature, product moisture and acidity.

Gertz says in discussions about possible pathways to the formation of acrylamide in deep-fried products, it has been assumed that acrylamide is formed via glycerol by oxidation of acrolein to acrylic acid, which reacts with ammonium from amino acids.

Another possible mechanism describes acrylic acid arising directly from the decomposition of two common amino acids, alanin and aspartic acid. Acrolein is also formed in various concentrations in the oxidation of linolenic acid (not via glycerol), depending on the kind of cooking oil heated and the temperature applied to the oil.

The role of silicone additives

Silicone is legally permitted in Europe as additive E900 and is often used as an anti-foaming agent in frying oils and fats. According to Gertz, the role of silicone in acrylamide formation is not clear. "It is evident that heat stabilising agents (not simple antioxidants) added to vegetable oils rich in linolenic or linoleic acid – such as rapeseed, sunflower and soya bean – help reduce the formation of oxidised reaction products, which can act as a partner in the Maillard reaction.

"Unfortunately, the standard antioxidants butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) do not have this effect."

Conclusions

Acrylamide formation during frying depends on many conditions, the most important being temperature and frying time. The formation of acrylamide in fried food can be decreased by lowering frying temperatures to below 175°C. However, this does not necessarily reduce acrylamide concentration in fried products unless all process parameters are taken into account. 🌱

This article was first published in the February 2019 edition of *Oils & Fats International*. For more information, visit www.ofimazine.com or contact Serena Lim on SerenaLim@quartzltd.com.

Getting to know the Protein Research Foundation

By Gerhard Keun, PRF

Certain objectives of the Protein Research Foundation and its predecessors, including funding research to achieve specific objectives, date back to 1973. Before 1990, certain other objectives had to be achieved using specific funds, but those were terminated in 1989 to make way for a pure research function and related matters. Those were determined formally in 1990, with the establishment of a research trust now known as the PRF.

The PRF's objectives focus on the following two aspects:

- **Protein research:** Research to the advantage of protein sources earmarked for animal feeds, related to animal proteins, as well as proteins obtained from oilseeds and other protein rich plants.
- **Oilcake research:** Research related specifically to the oilseeds protein value chain.

Vision

The PRF strives to contribute specifically to the promotion of locally produced protein on a sustainable basis, in order to satisfy the growing demand for protein for

animal production purposes, as well as the optimal utilisation thereof, which will lead to an increase in the standard of living of all people in South Africa.

Mission

The PRF contributes to the realisation of the vision for the provision and utilisation of protein by means of the proactive stimulation and funding of applicable purposeful research, as well as the promotion and implementation of such research results by means of technology transfer in order to fulfil the increasing demand for protein as well as its optimal utilisation for animal nutrition in South Africa.

The PRF subscribes to:

- A balanced, objective approach, sensitive to South Africa's developmental needs.
- A critical awareness of the latest developments regarding protein supply and utilisation.
- The promotion of cost-effective research.
- The dynamic promotion of the implementation of research results.
- The effective, sustained utilisation of natural agricultural resources.
- The reduction of foreign exchange payable for imports.

- The creation of employment opportunities by replacing imported protein, as far as possible, with locally produced protein.

In pursuit of these objectives, a well-developed structure is crucial.

Board of trustees

The Trust is administered and managed by a board of trustees consisting of at least five and at most 14 trustees, from various disciplines. The current chairperson of the board is AP Theron and Dr Erhard Briedenhann is the vice-chairperson.

Management committee

The management committee may be regarded as an extension of the board. The committee submits recommendations relating to policy issues to the board, passes resolutions in terms of delegated authority approved by the board, as defined in the administrative and financial guidelines, while also assuming responsibilities for financial and marketing matters.

The management committee consists of the PRF chairperson and vice-chairperson, the chairpersons of the board committees and/or elected board members. The management committee must consist of

at least three members. The PRF board chairperson acts as *ex officio* chairperson of the management committee.

The current management committee members are AP Theron, chairperson, Dr Erhard Briedenhann, vice-chairperson and chairperson of the technology committee, and Prof Ferdi Meyer, elected member.

Technology committee

The technology committee is one of the board's standing committees and reports directly to the board. The committee's functions involve:

- Evaluation and selection of all research projects submitted for funding within the policy and framework of the PRF mandate.
- Promotion of technology transfer by means of demonstration trials, transfer of information in the media and information days.
- Visits to researchers and research projects for support and encouragement of research.

