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OILSEEDS focus

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The critical role of the soya bean supply chain

By Dr Erhard Briedenhann, chairperson: Oilseeds Advisory Committee

The growth of South Africa's soya bean industry in the last 20 years is one of agriculture's great success stories. Soya bean production has increased by 450% – from 282 000 tons in 2007/8 to 1 550 800 tons in 2018. The long-term debate always revolved around which would come first – growth in production, or capacity to process?

Growth in crushing capacity has paved the way for value chain expansion, from an estimated 600 000 tons in 2010 to the current estimated capacity of 2,1 million tons. This capacity, and that of full-fat soya processing, is expected to meet the country's demands for at least the next five years.

Agronomic practice improvements have largely boosted increased yields. Practices such as rotational cropping, conservation agriculture and accurate application of Rhizobia are some of these improvements. Research worldwide has confirmed the fact that narrower rows increase yield potential in soya beans. Planting date has also become an integral part of the process and decision.

Chemicals have been made available for effective weed control, and the introduction of new chemicals and biological products to manage debilitating diseases such as Sclerotinia have become critical for the industry.

Fertiliser usage is better optimised through improved understanding of soil status and the nutrient requirements of soya beans, allowing for the application of appropriate nutrient ratios.

Cultivars selected for regional use have been successfully tested and trialled over many years. Daylight length, temperature during growing, the date of the first likely frost, and disease challenges can be more accurately estimated. These parameters are added to potential yield and influence cultivar selection. The continuous introduction of new technology and cultivars has had a positive effect on average yields.

The introduction of a new technology levy, effective from March, has created the expectation that we will not only maintain yields, but also boost them in future.

Nutrient content, namely oil protein and amino acids, is the reason why soya beans are grown and purchased, and it is imperative for the future of the industry that growers strive for increased nutrients harvested rather than vegetative mass. The focus on improved nutrient yield could benefit everyone in the supply chain. Should South Africa be fortunate enough to be able to export soya beans, we will need to meet minimum oil and protein content requirements to offer a marketable product to foreign countries.

Transformation has received significant attention in the soya bean industry. Emerging farmers have entered the market and soya bean processing at household level contributes to food security. Soya bean production in South Africa has the potential to increase our contribution to food security and reduce malnutrition. Expanding the transformation initiative requires ongoing focus.

The oilseeds supply chain faces numerous challenges, including political uncertainty and slow economic growth. The absence of reliable, continuous power supply and quality water has an extremely adverse effect on soya bean processors.

The feed industry is the biggest global consumer of soya bean meal (239 million tons). South Africa is no different, with the livestock feed industry consuming an estimated 1,2 million tons of soya bean meal per annum, or 98% of domestic soya bean production (including full-fat soya). There has been a slow, but steady, conversion of the local feed industry from imported to domestically produced soya bean meal. A reliable, consistent and quality supply is the guarantee the industry requires, and some end users have taken longer than others to be convinced.

Dr Erhard Briedenhann.

When looking at the future of the country, sustainable protein production is critical, and the contribution of the soya bean value chain should be emphasised. According to BFAP, we are predicted to consume 1,56 million tons of soya bean meal by 2027. If South Africa produces 2,1 million tons of soya beans by 2027, we could reach self-sufficiency.

It has been a long, rewarding and exciting journey, but now is not the time for us to sit back and claim 'mission accomplished'. There is still a long, hard road full of challenges ahead.

For more information, contact Dr Briedenhann at erhardb@netactive.co.za

The challenges that lie ahead

Exports of agricultural products from South Africa grew by 7% last year to reach a record level of $10,6 billion (±R150 billion), with fruit and wine making a major contribution. Africa and Europe remain the most significant export destinations.

Reduced grain production is predicted for this year due to non-optimal rainfall. Summer grain hectares planted have fallen from 3,85 million hectares in 2017/18 to an estimated 3,58 million hectares in 2018/19. Groundnuts have been particularly hard hit, with a cut of 66% in hectares planted. This will reduce the groundnut crop to its lowest in the past decade, and roughly 55 000 tons of imports will be required to satisfy demand. Yields for summer crops this year are predicted to be lower across the board.

Soya bean meal is unfortunately still a contributor to South African agricultural imports with an estimated 465 398 tons, worth R2,6 billion, imported during 2018. Some of the primary contributors to agricultural imports are rice, wheat and palm oil.

Growth in the South African soya bean industry is steadily reducing annual import requirements for soya bean meal (51% reduction during the past seven years) and should continue its contribution to reducing agricultural imports, which were $3,9 billion (±R55 billion) last year.

Difficulties and opportunities

The economic prospects remain gloomy, particularly considering the burden the debt of state-owned enterprises has placed on the economy. Eskom's dismal failure at a time when the problem was considered manageable and under control will also have grave repercussions on the growth of the economy. Only time will tell how long we are to suffer from the negative impact of this setback.

Agriculture is an important part of the economy and will need to play a major role in forging the country's progress. The focus on production for export, with the support of an enabling business environment, is reason for optimism. Uncertainty regarding land ownership will, however, continue to dampen optimism and confidence and must be resolved without delay.

The prolonged drought in certain areas of the country in 2018/19, which caused low yields and crop failure, is putting major strain on the financial viability of several farming operations, and future survival in these areas will be tough.

We trust that we will face up to this year's many challenges and emerge victorious.

Dr Erhard Briedenhann

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

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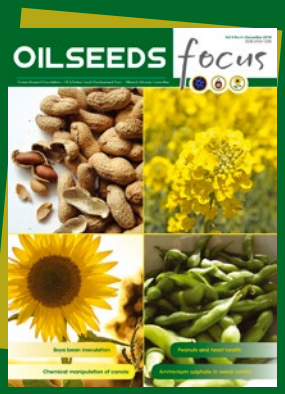

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NEWS

Canola yield winners announced

The winners of the 2018 Canola Yield competition, awarded annually by the Protein Research Foundation (PRF), were announced towards the end of last year. The regional winners were:

- Swartland: Melt van der Westhuizen of Klipheuwel Boerdery, Moorreesburg, with a yield of 3,437 ton/ha.
- Southern Cape: Pieter Beukes of Yahshua Boerdery, Caledon, with a yield of 2,96 ton/ha.

This is the third consecutive win for Beukes, who has an outstanding recipe for canola production. – *PRF*

PRF achievement awards announced

The PRF presents annual awards in recognition of academic work that contributes to research aimed at enhancing the optimal utilisation of protein. The winners of the 2016/17 achievement awards were announced towards the end of last year.

Nina Parry of the University of Pretoria received the award for the best thesis for a master's degree in 2017. Her thesis evaluated the potential of three *Chrysomya* spp. and *Lucilia sericata* (*Diptera: Calliphoridae*) for the bioconversion of waste products.

The PRF presented Nina Parry of the University of Pretoria with the award for the best thesis for a master's degree in 2017.

Nominations for the 2018/19 awards close on 29 March and can be submitted for the following categories: best doctoral thesis; best master's degree treatise; best article in a scientific journal; and outstanding contributions by an individual promoting the PRF's objectives. – *Ursula Human, Oilseeds Focus*

New findings on polyunsaturated fat

The so-called 'muffin study' received a lot of attention when it was published in 2014. In this study, the participants ate three muffins a day, on average, for a period of seven weeks. Half of the muffins had been baked using saturated fat (palm oil) and the other half using polyunsaturated fat (sunflower oil). The carbohydrate and protein content was the same in each muffin, the only difference between them being the type of fat.

In a collaboration with the person in charge of the muffin study, Associate Prof Ulf Risérus at Uppsala University in Sweden and Prof Charlotte Ling at Lund University in Sweden have now studied the epigenetic changes in the study participants' fat tissue, through biopsies taken before and after the project. The results show that the epigenetic pattern in more than 3 000 genes (out of approximately 25 000 that exist in a human being) had changed differentially, depending on whether the participants had eaten saturated fat or polyunsaturated fat.

"We believe the discovered epigenetic changes, depending on the type of fat eaten, could contribute to the difference in fat storage, in which saturated fat has a more negative impact," says Prof Ling. "We have previously shown that exercise can affect the epigenetic pattern in fat tissue. These findings support the fact that through diet and exercise, we can affect our health through epigenetic changes." – *Lund University*

Systems thinking to solve contamination problems

Systems thinking can help structure a framework to simulate solutions to pressing food concerns, such as the presence of aflatoxins in African groundnuts. This is according to Dr Willeke de Bruin, postdoctoral fellow at the Centre of Excellence in Food Security and Agricultural Transformation in Africa programme, University of Pretoria, who spoke during the second International Conference for Food Safety and Security, held in Pretoria.

Different countries have set different limits for aflatoxins in groundnuts, varying from four parts per billion to 20 parts per billion. De Bruin said many factors may influence aflatoxin contamination, from soil and watering, to harvesting and threshing, sorting, storing, transporting, trading and processing into peanut butter.

De Bruin proposes a different approach to predict and find ways of changing the internal behaviour of such a system. The systems thinking approach allows researchers to dissect complex food environments. Systems thinking and modelling using system dynamic diagrams can illustrate the series of interconnected components indicating how the value chain is influenced by all internal and external factors.

"In the system dynamics diagram of the groundnut value chain, it shows a myriad of elements within the chain that are all interconnected, and all influence each other. The least obvious component or factor, such as access to extension services in this context, is often a major driver that influences the whole chain. You would not have been able to see this if you had not used a systems approach," De Bruin said.

Simulation modelled, system generated behaviour can be used to find optimal intervention points to address problems. – *www.foodsecurity.ac.za*

Update on US-China trade

US president Donald Trump said he would soon meet his Chinese counterpart, Xi Jinping, to try and secure a comprehensive trade deal between the world's two largest economies, as two-day talks to resolve the conflict that has rattled the global economy ended without any agreement.

The US and China have been locked in an escalating trade spat since early last year, raising import tariffs on each other's goods that especially impacted the soya bean industry. Last year, Trump imposed tariff hikes of up to 25% on $250 billion worth of Chinese imports. The move prompted China to increase tariffs on $110 billion of US goods. Trump and Jinping agreed to halt further tariff increases for 90 days starting 1 January.
– *www.economictimes.indiatimes.com*

Indian oil meal exports on the rise

The export of Indian oil meal during January increased by 5,5% to reach 283 850 tons compared to 269 668 tons exported in January last year, according to figures published by the Solvent Extractors' Association of India.

Overall exports from April last year to January this year are reported at 2 692 452 tons compared to 2 516 657 tons during the same period last year, which represents a 7% increase. The export of rapeseed meal increased sharply to 897 537 tons in the first ten months. The meal was exported mainly to South Korea, Vietnam and Thailand.

The export of rapeseed meal and soya bean meal to China is unlikely to resume during the current financial year, as the procedure for registration is too cumbersome, lengthy and time consuming.
– *www.economictimes.indiatimes.com*

Producer participation in CEC estimates

The Crop Estimates Committee's (CEC) objective is to release reliable, accurate and credible estimates to the agricultural industry. The late rain and late plantings this season made the estimate very challenging.

It is important to note that the first three production estimates (February to April) are largely determined by, and rely on, producer information, completed through monthly questionnaires. Grain SA urges every producer to complete the questionnaire sent out in February, as this will determine the size of the first production estimate. An accurate first estimate will only be possible if all producers participate.

Producer information facilitates the committee's task and leads to credible published information, carrying more weight when establishing an estimate. Improved participation by producers leads to a more accurate estimate.

Contact Rona Beukes of the CEC on 012 319 8032 or RonaB@daff.gov.za to participate in the production estimate. – *Petru Fourie, Grain SA*

ON THE PRF CALENDAR

MARCH

6 – 7 Grain SA Congress, Nampo Park, Bothaville, Free State, South Africa
6 – 7 Canola Working Group Information Day, Grain SA Congress, Nampo Park, Bothaville, Free State, South Africa
6 – 7 Soya Bean and Sunflower Information Day, Grain SA Congress, Nampo Park, Bothaville, Free State, South Africa

APRIL

11 59th Fertasa Annual Congress, Spier, Stellenbosch, Western Cape, South Africa

MAY

14 – 17 Nampo Harvest Day, Nampo Park, Bothaville, Free State, South Africa
14 – 17 Soya Bean and Sunflower Information Day, Nampo Harvest Day, Nampo Park, Bothaville, Free State, South Africa
22 – 23 Ensminger Pig Symposium, Kopanong Hotel and Conference Centre, Benoni, Gauteng, South Africa

Biocontrol agent against
Mexican sunflower released in South Africa

By Khethani Mawela and David Simelane

A decade of research on biocontrol of the invasive Mexican sunflower, *Tithonia diversifolia (Asteraceae: Heliantheae)*, has finally paid dividends following the release of the first biocontrol agent against this invader. The leaf-defoliating tortoise beetle, *Physonota maculiventris (Coleoptera: Chrysomelidae: Cassidinae)*, originally from Mexico, was finally approved for release in July last year, and researchers are currently hard at work mass-rearing the beetle for release and distribution throughout the country.

Aggressive, invasive weed

Mexican sunflower is an aggressive, invasive weed that is naturalised in Southeast Asia, South America and tropical Africa, including South Africa. Initially introduced into South Africa during the 1930s as an ornamental plant, Mexican sunflower has become invasive in the tropical and subtropical provinces, including Limpopo, Mpumalanga and KwaZulu-Natal.

It is rapidly invading farms, forest margins, disturbed lands, railway lines and roadsides, outcompeting native flora by transforming landscapes into a monoculture. Because of its perennial and allelopathic properties, the Mexican sunflower is able to maintain monocultures throughout the year, making it impossible for native flora to reclaim the space at those sites. Its ability to reproduce through seeds and vegetatively makes it a highly aggressive weed. Branches that have been cut off and discarded during mechanical control may regenerate and produce new plants, while wind-dispersed seeds enable it to colonise remote, new sites. Mexican sunflower is classified as a category 1b and 1 weed by the *National Environmental Management: Biodiversity Act, 2004* (Act 10 of 2004, or *NEMBA Act*) and the *Conservation of Agricultural Resources Act, 1983* (Act 43 of 1983, or *CARA Act*) of South Africa, respectively.

Khotso Malatji releasing Physonota maculiventris on Mexican sunflower at Umkomaas in KwaZulu-Natal.

Adult Physonota maculiventris and the larvae of P. maculiventris.

Biological control programme

Although mechanical and chemical control measures are often applied by land owners in South Africa, these measures are expensive and unsustainable. As part of control efforts to contain the Mexican sunflower, a biological control programme was launched in 2007 by the Agricultural Research Council's Plant Health and Protection Institute through funding by the Natural Resources Management Programme (NRMP) of the Department of Environmental Affairs (DEA). This programme resulted in the collection and identification of the leaf-defoliating tortoise beetle *P. maculiventris* in Mexico in 2009, and its subsequent development as a biological control agent in South Africa. Extensive evaluation of host-specificity and potential impact of the beetle were

conducted over a four-year period to determine its safety for release and effectiveness in controlling the Mexican sunflower in this country. The beetle was eventually recommended for release, and permission for its release was granted by the Department of Agriculture, Forestry and Fisheries (DAFF) in July 2018.

The female beetle lays batches of around 30 eggs on the lower leaf surface. Each female may produce at least six egg batches during her lifetime. As the eggs hatch, early instar larvae feed gregariously, which makes the larval stage the most damaging stage of this beetle. Thereafter, late instar larvae feed solitarily and pupate mostly on dry, damaged leaves that are still attached to the plant.

The damage by larvae and adults of *P. maculiventris* often results in skeletonisation of the leaves, leaving only the leaf veins behind. This damage leads to substantial loss of photosynthetic area, resulting in loss of biomass and reproductive capacity of the plant.

Mass-rearing of the beetle has been initiated at Roodeplaat and Tzaneen. The conditions in gauze-covered tunnels appear to be conducive for the beetle to multiply, and it is anticipated that thousands of beetles from the Tzaneen tunnels alone will be distributed throughout the country before winter. Adult beetles, bred in the quarantine facility in Pretoria, have already been released at 21 sites in KwaZulu-Natal, Mpumalanga and Limpopo since August 2018, with 200 to 1 000 beetles released per site.

Mexican sunflower skeletonised by the larvae and adult beetles.

We anticipate that, having been reunited with its host plant in the wild, the tortoise beetle will multiply and build up populations big enough to reduce the fitness and invasiveness of Mexican sunflower in South Africa.

For more information, contact Khethani Mawela at MawelaK@arc.agric.za and David Simelane at Simelaned@arc.agric.za.

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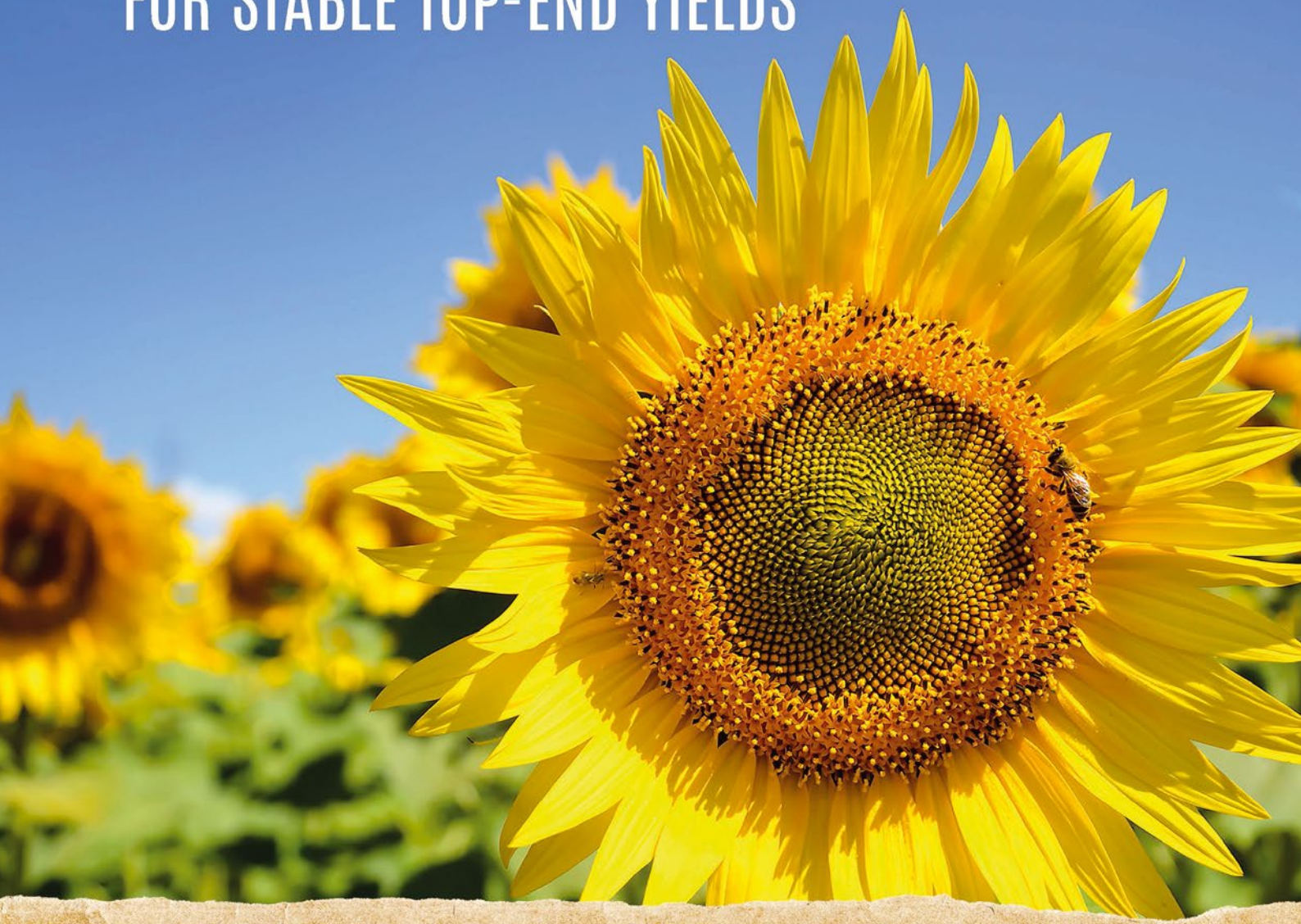

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Soya bean rust and Sclerotinia stem rot in the spotlight

By Dr Chrisna Steyn, Faculty of Natural and Agricultural Sciences, Department of Plant Sciences, University of the Free State

Sclerotinia stem rot, caused by *Sclerotinia sclerotiorum*, is increasing in importance locally and globally, and the wide host range challenges disease management strategies. Soya bean rust, caused by *Phakopsora pachyrhizi,* is a serious yield limiting foliar disease that has rapidly spread over large geographic areas. The absence of disease resistant cultivars has necessitated extensive fungicide control to ensure acceptable yields.