- Identification of gaps and new subjects in terms of research projects and fields, as well as related recommendations to the PRF board.
- Identification of new supply sources and utilisation of proteins for animal feeds, as well as related recommendations to the PRF board.
- Decisions about bursaries and achievement awards.

Canola working group

The functions of this group are to discuss industry matters in the interests and to the benefit of the canola industry, as well as the identification of research projects and technology transfer to the advantage of the industry. The canola working group is attended by role-players in the industry and decisions are consensus based.

Canola planning committee

The functions of the planning committee are to discuss industry matters and to submit recommendations to the PRF

committees, insofar as these relate to research, technology transfer, liaison and other actions required to promote canola production.

Soya bean working group

The functions of this working group are to discuss industry matters in the interests and to the advantage of the soya bean industry, as well as the identification of research projects and technology transfer to the benefit of the industry. The soya bean working group is currently combined with the sunflower, soya bean and soy food forums of the oilseeds industry. Role-players within the industry participate and decisions are consensus based.

Soya bean planning committee

A soya bean planning committee is in the pipeline. It will be formed to discuss industry matters and submit recommendations to the PRF committees about research, technology transfer, liaison and other actions required for the promotion of soya bean production. 🌱



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WASA wind resource map launched

Issued by the Department of Energy

The acting director-general of the Department of Energy (DoE), Ompi Aphane, recently launched the Wind Atlas for South Africa (WASA) high-resolution wind resource map, which covers the country's nine provinces. The launch took place at the WASA 2 Seminar in the Eastern Cape.

Addressing delegates, Aphane emphasised the importance of accurately predicting wind conditions. "As we continue on our ambitious renewable energy path, wind energy remains an integral part of this goal. However, it would be difficult to plan thoroughly for the increased uptake of wind energy without certainty on wind resource availability," he said.

"The need for reliable, accurate and representative data on wind is critical and it was because of this that the Department of Energy undertook to complete WASA."

Project partners and support

The WASA 2 Seminar was hosted by the DoE in partnership with the South African National Energy Development Institute (SANEDI), the Royal Danish Embassy and the United Nations Development Programme (UNDP). Jørgen Erik Larsen, counsellor for water, energy, research and innovation at the Embassy of Denmark in South Africa, and UNDP resident representative Walid Badawi, also addressed delegates.

WASA is a project of the South African Wind Energy Project (SAWEP) with the DoE as the executing partner. It is funded by the Global Environment Facility (GEF) through the UNDP country office support and project managed by SANEDI.

Scope for price reductions

The acting director-general commented that the latest iteration of the Integrated Resource Plan (IRP), though still in draft form, would demonstrate South Africa's continued commitment to investing in renewable energy.

"The Renewable Energy Independent Power Producer Procurement Programme

(REIPPPP) initiative has resulted in the procurement of 6,3GW of new renewable energy capacity to date, with 3,9GW already online. The transparent and competitive bidding nature of the REIPPPP has been the main driving force behind the reduction in costs of these renewable energy projects," he said.

"Solar PV power and wind power have seen the most rapid decline in costs, which can now compete with conventional power generation sources. Solar PV power costs have dropped by more than 80% since 2011, while costs involving the use of onshore wind have fallen by around 60%," Aphane explained.

"The draft IRP proposes a significant share of new generation to be from renewable energy. While the final IRP is awaited, I am confident that the outcome will provide greater scope and impetus for further price reduction in renewable energy," he added.

The wind resource map

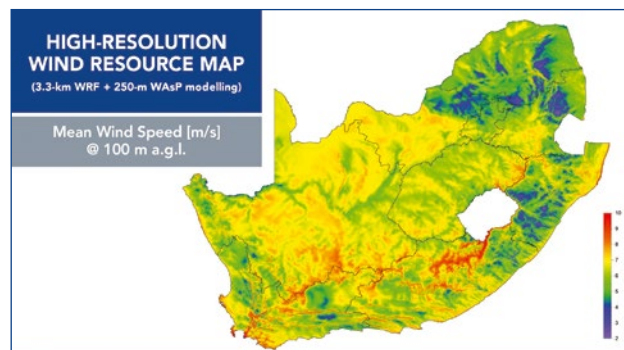
The WASA high-resolution wind resource map, available at www.wasaproject.info, shows detailed information on surface winds across South Africa, such as mean surface wind speed, which helps planners, wind farm developers and others to identify areas for wind exploration.

It also helps government, through the Department of Environmental Affairs' Strategic Environmental Assessment, with wind development zones that support the country's energy investment drive.