Stems infected with Sclerotinia sclerotiorum and covered in mycelium take on a white, bleached appearance.

Symptoms of leaves infected with Phakopsora pachyrhizi include development of chlorotic spots that gradually develop into coloured lesions.

Soya bean rust

A study was conducted to compare the reaction of experimental soya bean lines to soya bean rust in the greenhouse, and to evaluate epidemiological factors.

Greenhouse trials indicated significant differences in rust severity between lines, while field data illustrated the importance of differences in relative lifetime at disease onset, apparent infection rate, area under disease progress curve (AUDPC), and relative lifetime at which 100% disease severity was reached.

Although lines differed in disease severity, only Selection 43 showed late disease onset and slow apparent infection rate, and hence a significant level of rust resistance.

Yield losses associated with soya bean rust in varieties from three maturity groups, as well as the effects of row spacing and fungicide application on disease development were evaluated. Fungicides had little effect on delaying disease onset, which was closely related to host growth stage.

The apparent infection rate was higher in 45cm, compared with 90cm, row widths in the absence of fungicide applications, while greater reductions in apparent infection rate due to fungicide applications were recorded in the wider rows.

Differences in these variables between sprayed and unsprayed plots were more pronounced in the long-maturity cultivar compared to the shorter maturity cultivars, but the extent of these differences is dependent on spray efficiency. Differences in cultivar responses to the disease and row spacing do not provide adequate control, and fungicide applications remain the primary disease control strategy against soya bean rust.

Physiological changes associated with soya bean growth stage in field trials indicated that soya bean rust onset and development are determined by the activity of key pathogenesis-related enzymes. Environmental effects on disease severity were relatively small, once infection was initiated.

Host responses to rust infection were directly related to the decline in chitinase and β-1,3-glucanase, which coincided with flowering and pod formation, and the subsequent rapid increase in rust severity. Plots treated with fertiliser indicated that chitinase, β-1,3-glucanase, peroxidase and phenol content were related to the form of nitrogen received. Higher chitinase activity was associated with lower disease severity.

Sclerotinia stem rot

Evaluation of cultivars for resistance to Sclerotinia stem rot in the greenhouse and field failed to identify sources of resistance, although lower risk cultivars were observed in field trials. Most cultivars were susceptible to Sclerotinia stem rot, even when disease conditions were sub-optimal. A poor correlation between greenhouse and field data was observed.

Field trials indicated that cultivars react differently to changing environmental conditions and disease potentials, and high genotype x environment interactions were recorded. Data indicates that local cultivars still lack the desired level of resistance to Sclerotinia stem rot or stability to changing disease potentials.

In vitro studies indicated that *S. sclerotiorum* is favoured by cool to moderate temperatures (20°C to 25°C), while extreme cold or hot temperatures impair growth. Molecular characterisation of isolates using amplified fragment length polymorphism (AFLP) analysis revealed a relatively uniform distribution with evidence of genetic diversity within and among isolates across the five provinces evaluated.

A low recombination frequency suggests that the population is in a developing stage, which is emphasised by isolates found on the end of the minimal spanning network. No correlation between host plant or locality and genetic similarity was observed, but AFLP proved to be a valuable tool to characterise *S. sclerotiorum* isolates.

This excerpt was originally published as part of Dr Chrisna Steyn's PhD in plant pathology titled *Soya bean response to rust and Sclerotinia stem rot under different biotic and abiotic conditions*. For more information, contact her on 051 401 9378.

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Swath desiccation and harvest timing for higher yield

By Izané Crous, agriculturist, Southern Oil (SOILL)

The constant change in climatic conditions during the growing season, especially during the physiological ripeness stage and harvest, makes it difficult for producers to determine the correct swath and harvest timing. According to Australian research, incorrect swath timing (e.g. at 40% seed colour change) can result in a yield loss of approximately 11%. An 11% yield loss amounts to a loss of R927, the 2018 fixed minimum price per ton.

The following guidelines can assist producers in making informed decisions regarding correct harvest and swath timing to minimise yield losses.

Swathing canola

For maximum yield and quality, a swath timing of 60% seed colour change on the main stem must be targeted. Once the canola plant has been swathed, seed filling stops, resulting in potential yield loss if not executed at the right time. It is very important to make sure the field's seed colour change percentage is at least 60% (*Figure 2*) before swathing.

Determination of 60% seed colour change:

- Collect 100 pods on the top, middle and bottom part of the main stem as indicated in *Figure 1*. The pods must represent the 'average' ripening stage of the entire field.
- If more pods are present on the side branches, the seed colour change of the side branch pods must be determined accordingly.
- Do not hurry to swath if ripening is not uniform, and never swath before there is a 30% seed colour change. Swathing at a 30% seed colour change results in an 11% yield loss compared to swathing at a 60-70% seed colour change (*Figure 2*). By waiting three to four days, a seed colour change of 4-10% will occur, depending on climatic conditions, and the yield will increase.
- Never swath when temperatures are high. Swathing during high temperatures will result in the shrinking of seeds and the eventual capturing of chlorophyll in the seed, which will negatively affect oil quality.

Figure 1: Top, middle and bottom pod section on the main stem of canola.

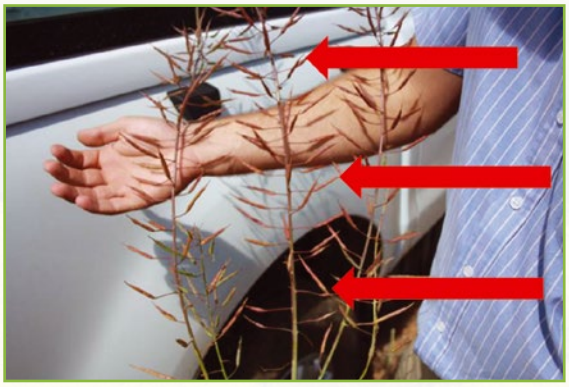
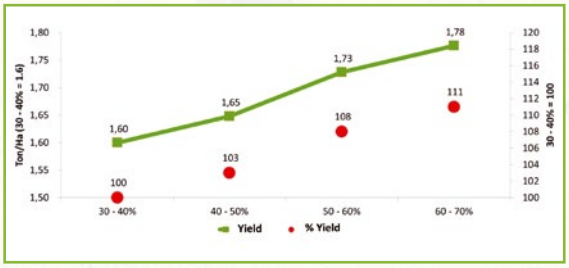


Figure 2: Canola yield at different swath timings. (Source: Department of Agriculture, West Australia)



Desiccating canola

Up-to-date Reglone® is the only product registered for the desiccation of canola. Reglone® is an advanced formulation of the active ingredient diquat, a contact herbicide with quick leaf penetration.

The ideal time to desiccate canola is at an 85-90% seed colour change. For best results, the herbicide should be applied on an overcast day. During sunny weather, diquat will immediately activate the outside tissue of the plant and will not penetrate the plant effectively enough to allow proper desiccation. This will result in non-uniform ripening and chlorophyll percentages that are potentially too high (> 4%).

Harvesting canola

Most producers think canola requires high temperatures during curing, after swathing. This is, however, not the case since the enzyme responsible for clearing chlorophyll requires moisture. If moisture in the swath is optimal and temperatures are moderate, green seed may drop to an acceptable level for combining between ten to 14 days after swathing. Under dry or cool conditions, curing may take longer. It is also important to take the seed moisture content into consideration before combining.

Canola is considered harvest-ready at a seed moisture content of 8-10% with a chlorophyll percentage of < 4%. To check on harvest readiness, take regular samples to the laboratory for analysis.

Monitor for best results

Regular monitoring is required to minimise timing losses during harvest. Canola needs a month after full bloom to mature and it is very important to monitor fields on a regular basis during the third and fourth week after full bloom.

For more information, send an email to Izané Crous at izane@soill.co.za.

Canola cultivar evaluation:
Western and Southern Cape 2018

By PJA Lombard, L Smorenburg and J Strauss, RTDS Plant Sciences

During the 2018 season, a total of 18 canola cultivars were tested in the cultivar evaluation programme. The programme included six conventional, six CL (ClearfieldR, Imazamox tolerant) and six of the TT (Triazine tolerant) group.

These 18 cultivars are the same hybrid cultivars used during the past few seasons. One new conventional cultivar (Quartz) and one new TT cultivar (Hyola 350TT) were tested. The name of the AG4510 TT cultivar was changed to Alpha TT.

National cultivar trials

The Western Cape Department of Agriculture planted eight trials in the Southern Cape during the 2018 season. Data was collected from six of the trials.

The Heidelberg flats trial suffered damage due to low soil moisture, porcupines and wild geese, while weed problems led to poor establishment in the Caledon trial. In the Swartland, eight trials were planted at seven localities, one of which was not harvested due to WP grain worm damage at Darling.

Climate of localities

The past season in the Swartland was characterised by mostly average conditions during April and May. Plantings in soil with sufficient moisture were done earlier than the previous two seasons. The Swartland's rainfall is summarised in *Table 1* and *Figure 1*.

The Pools area had an extremely dry season and although the data did not indicate the extent, the area north of the weather station was very dry. The yield data of the area was very low. Low average temperatures during August and September had a positive effect on yields (*Figure 1*).

Figure 1: Monthly and annual rainfall at Langgewens for 2018 and long term.

Figure 2: Minimum and maximum temperatures at Langgewens for 2018 and long term.

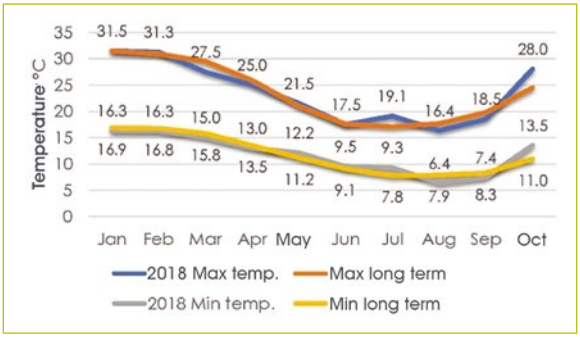


Table 1: Rainfall in the Swartland and Rûens (2018).

	Bredasd.	Caledon	Caledon	Heidelb.	Riversdal	Swellend.	Riviersd.	Piketb.	Malmesb.	Hopef.	Malmesb.	Porterv.
	Prinskraal	Dunghye P.	Protem	Voorstekop	Uitkyk	Napky	Tygerhoek	Pools	Langgew.	Koperf.	Schaapkraal	
Jan	1,5	23,3	28,7	52,1	25,4	18,8	22,9	0	4,2	2,4	6,4	0,25
Feb	6,4	12,7	2,79	9,91	11	3,8	14,7	0,3	4,6	4,6	5,3	9,65
Mar	8,9	16,7	15,5	37,3	28,8	9,4	33,3	10,9	10	10,2	6,9	33,5
Apr	6,9	21,6	11,4	22,4	6,8	6,4	18,1	19,8	32,6	21,4	35,3	21,8
May	21,1	38,4	18	18,8	12,6	12	21,8	27,7	59,8	55,6	88,9	89,2
Jun	32	70,1	22,9	31	18,2	20,3	37,6	38,9	87,6	63,8	60,2	85,3
Jul	40,4	87,4	29	38,4	14,8	23,6	52,6	40,6	33,2	39,4	43,2	64,8
Aug	67,6	74,4	42,7	47,8	30,6	24,4	42,4	27,4	49,4	42,6	56,4	58,7
Sep	95	51,3	63,5	86,8	68,6	48	72,4	34,1	46	44,4	47,5	94,5
Oct	8,1	29,5	6,9	16	12,4	6,4	14,8	7,6	6,2	7,2	7,37	8,1
Apr-Oct	271	373	194	261	164	141	260	196	315	274	339	422

The Southern Cape received very little summer rain. Total rainfall during the growing season decreased from the western to eastern regions (*Table 1* and *Figure 1*). The Southern Cape area received very good rains during September. The average temperature during August and September was below average (*Figure 4*). The yield in most areas benefited from favourable temperatures and late rain.

The average maximum temperature at Tygerhoek was above average during the growing season, except during August and September. Above-average temperatures occurred during July at Langgewens in the Swartland. This resulted in earlier flowering of certain plantings than in 2017 (two days earlier for Langgewens and ten for Eendekuil), while others took longer to flower (21 days for Porterville and 14 for Philadelphia and Grasrug).

Figure 3: Annual and monthly rainfall at Tygerhoek for 2018.

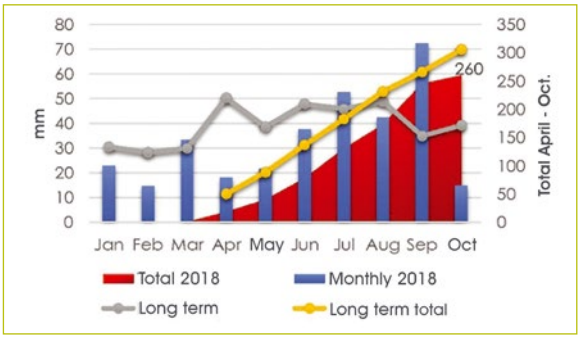
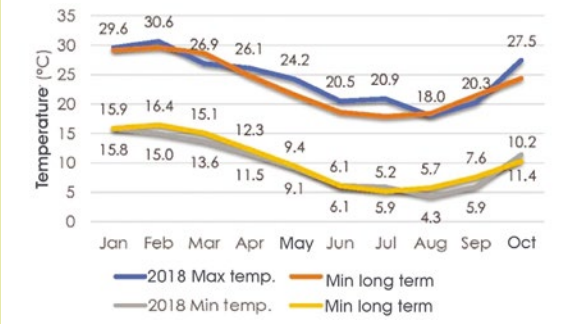


Figure 4: Monthly minimum and maximum temperatures at Tygerhoek for 2018 and long term.



Trial results

The yield results for the respective areas are summarised in *Tables 2* and *3*. Data from the Clearfield (CL) and Triazine tolerant (TT) cultivars is indicated separately from the conventional cultivars.

Table 2: Swartland seed yields for 2018 (kg/ha).

	Langgewens 1		Langgewens 2		Eendekuil		Grasrug		Philadelphia		Pools		Porterville		Swartland	
	9 May		28 May		3 May		15 May		11 May		3 May		4 May			
Diamond	4 018	a	2 903	ab	1 839	a	2 607	a	2 578	bcdef	915	a	2 357	ab	2 505	a
Quartz	3 789	abc	2 728	abcd	1 706	abc	2 066	bcdef	2 196	fg	937	a	2 157	ab	2 309	b
CB Agamax	3 497	bcdef	2 698	abcde	1 249	defg	2 603	a	2 732	abcde	468	efg	1 903	ab	2 142	cd
CB Tango	3 421	bcdef	2 730	abcd	1 712	abc	2 332	abcde	1 851	g	677	c	1 777	b	2 126	cd
Hyola 50	3 646	abcd	2 539	cdef	1 298	cdefg	1 854	efg	2 452	def	495	defg	1 897	ab	2 104	cd
Belinda	3 285	def	2 582	bcde	1 226	efg	2 087	bcdef	2 589	bcdef	582	cdef	1 914	ab	2 025	de
Conv. ave.	**3 609**		**2 697**		**1 505**		**2 258**		**2 400**		**679**		**2 001**		**2 202**	
44Y89	3 822	ab	2 896	ab	1 656	abcde	2 438	abc	2 997	ab	831	ab	2 345	ab	2 360	ab
43Y92	3 657	abcd	2 665	abcde	1 670	abcd	2 414	abcd	3 076	a	683	a	2 474	a	2 356	ab
44Y90	3 776	abc	2 953	a	1 597	abcdef	2 512	ab	2 926	abc	630	ab	2 359	ab	2 326	b
45Y91	3 634	abcde	2 628	abcde	1 211	fg	2 286	abcdef	2 894	abcd	430	ab	2 178	ab	2 135	cd
Hyola 575CL	3 336	cdef	2 631	abcde	1 531	abcdef	2 171	abcdef	2 298	efg	707	ab	2 067	ab	2 111	cd
Hyola 577CL	3 294	def	2 625	abcde	1 176	fg	1 543	g	2 233	fg	385	ab	1 900	ab	2 000	de
CL ave.	**3 586**		**2 733**		**1 473**		**2 227**		**2 738**		**611**		**2 220**		**2 214**	
Hyola 350TT	3 442	bcdef	2 863	abc	1 747	ab	2 065	bcdef	2 521	cdef	712	ab	2 087	ab	2 200	bc
Alpha TT	3 343	cdef	2 369	efg	1 446	abcdef	1 933	defg	2 712	abcde	631	ab	2 188	ab	2 037	de
Hyola 559TT	3 159	efg	2 235	fg	1 382	bcdefg	1 925	efg	2 347	ef	605	ab	1 951	ab	1 924	e
Hyola 555TT	3 147	fg	2 079	g	1 245	defg	1 835	fg	2 441	def	587	b	1 811	b	1 888	e
Hyola 650TT	3 026	fg	2 421	def	970	g	1 976	cdefg	2 210	fg	458	ab	2 132	ab	1 883	e
Atomic HT	2 805	g	2 044	g	1 173	fg	1 823	fg	2 704	abcde	385	c	1 112	c	1 599	f
TT ave.	**3 154**		**2 335**		**1 327**		**1 926**		**2 489**		**563**		**1 880**		**1 922**	
Average	3 450		2 588		1 435		2 137		2 542		618		2 034		2 113	
kv	8,32		7,57		17,77		13,3		10,77		14,97		17,7		12,35	
kbv	477		334		431		486		461		153		614		160	

Cultivars marked with the same letter do not differ significantly.

Table 3: Rûens seed yields for 2018 (kg/ha).