Evidence-based measurement

Through WASA's implementation, the country has established critical and quality wind measurement infrastructure in five provinces:

- WASA 1 encompasses the Western Cape and parts of the Northern and Eastern Cape. It was completed in 2014 and includes nine wind measurement stations.



- WASA 2 focuses on KwaZulu-Natal, the Free State and remaining areas of the Eastern Cape. It was completed in 2018 and features five measurement stations.

At the beginning of September last year, four additional wind measurement stations were erected in the Northern Cape under WASA 3, which is scheduled for completion by 2020. This brings the total number of WASA wind measurement stations in operation to 18, across five provinces, covering an estimated 75% of South Africa's land surface area.

Excellent assessment capability

The WASA 2 Seminar coincided with the ten-year anniversary of the WASA project. WASA constitutes one of the most critical elements of South Africa's renewable energy efforts and enables the country to contribute to the Global Renewable Energy Atlas led by the International Renewable Energy Agency.

Through WASA, the country has developed an excellent wind resource assessment capability at the Council for Scientific and Industrial Research, the South African Weather Service and the University of Cape Town. This capability allows for the planning of large-scale exploitation of wind power in South Africa and critically needed knowledge and skills transfer. 🌍

For more information,
email info@energy.gov.za or
visit www.wasaproject.info.

MAKING A DIFFERENCE in the oilseeds industry

By Gerhard Keun

The Oil and Protein Seeds Development Trust (OPDT) and Oilseeds Advisory Committee (OAC) were established in 1997. The main objectives of the OPDT are the promotion and development of the oilseeds industry in South Africa through:

- Financing for research projects pertaining to the improvement, production, storage, processing and marketing of oilseeds.
- Financing for the provision of information and advisory services to the oilseeds industry pertaining to the production of oilseeds and marketing conditions.
- Financing of market access or of any further conduct which is in the interest of the oilseeds industry.

Transformation was always a part of the OPDT/OAC research budget. Since inception, training of emerging farmers was done via NOPO and then through Grain SA. The OPDT/OAC realised that community upliftment had to be addressed and could be done by way of the production of soya beans and the inclusion of soya as a protein source in the diets of communities.

During the 2010/11 financial year, the Eden Social Development Foundation registered a project called 'The development and training of entry-level soy consumers with further progression to soy-preneurs level', with the OPDT/OAC. The main aim was soya awareness, small-scale soya bean production and the development of small enterprises. The project was later supported by various other projects and actions, all financially supported by the OPDT.

A business plan for upliftment

During 2015, Dr Marinda Visser of Grain SA introduced the Department of Science and

Technology (DST) to the OPDT/OAC and a business plan was submitted, including all upliftment and soya food projects in the Soybean Food and Nutrition Development Programme.

During the 2016/17 financial year, the DST allocated funding for the first time and the following projects were included in the programme:

- Development and training of entry-level soy consumers with further progression to soy-preneurs level.
- Addressing food insecurity by supporting economic growth for emerging farmers.
- Promoting household production and processing of soya beans as a major source of quality protein.
- Farmer development by Grain SA.

We built on the success of the 2016/17 financial year and the DST via the Technology Innovation Agency (TIA), which kept its commitment and approved funding for the 2017/18 and 2018/19 financial years. The additional funding resulted in more projects and more collaborators, such as the Vaal University of Technology (VUT), the Agricultural Research Council (ARC), the University of Pretoria (UP), and the Grain Farmers Development Association (GFADA), as well as the expansion of the programme to other provinces. To date, the DST/TIA has contributed R3,5 million towards the programme, which has been matched on a rand-to-rand basis by the OPDT/OAC.

As mentioned, the additional funding allows for expansion of the programme and the following projects have been included in the application for programme continuation in the 2019/20 financial year, which has already been submitted to TIA for consideration:

- The development and training of entry-level soy bean consumers with further progression to soy-preneurs level, Eden Social Development Foundation.
- Addressing food insecurity by supporting economic growth for emerging farmers, VUT.
- Promoting household production and processing of soya beans as major source of quality protein (Limpopo), VUT.
- Promotion of soya beans and groundnuts in a crop rotation system, ARC.
- Farmer Development: Training, Grain SA.
- Reviewing soya in the school feeding programme, UP.

Although not directly related to the programme, the following projects are also supported:

- *Pula/Imvula*, Grain SA.
- *Oilseeds Focus*, Protein Research Foundation/OAC and OPDT.
- Transformation Project, GFADA.