	Klipdale		Napier		Riversdale		Swellendam		Tygerhoek		Southern Cape	
	19 Apr		19 Apr		24 Apr		20 Apr		16 May			
Quartz	3 284	ab	2 901	a	2 714	a	2 643	a	1 934	bcd	2 733	a
Diamond	3 197	bcd	2 472	abc	2 424	ab	2 102	bcdefg	1 944	bc	2 452	cde
Hyola 50	2 832	cde	2 512	abc	2 046	cdefg	2 544	ab	1 628	cdef	2 316	defg
CB Agamax	2 949	bcde	2 551	ab	2 096	bcdefg	2 053	cdefg	1 657	bcde	2 265	efgh
Belinda	2 954	bcde	2 575	ab	1 866	fg	1 894	defgh	1 938	bcd	2 206	fghi
CB Tango	2 810	de	2 044	c	2 111	bcdef	1 662	gh	1 781	bcd	2 102	hijk
Conv. ave.	**3 004**		**2 509**		**2 209**		**2 150**		**1 814**		**2 346**	
44Y90	3 674	a	2 642	ab	2 320	bcde	2 453	abc	2 487	a	2 688	ab
43Y92	3 108	bcd	2 946	a	2 399	abc	2 227	abcde	2 173	ab	2 557	abc
45Y91	2 975	bcde	2 356	bc	2 291	bcde	2 329	abcd	1 718	bcde	2 367	cdef
44Y89	3 204	bcd	2 445	abc	2 337	bcd	2 040	cdefg	1 574	cdef	2 359	def
Hyola 577CL	2 762	de	2 356	bc	1 770	fg	2 257	abcde	1 588	cdef	2 130	ghij
Hyola 575CL	2 793	de	2 272	bc	1 919	fg	1 858	efgh	1 427	cdef	2 066	ijk
CL ave.	**3 086**		**2 503**		**2 172**		**2 194**		**1 828**		**2 361**	
Alpha TT	3 303	ab	2 609	ab	2 426	ab	2 173	bcdef	1 855	bcd	2 497	bcd
Hyola 350TT	3 263	abc	2 482	abc	1 870	fg	1 775	fgh	1 778	bcd	2 208	fghi
Hyola 650TT	2 837	cde	2 293	bc	2 020	defg	1 938	defg	1 194	ef	2 092	hijk
Hyola 559TT	2 625	e	2 384	bc	1 963	efg	2 035	cdefg	1 108	f	2 054	ijk
Atomic HT	2 634	e	2 030	c	1 799	fg	1 993	defg	1 409	def	1 985	jk
Hyola 555TT	2 939	bcde	2 031	c	1 743	g	1 450	h	1 486	cdef	1 929	k
TT ave.	**2 933**		**2 305**		**1 970**		**1 894**		**1 472**		**2 128**	
Average	3 008		2 439		2 117		2 079		1 704		2 270	
kv	8,91		12,48		10,19		12,78		18,75		0,04	
kbv	444,9		505,1		358,1		446,5		530,5		105,4	

Cultivars marked with the same letter do not differ significantly.

During the past season, moisture conditions in the Swartland trials varied from average to very dry in the Pools area. Little *Sclerotinia* occurred in 2018. Black stem infection was evident in all the Swartland trials, showing a 51% decrease compared to the 2017 season. As with the past few seasons, white leaf spot occurred at Grasrug, although its incidence was much higher than in 2016 and 2017. Average yields in the Swartland were 2 113kg/ha compared to 1 777kg/ha and 2 746kg/ha in 2017 and 2016, respectively.

All trials, except the second planting at Langgewens (28 May), were planted between 2 and 11 May. The trials at Pools, Eendekuil and Porterville only germinated at the end of May after adequate rain was received. The trial averages for the Swartland ranged between 618kg/ha for Pools and 3 450kg/ha for Langgewens.

The conventional cultivar Diamond (2 505kg/ha) was the cultivar with the highest yield in the Swartland. Diamond's yield was significantly higher than that of the new cultivar, Quartz (2 309kg/ha), which had the second highest yield. The yields of CB Agamax (2 142kg/ha) and CB Tango (2 126kg/ha) were significantly lower than that of Diamond and Quartz.

The CL cultivar with the highest yield in its group was 44Y89 (2 360kg/ha) followed by 43Y92 (2 356kg/ha) and 44Y90 (2 326kg/ha). The yields of the three cultivars did not differ significantly. The remaining CL cultivars' yields were significantly lower than those of 44Y89, 43Y92 and 44Y90.

Hyola 350TT (2 200kg/ha) and Hyola

650TT (1 883kg/ha) were the two new TT cultivars tested this season. Hyola 350TT was also the TT cultivar with the highest average yield in the Swartland. The yield was significantly better than the second-placed Alpha TT (2 037 kg/ha). Alpha TT (AG4510 TT) had the highest yield in 2017. Alpha TT was followed by new cultivars Hyola 559TT (1 924kg/ha), Hyola 555TT (1 888kg/ha) and Hyola 650TT (1 883kg/ha).

The average yield of the TT cultivars in 2018 was 12,7% lower than that of conventional cultivars. The yield was 9,8% and 13% lower in the 2017 and 2016 seasons. The yield of the CL cultivars was on average 12kg/ha higher than the yield of the conventional cultivar group.

In Rûens (*Table 3*), the trial averages varied between 3 008kg/ha at Klipdale and 1 704kg/ha measured on Tygerhoek's second planting date. The average yield was 2 270kg/ha compared to 2 240kg/ha in 2017 and 2 885kg/ha in 2016.

The conventional cultivar Quartz (2 733kg/ha) had the highest average yield in the conventional group and in the Southern Cape as a whole. This was followed by Diamond (2 452kg/ha), which had the highest yield in 2017. Diamond's yield was significantly lower than that of Quartz. Diamond was followed by Hyola 50 and CB Agamax, although the yields were not significantly lower.

The CL cultivar with the highest yield in the Southern Cape was 44Y90 (2 688kg/ha). The cultivar 43Y92 (2 557kg/ha) was second in the CL group and the yield was not significantly lower. The cultivar 45Y91 (2 367kg/ha) was third, followed by 44Y89 (2 359kg/ha) – these cultivars did not differ significantly from 43Y92.

In the TT group, Alpha TT (2 497kg/ha) had significantly higher yields than the other TT cultivars. Alpha TT was followed by Hyola 350TT (2 208kg/ha), with Hyola 650TT (2 070kg/ha) in third place.

The average yield of the TT cultivars was 9,3% lower than the yields of the conventional cultivars. In 2017, the difference was 9% compared to 14,2% in 2016. The average yield of TT cultivars was 9,9% lower than the CL cultivars. The CL and conventional cultivars differed on average by only 15kg/ha. As in the Swartland, the CL cultivars also performed somewhat better in this instance.

Die alles-in-een-saadverskaffer

Kanola, die ideale wisselbougewas

Dit is bekend dat wisselbou met kanola vir verhoogde opbrengste by opvolggewasse soos mielies, sigorei, koring en selfs grastipe weidingsgewasse sorg. Daarby is kanola ook ‘n besonder geskikte weidings- en kuilvoergewas. Dus kan kanola as deel van ‘n wisselbouprogram baie voordelig wees.

K2 Saad bied ‘n verskeidenheid kanolakultivars met eiesoortige eienskappe. Hyola 50 (konvensioneel), Hyola 575 CL (Clearfield), Hyola 350 TT en Hyola 555 TT (Triazine) - almal geskik vir graan en weiding, is die verskeidenheid medium-kort tot medium-laat tipe kanolakultivars beskikbaar vanaf K2 Saad.

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Aspects influencing the choice of canola cultivars in 2019

By PJA Lombard, L Smorenburg and J Strauss

During the 2018 season a total of 18 cultivars were tested in the cultivar evaluation programme. The cultivars tested included six conventional, six CL (ClearfieldR, Imazamox tolerance) and six from the TT group (Triazine tolerance). All 18 cultivars were hybrids. One new conventional cultivar, Quartz, and one new TT cultivar, Hyola 350TT, were tested. The cultivar AG4510 TT underwent a name change and is now known as Alpha TT.

Physiological development

The speed of physiological development is determined by the season. In the Swartland the average number of days to flowering per trial varied from 67 to 90 days last year. This means the Swartland and the Southern Cape will differ from year to year.

It is important that cultivars maintain their position relative to other cultivars; fast cultivars must remain fast and slow cultivars must remain slow. *Table 1* contains a summary of the characteristics of all locally tested cultivars. When choosing a cultivar, it is important that producers keep certain aspects in mind.

Available seed

It is important for producers to know if their selected cultivar is available. If this is not the case, does the expected yield of the producer's second or third choice match that of the first? Is the cultivar proven (previously tested in the national cultivar trials)?

Yield potential and yields are summarised in *Table 2* and *Table 3*. The ideal is to compare more than one year's data. Evaluation of cultivar performance in the Swartland and in the Southern Cape region indicates adaptability. This can also influence management decisions.

Open pollinated cultivars are virtually unobtainable. Producers are advised not to keep back the seed of hybrid varieties. This practice leads to reduced yields and uneven ripening.

Table 1: Characteristics of the cultivars trialled from 2017 to 2018.

Cultivar	Type		Year 1st test	Days to flower Rûens	Days to flower Swartl.	Growth period. Days to flower	Days to end flowering (Lang.)	Yield (% trial ave.) Swartl.	Yield (% trial ave.) Rûens	Black stem index	Black stem index + Jockey #	Black stem resistance group #
CB Agamax	Conv	Agricol	2008	99	77	med. early	med. early	100	99	ms^{2014}	mr^{2014}	AB
Hyola 50	Conv	K2 Seed	2009	103	86	med.	late	100	100	r^{2016}	r^{2016}	AD
CB Tango	Conv	Agricol	2013	84	70	early	early	103	98	ms^{2014}	mr^{2014}	B
Belinda	Conv	Bayer	2014	100	81	med.	late	99	98	-	r^{s}	-
Diamond	Conv	Agricol	2015	86	68	early	early	114	113	mr^{2017}	-	ABF
Quartz	Conv	Agricol	2018	101	80	-	-	110^{2018}	120^{2018}	r^{2018}	-	ABD
Hyola 575CL	CL	K2 Seed	2011	101	79	med.	med.	101	94	r^{2017}	r^{2015}	BF
44Y89CL	CL	Pioneer	2014	96	77	med. early	med. early	110	106	mr^{2017}	r^{2017}	BC
Hyola 577CL	CL	Barenbrug	2014	107	85	late	late	95	94	r^{2016}	r^{2015}	B
44Y90CL	CL	Pioneer	2016	98	79	med.	med. early	113	116	r-mr^{2017}	r^{2017}	B
45Y91CL	CL	Pioneer	2016	107	88	late	med.	103	105	mr^{2017}	r^{2017}	B
43Y92	CL	Pioneer	2017	95	80	med. early	med. early	101	111	r-mr^{2017}	r^{2017}	B
CB Atomic HT	TT	Agricol	2013	99	80	med.	med.	82	89	ms^{2015}	mr^{2015}	AB
Hyola 555TT	TT	K2 Seed	2011	93	76	med. early	med. early	92	88	mr^{2014}	r^{2014}	D
Hyola 559TT	TT	Barenbrug	2014	97	80	med. early	med.	91	92	r-mr^{2017}	-	ABD
Hyola 650TT	TT	Barenbrug	2017	97	84	med.	late	91	93	r^{2017}	-	ABD
Alpha TT	TT	Agricol	2017	99	79	med. early	med.	96	106	ms-mr^{2018}	r^{2018}	BF
Hyola 350TT	TT	K2 Seed	2018	88	72	-	-	104^{2018}	97^{2018}	r^{2017}	-	ABDF

r = resistance; mr = moderate resistance; ms = moderately susceptible; s = susceptible. # Data from Australia in 'Blackleg Management Guide Fact Sheet – Western and Southern Regions' (2014 to 2017). Swartland black stem data has been used where no other data was available.

The rate of physiological development, especially the days to flowering and the flowering period, is important. Early moisture will occasionally be available in the Rûens area. For early planting (beginning of April), cultivars with a slightly longer growing season are recommended. Fast-growing cultivars can be planted too early. In areas where there are brief rainfall periods, short growing season cultivars are preferable (*Table 1*).

Resistant weeds

Cultivar selection may be determined by the presence of resistant weeds. The vigorous growth and establishment of conventional and CL cultivars helps to suppress weeds. Producers must plan properly beforehand and consider weed history before deciding on a cultivar. The type of cultivar (conventional, TT or CL) planted will determine the annual chemical herbicide programme. The possibility of group two herbicide transfer (SU) may also influence cultivar selection.

Conventional and CL cultivars are more vigorous than TT cultivars. The average yields of the first two groups were approximately 10 to 15% higher than those of the TT group.

Disease threats

Growers who plant in areas where the risk of black stem is high should plant cultivars with good black stem resistance. (*Table 1* and *Canola Focus 51*). In 2018, black stem occurrence in the Swartland was 51,2% lower in the corresponding trials than it had been in 2017. Alternate planting of cultivars with varying genetic resistance is recommended.

There were only a few cases of Sclerotinia in 2018, but the range of the disease expanded in the Swartland. Sclerotinia is common in the Rûens and there is no resistant cultivar. The sclerotia, the fungal storage bodies, may go dormant in the soil for a few seasons, emerging when conditions are favourable. The disease must be managed (see *Canola Focus 63*).

Information and cultivar traits are summarised in *Table 1*. The information includes days to flowering and flowering period, as well as yield potential, which has been recently added. The black stem index is divided into two columns. The second column

Table 2: Swartland seed yields expressed as a percentage for 2016 to 2018.

	2016	2017	2018	2016-2018		2017-2018	
Diamond	113	108	119	116	1	114	1
Belinda	101	103	96	102	5	99	5
CB Tango	103	105	101	106	2	103	2
Hyola 50	102	100	100	103	4	100	4
CB Agamax	102	98	102	103	3	100	3
Quartz			110				
Conv. ave.	**104**	**103**	**103**	**106**		**103**	
44Y90	106	114	110	112	1	113	1
45Y91	110	104	101	108	3	103	4
Hyola 577CL	90	95	95	95	5	95	6
44Y89	105	106	112	110	2	110	2
Hyola 575CL	96	100	100	101	4	101	5
43Y92		105	112			109	3
CL ave.	**101**	**104**	**105**	**105**		**105**	
Hyola 559TT	91	90	91	93	1	91	4
CB Atomic HT	90	89	76	88	3	82	5
Hyola 555TT	91	94	90	93	1	92	2
Hyola 650TT		93	89	82	4	91	3
Alpha TT		95	97			96	1
Hyola 350			104				
TT ave.	**91**	**92**	**91**	**88**		**91**	

Table 3: Rûens seed yields expressed as a percentage for 2016 to 2018.

	2016	2017	2018	2016-2018		2017-2018	
Diamond	114	116	108	115	1	113	1
Belinda	111	98	97	105	5	98	5
CB Tango	92	102	92	97	2	98	2
Hyola 50	91	98	102	98	4	100	4
CB Agamax	102	98	99	102	3	99	3
Quartz			120				
Con. ave.	**102**	**102**	**100**	**103**		**102**	
44Y90	111	112	118	116	1	116	1
45Y91	116	106	104	112	3	105	4
Hyola 577CL	96	93	93	96	5	94	6
44Y89	109	106	104	109	2	106	2
Hyola 575CL	96	95	91	96	4	94	5
43Y92		109	112			111	3
CL ave.	**106**	**104**	**104**	**106**		**104**	
Hyola 559TT	86	92	90	91	1	92	4
CB Atomic HT	89	89	87	90	2	89	5
Hyola 555TT	87	90	85	89	3	88	2
Hyola 650TT		93	92	86	4	93	3
Alpha TT		101	110			106	1
Hyola 350			97				
TT ave.	**87**	**93**	**93**	**91**		**93**	

shows the black stem index after seed treatment with Jockey® or Galmano.

Local and international data

Where international information for specific cultivars is not available, local data was used. The last column indicates genetic resistance of cultivars with the best black stem resistance. The yield per cultivar, expressed as a percentage of the area average between 2016 and 2018, is summarised in *Table 2* and *Table 3*. In 2018, 14 of the 16 cultivars trialled had been tested for two or more seasons.

In the Swartland, the conventional cultivar Diamond (114%) and CL cultivar 44Y90 (113%) had the highest average percentage yield over the previous two seasons. The TT cultivar with the highest percentage yield for 2017 and 2018 in the Swartland was Alpha TT (96%), followed by Hyola 555, Hyola 559 and Hyola 650. The cultivars that performed best over three seasons in their respective groups were Diamond (conventional), 44Y90 (CL) and 44Y89.

In the Rûens, the CL cultivar 44Y90 (113%), followed by the conventional cultivar Diamond (110,9%), had the highest average percentage yield over the previous two seasons. The TT cultivar with the highest percentage yield for 2017 and 2018 in the Rûens was Alpha TT (106%), followed by Hyola 650TT (93%) and Hyola 559TT (92%). The cultivars with the best performance over three seasons in their respective groups were Diamond (conventional), 44Y90 (CL) and Hyola 559 (TT).

This article was published courtesy of *Canola Focus*, December 2018 no 85.

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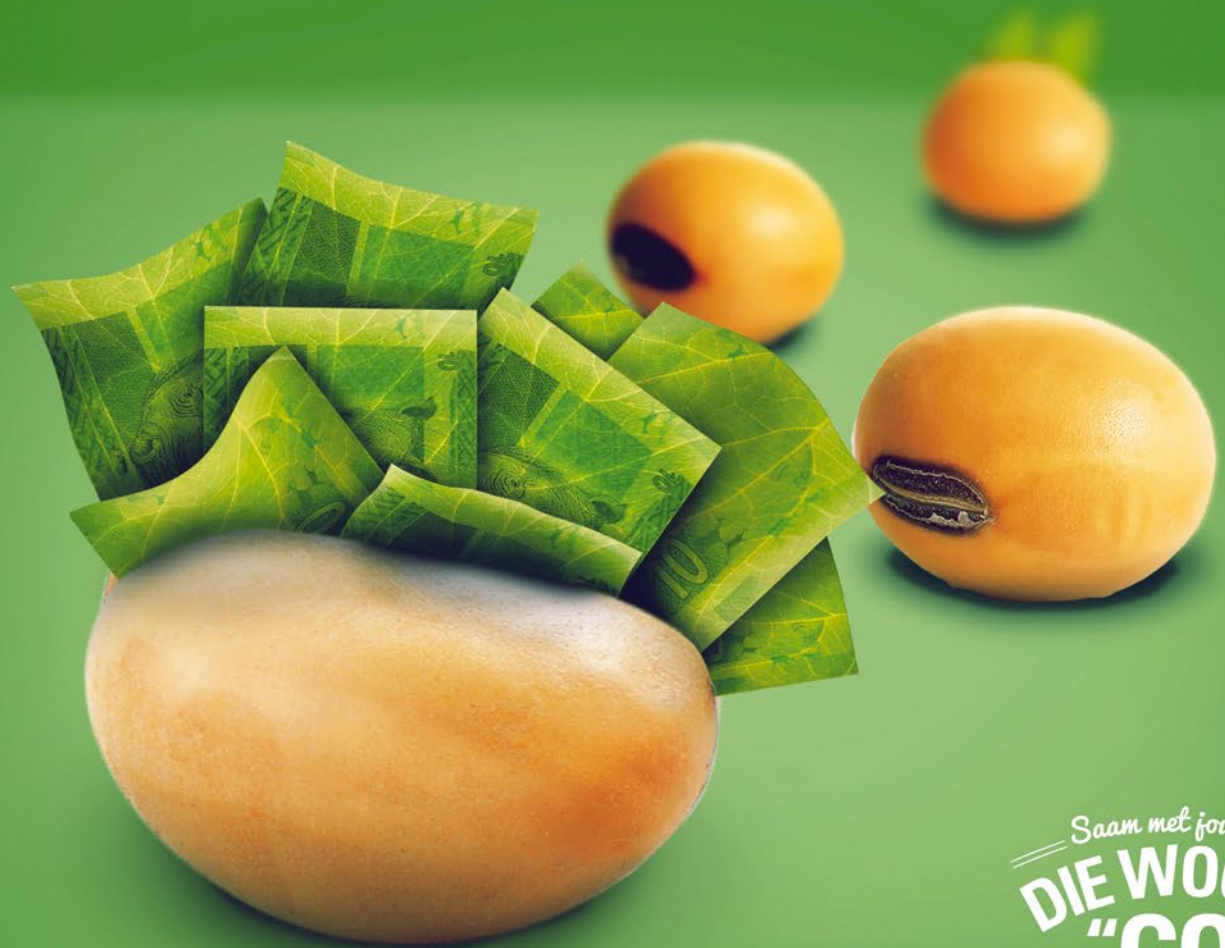

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Global seed companies address **climate change and nutritional needs**

Press release by the Access to Seeds Foundation

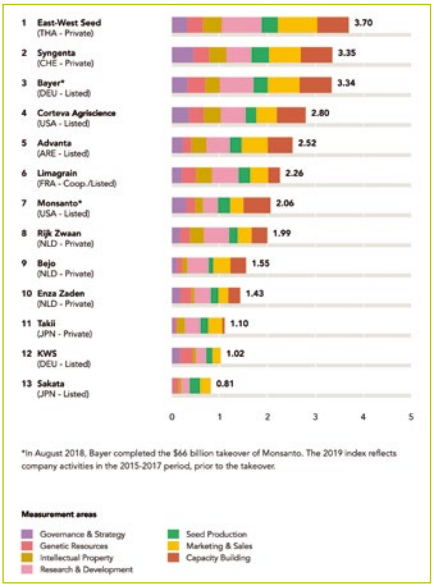
Global seed companies are adapting their products to combat the impact of climate change and address nutritional needs. But, according to a new study, limited access to quality seed in many emerging economies persists, with the global seed industry reaching only 10% of the world's smallholder farmers.