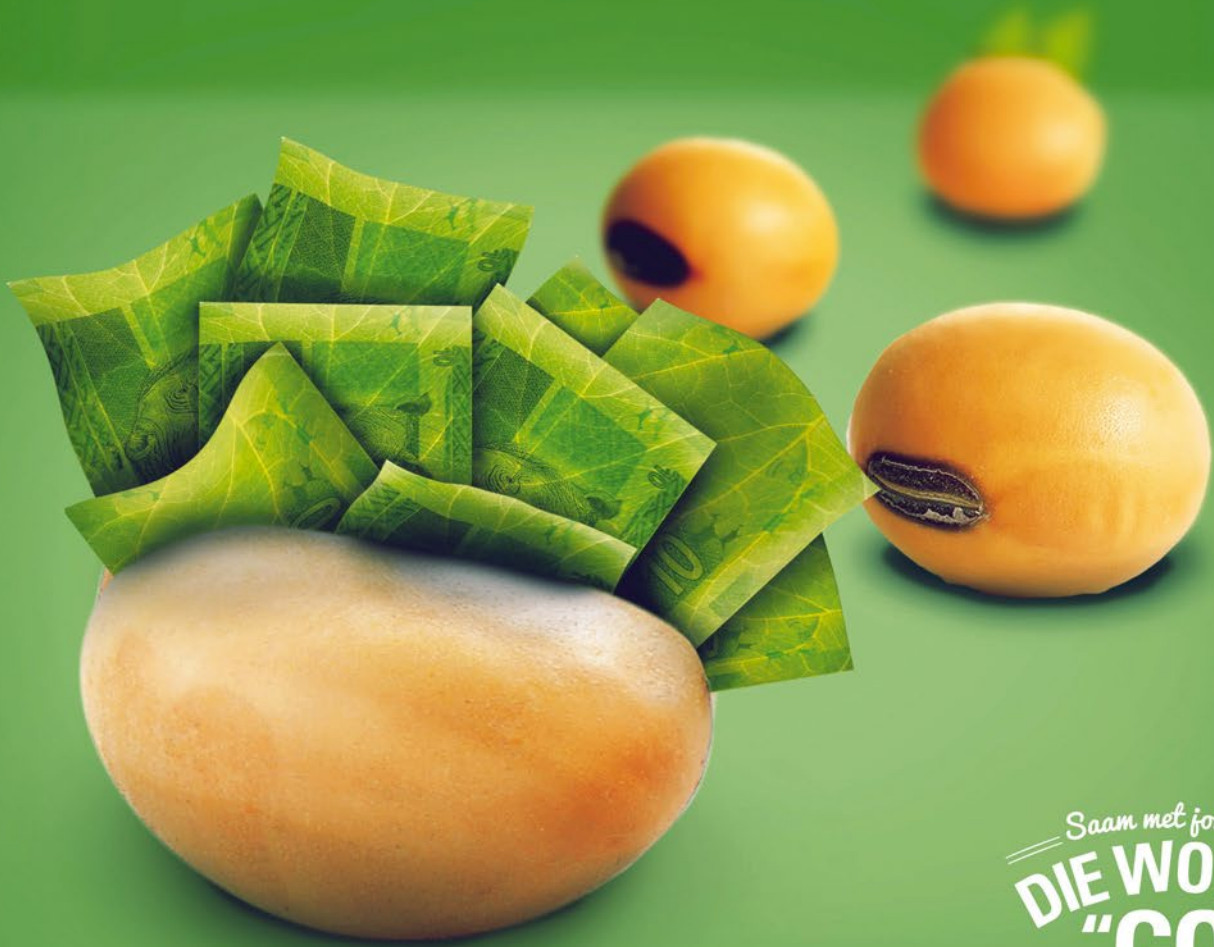
Touching lives

The Soybean Food and Nutrition Development Programme has touched the lives of many people. During the 2017/18 financial year, group training led to the training of 359 women and 78 men; farmer training accounted for 66 farmers trained and 65ha of soya beans planted. Three black commercial farmers planted 64ha of soya beans.

A Women's Day workshop, held in Okhahlamba, was attended by approximately 200 women, and the training of 170 additional farmers in collaboration with VUT, GFADA and Grain SA was carried out. A soya bean awareness DVD was also produced in co-operation with Grain SA and translated into isiXhosa and isiZulu.

There is still a lot to do, but by joining forces with other industry role-players, much more can be achieved. The past three years have demonstrated the benefits of collaboration and co-operation. 🌱

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