The Access to Seeds Index 2019 – Global Seed Companies, published by the Amsterdam-based Access to Seeds Foundation, evaluates 13 leading global seed companies to focus on areas where the industry can do more to uplift smallholder farmer productivity, improve nutrition and mitigate the effects of climate change, through the development and dissemination of quality seed.

A strong market

Research shows that sales of these 13 global seed companies reached only around 47 million of the world's 500 million smallholder farmers in 2017 (*Figure 1*). Investment went mainly to a few countries, mostly in South and Southeast Asia. In these regions, global companies invest heavily in local seed business activities – twelve of them in breeding and twelve in production. In contrast, such activities are rare in Western and Central Africa, with only two companies investing in local breeding and one in production.

Figure 1: Access to Seeds Index 2019 – Global Seed Companies.



"Although the industry is making advances in developing more nutritious and climate-resilient varieties, it is clear that more needs to be done," says Ido Verhagen, executive director of the Access to Seeds Index. "Material changes won't be possible without reaching a greater percentage of smallholder farmers, who account for the lion's share (80%) of global food production."

Shaping business models around smallholder farmers' needs can be profitable, as shown by East-West Seed, a Thailand-based company that tops the index thanks to strong performance across all the assessed areas. It has a unique smallholder-centric approach and a customer base made up almost entirely of smallholders (98%). Switzerland's Syngenta and Germany's Bayer, in second and third place respectively, are virtually tied.

Improved seed, reduced hunger

Reaching more smallholder farmers and directing investment to other geographies are critical in tackling rising malnourishment. The number of people suffering from hunger rose from 784 million in 2014 to nearly 821 million in 2017, partly due to lack of access to nutritious food. However, only six of the 13 global seed companies state that nutritional value is a breeding programme priority. Although this is higher than the four companies identified in 2016, progress is slow.

The importance of developing improved varieties of seed, offering better nutritional value and supporting crop diversity is echoed in a recent report by the EAT-Lancet Commission. The global seed industry can do more to address diversification needs by supplying more crops and varieties, including legumes and local crops, which are currently neglected.

The index also reveals a sharpened focus on climate change. Of the 13 companies evaluated, twelve emphasise that targeting increased yields and improving tolerance to changing climate and the accompanying weather risks are essential when breeding. This has been reflected in increased breeding for climate-resilient field crops and vegetable varieties, since 2016.

By broadening their offering, including the provision of farmer training and other services such as weather-based crop insurance, seed companies have found new ways to help farmers adapt to changing climatic conditions. There are now eight companies integrating sustainability strategies at corporate level, compared to three in 2016.

Sustainable development goals

The Access to Seeds Index 2019 – Global Seed Companies is one of the first benchmarks of the sustainable development goals (SDGs) published by the World Benchmarking Alliance, which was launched in September 2018 during the UN General Assembly in New York. The Access to Seeds Index was established with support from the Bill & Melinda Gates Foundation and the Dutch government. The global index is complemented by regional indices that provide in-depth analyses of South and Southeast Asia, Eastern and Southern Africa, and Western and Central Africa.

"The private sector is essential for achieving food and nutrition security, one of the major challenges outlined by the SDGs. With the world's population rising – and hunger with it – amid growing concerns around the environmental impact of crop production, the role of the global seed industry remains crucial if zero hunger (SDG 2) is to be achieved by 2030," says Verhagen.

For more information, visit *www.accesstoseeds.org.*

Gene editing and the future of sunflower production

By Don Lilleboe

A discussion on gene editing – what it is and what it may mean for sunflower production – was presented at last year's National Sunflower Association's (NSA) Summer Seminar by Brent Hulke and Dylan Moxley.

Hulke is a sunflower research geneticist with the USDA Agricultural Research Service in Fargo, North Dakota. Moxley is a graduate student in the Rieseberg Lab, in the Department of Botany at the University of British Columbia.

Changing the DNA sequence

Gene editing has gathered much attention in recent years among scientists working in human and plant biotechnology research. Gene editing refers to the utilisation of biotech techniques to orchestrate changes to specific DNA sequences within the genomes of living organisms, so it is indeed a method of genome engineering.

However, unlike genetically modified organisms (GMOs), in which a gene is inserted into one species from a different species (transgenic), the gene editing concept in plants focuses on engineering the plant so that it expresses its own genes in a way that is different to the standard expression. In that sense, gene edited plants could offer a less controversial route to breeding progress than the GMO pathway. Both methods, though, should be considered a process towards a destination rather than the destination itself.

Developing technology

The Rieseberg Lab is well known and highly regarded for its work with high-throughput genomic methods, bioinformatics, ecological experiments and evolutionary theory, studying the origin and evolution of species, domesticated plants and weeds. The sunflower genus (*Helianthus*) is a primary focus at the lab.

Moxley explained to the NSA audience that 'genome engineering' in the broad sense is used to better understand the function of a specific gene, to introduce desirable traits and/or to remove or modify a trait. Its advantages include the ability to rapidly generate desired lines, saving time and resources.

Genome editing systems to date, Moxley noted, have included recombinant DNA technologies such as gene guns and agrobacterium transgenics. While these technologies have the benefit of being very versatile in terms of moving genes from one organism to another, they have been controversial among the general public.

The possibilities of CRISPR

Moxley observed that true gene editing refers to lesser-known systems (e.g. zinc finger and TALENs) and the now more recognisable CRISPR. CRISPRs are specialised stretches of RNA that guide the process to the target DNA sequence. The protein Cas9 (CRISPR-associated) is an enzyme that acts like a pair of molecular scissors, capable of cutting strands of DNA.

CRISPR technology has emanated from the natural defence mechanisms of bacteria (agrobacterium-mediated transformation). While it holds exciting possibilities for editing genomes of sunflowers and other plants, it comes with some big challenges. With sunflower specifically, the challenges include low transformation efficiencies (< 1%) and the lack of a stable transformation pipeline.

USDA's Hulke told Summer Seminar attendees that using pollen as a foreign DNA carrier currently offers the most promise when it comes to editing the sunflower genome via CRISPR technology. It's inexpensive and routine (once the method has been optimised), he noted.

Not surprisingly, though, there are significant research obstacles, too. The regulatory environment should be less of an obstacle than that of GMOs, Hulke added, since gene editing does not include the insertion of foreign DNA into the genome. However, bringing it to commercialisation is complicated by legal issues involving intellectual property rights.

If, and when, CRISPR technology becomes a reality in sunflower production, Hulke envisions several targets for application. *Sclerotinia* and *Phomopsis* resistance genes would certainly be on that list, as well as genes affecting seed size and oil composition. Other areas of research would be downy mildew, and rust and herbicide resistance.

For now, though, the utilisation of CRISPR technology in sunflower breeding "is still in the hypothetical phase," Hulke said. Biologists are in the process of mastering its fundamentals in 'amenable' species; and sunflower is not currently amenable due to transformation issues. Plus, there are regulatory issues (not so much in the US, but rather abroad*), as well as continuing legal debates regarding intellectual property rights.

So, while the potential for gene editing may be promising, making it a reality would come with a lot of, as yet, unresolved scientific and commercial complications.

*In July 2018, the Court of Justice of the European Union issued a judgement that organisms created through many newer genome editing techniques are to be regulated as genetically modified organisms (GMOs) in the EU. "This decision subjects such organisms, and food and feed products containing these organisms, to expensive and lengthy approval processes as well as traceability, labelling and monitoring obligations," noted a USDA Foreign Agricultural Service report on this development.

This article was first published in *The Sunflower,* August/September 2018.

Breeding and technology levies: **The role of SACTA**

By Gert Heyns, CEO of SACTA

An approved breeding and technology levy on wheat and barley has been introduced over the past two seasons. Last year the levy, which applies to wheat, barley and oats, was approved for a further two years. A statutory levy, which came into effect on 1 March, has also been approved for soya bean breeding and technology.

There are some important agricultural crops that are self-pollinating. In the case of self-pollinating crops, producers can hold back grain from those crops with a view to replanting. While this practice is legal, it also means that large volumes of grain are being held back for this purpose, resulting in low seed sales.

Seed companies are therefore reluctant to make large investments in new products and technology, unless systems can be put in place that provide for fair compensation for their genetic rights.

The role of SACTA

Producers are willing to pay a grain supply levy if it paves the way for the development of new cultivars and technology. However, there must be some guarantee that the fund will be properly administrated and controlled. Such an administrative body would also have to ensure that available funds are used specifically for new breeds and technology.

The South African Cultivar and Technology Agency (SACTA) is a non-profit company established to manage the fund. SACTA is governed by the *Companies Act, 2008* (Act 71 of 2008). The SACTA board of directors is made up as follows:

- Two directors on behalf of Grain SA.
- Two directors on behalf of the South African National Seed Organization (SANSOR).
- Two directors on behalf of the Minister of Agriculture.
- One director on behalf of Agbiz Grain (grain silo industry).
- One director on behalf of the soya bean processing industry.

The benefits of SACTA

Compared to several existing industry structures, an organisation such as SACTA promises many benefits. The following are among the key benefits:

- It is not crop-specific and can facilitate the administrative function for all self-pollinating crops.
- It is a low-cost administrative company (administrative functions are provided by L&L Agricultural Services, a well-known agricultural administration company).
- It represents new cultivars and technology at various operational levels.
- With the acquisition of statutory levies, there are certain obligations that have to be met. One such obligation is that 20% of the collected amount must be spent on transformation. SACTA needs to comply with this by means of developing and implementing transformation plans in line with the guidelines of the National Agricultural Marketing Council.

Levy funds

Each seed company that contributes to the prosperity of the specific crop and products (cultivars and biotechnology) is entitled to fair compensation. It is SACTA's task to determine each role-player's market share and to pay out the available funds accordingly.

Producers can be of great help in determining each company's market share. One of the key factors determining market share is the portion each company derives from the delivered grain crop. Producers are therefore requested to declare, as accurately as possible, which cultivar and seed company was used. This information must be supplied to the grain handler upon grain delivery.

SACTA will then process this information, along with other information such as seed sales, market research and grain analyses, into a formula that will determine market share.

An urgent appeal is being made to producers to assist in this regard.

Administrative obligations

It is important to note that the levy on a ton of grain to which a statutory levy applies is only charged once. The following is therefore important for buyers, processors and handlers of such grain:

- The levy amount can be recovered from the grain producer.
- The levy should be charged at the first point of trading.
- The levy must be charged at the first point of processing, if it has not already been charged at trading.
- The levy must be charged when a silo certificate is issued, if the levy has not yet been charged by a buyer or processor.
- If grain is purchased from any party other than the producer, it must be verified whether the charge has already been levied.

If there is any uncertainty regarding the deduction of a levy, grain buyers can contact Awie Coetzee on 082 818 9620 or awie@llagric.co.za, or Sakkie Kloppers on 076 221 3554 or sakkie@llagric.co.za.

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SENSAKO presents
competitive winners to the market

By Willem Otto, Sensako

As a proudly South African company, Sensako aims to develop seed products for the local market in a bid to help keep producers profitable in a competitive market environment.

The well-known brand recently released five adapted SSS soya bean cultivars and has Syngenta's Clearfield sunflower hybrid SY 3970CL available.

Soya bean cultivars released by Sensako for production in South Africa originate from the breeding programme of Argentina's Estación Experimental Agroindustrial Obispo Colombres (EEAOC) – the country's oldest agricultural research station. It was established in 1909 with the aim of improving and supporting agricultural production in the Tucumán province through research and extension services. To acknowledge the important part this international connection plays in local production, the soya bean cultivar name has 'tuc' as a suffix.

The cultivars and advanced breeding lines developed by EEAOC are tested in statistical trials in the local soya bean production areas. The Sensako trial programme is visited annually by the EEAOC research team to evaluate statistical trials and seed production. Insights around the newest production practices for soya beans are also discussed with the team.

The soya bean cultivars (indeterminate growers with Roundup Ready resistance) released from the programme have excellent agronomic characteristics, different maturity groupings and wide adaptation. Independent results from commercial strip trials, in conjunction with several study groups and farmers' associations, have confirmed the exceptional yield performance, adaptation, stability and stress tolerance of these winning cultivars.

Three best performers

- **SSS 6560tuc:** A long grower and bushlike cultivar with exceptional yield potential adapted for the warmer irrigation, moderate and cooler areas as well as dryland production. Well suited for wider row widths.
- **SSS 5052tuc:** Stable and adapted high-yield potential cultivar for dryland and irrigation. A bushlike but more upright cultivar with good lodging resistance and resistance to shattering.
- **SSS 5449tuc:** Eastern Highveld winner, adapted for high-yield potential in the cooler dryland and irrigation areas. This cultivar is semi-bushy with excellent pod height and lodging resistance, as well as good resistance to shattering. Well suited for narrow row spacings.

Insight into production management

Cultivar and growth class must be selected for maximum utilisation of the two main yield-determining aspects: leaf area (length of vegetative growth phase) and grain-filling period. The planting date is, of course, an inextricable part of the process as the daylight length pattern for the remainder of the season is directly linked to it.

Soil water determines planting

As rainfall distribution varies across areas, the optimal soil water conditions for successful planting also vary. Especially under dryland production conditions, planting time is determined by soil water conditions, which are, in turn, affected by rainfall and cultivation activity. Changes in the planting date necessitate an adjustment in the choice of growth class of a cultivar that will be least affected by that planting date. If planting is postponed to a later date, the row width and plant population should also be adjusted.

When considering the available planting window, flexibility in cultivar choice is a key management option. Choose the most suitable growth class and cultivar and adjust the row width and plant population to achieve the best yield reaction. The planting window for growth classes includes the risks related to emergence and seedling establishment, length of vegetative growth period, temperatures during flowering period, and the risks early frost can have on grain filling and physiological maturity. These factors directly impact final grain yields.

Competitive sunflower hybrid

Sensako also offers a competitive yield in sunflower plantings with the Clearfield sunflower hybrid SY 3970CL, developed by Syngenta. The tested effect of a focused product – yield plus better weed control – is a winning combination. The cultivar has excellent agronomic characteristics, stable yields in various production areas, and resistance against prevailing diseases.

Performance seed with proven genetics delivering increased profitability by Sensako.

For more information, visit *www.sensako.co.za* or phone 058 303 4690 (Bethlehem).

Stressed crop plants **provoke herbicide injury**

By Dr Charlie Reinhardt (Photos by Dr Charlie Reinhardt)

Stress in plants can be defined as any external factor that negatively influences plant growth, productivity, reproductive capacity or survival (D Rhodes and A Nadolska-Orczyk, 2001).

Herbicide injury on crops represents an abiotic (non-biological) stress factor that is of synthetic chemical nature. Other abiotic stresses include natural factors such as wind, hail, wounding and physical impedance of roots in compacted soils.

The abiotic stresses that crop plants most commonly suffer are extremes in water supply (drought or flooding), temperature (low or high), irradiance (low or high sunlight), nutrition (deficiency or excess) and soil pH (acidic or alkaline). Biotic or biological stresses include plant pathogens (bacteria, fungi, viruses) and herbivores such as insects and animals.

This article focuses on the interactions between herbicides and other abiotic stress factors, specifically those that can cause a herbicide that is supposed to be safe for use in a crop (i.e. registered for use in that crop) to unexpectedly injure the crop.

Disruptive abilities

Herbicides have the inherent ability to disrupt the metabolism of all plants (crops and weeds) at a physiological level, which can lead to plant injuries manifesting in various forms as symptoms of injury or damage. Ultimately plants can die – in fact, the latter consequence of plant response to a herbicide is the fundamental expectation underpinning chemical (herbicide) weed control.

The ability to select between weeds and crops makes herbicides unique among pesticides (xenobiotics) – the onus on the pesticide not to directly harm the crop, or other desirable vegetation, is nowhere greater than in the case of herbicides.

Stress factors and crop yield loss

Metabolic impairments or injuries caused by herbicides range from inhibition of photosynthesis and protein synthesis, and damage to cell membranes as well as membranes of organelles (e.g. chloroplasts) in cells. Herbicide injury typically progresses in a sequential way as one after the other life process are impaired, and secondary effects of non-herbicidal nature can follow on the primary herbicide effects. Plants weakened by herbicide injury (primary stress) can be predisposed to pathogen attack (secondary stress), and *vice versa*.

In recent growing seasons, field observation of heat/drought and sandblast damage on sunflower and soya bean seedlings coincided with apparent reduced ability to tolerate or resist herbicides that are normally perfectly safe towards the crop.

Understandably, such doubly stressed crop plants are likely to be susceptible to a third stress factor such as pathogens, which gain access through physical lesions (wind and drought/heat damage), and due to a physiologically weakened (herbicide damage) crop plant whose natural defence mechanisms are impaired.

Ultimately it does not matter which factor had the primary effect and which the secondary effect, because crop growth and development are negatively affected by the interaction of stress factors, and serious yield loss is a real risk.

Herbicide and environmental factors

Another example of herbicide interaction with environmental factors that can provoke herbicide injury of the crop, is when the soil-applied herbicides metolachlor and acetochlor are used in maize under a specific set of soil/climate factors. These two herbicides can safely be used in maize for grass and nutsedge control only if a so-called 'safening' chemical is included in the herbicide formulation.

The 'safener' works by boosting an enzyme system in the maize plant, glutathione-s-transferase, which

A sunflower seedling showing symptoms most likely caused by a combination of heat and herbicide injury.

deactivates the herbicide and thus ensures crop safety. Grass and nutsedge weeds possess a less efficient enzyme system and, hence, are controlled.

Under wet, cold conditions, which are common early in the summer rainfall regions, the herbicide is taken up by plants (crop and weed) due to adequate soil moisture and relatively warm days, but during the colder nights the activity of the enzyme system doing herbicide inactivation is reduced and the result can be crop injury.

Moreover, a cool/cold soil slows the maize seedlings' emergence rate and hence allows for uptake of more herbicide than would be the case in warmer soil where coleoptile development would be boosted, and therefore, result in reduced exposure of the crop to the herbicide. This higher than usual uptake of metolachlor or acetochlor can be sufficient to overwhelm the enzyme system doing herbicide inactivation, with dire consequences for the crop.

The coleoptile part of grass seedlings, maize included, is where preferential uptake of herbicides such as metolachlor and acetochlor occur; roots absorb significantly less of these herbicides than the coleoptile.

Herbicide-resistant crops

Selectivity of herbicides (i.e. the ability to be safe towards the crop and injurious towards weeds) relies on the superior ability of the crop to detoxify (deactivate) the herbicide faster than the weed it is expected to kill. Exceptions are herbicide-resistant (HR) crops that have been engineered to resist the harmful effects of specific non-selective herbicides.

The dominating genetic modification (GM) technology, since the turn of this century, remains Roundup Ready™ transgenic maize, soya bean and cotton that have been made tolerant, and fundamentally resistant, to the non-selective herbicide glyphosate. Examples of other technologies available on the South African seed market, which followed different development routes than Roundup Ready™ technology to produce HR crops, are atrazine-resistant canola and imidazolinone-resistant maize and sunflower.

A sunflower seedling with a heat scorch lesion at the soil surface, which is a possible entry point for pathogens. Affected plants can be more susceptible to herbicide injury.

Herbicides that inhibit photosynthesis

Chilling stress, heat shock and water stress are disruptors of electron transport in the photosynthesis process that occurs in all green plants. The energy contained in electrons is built into carbohydrates that are end-products of photosynthesis, and that constitute the basis of all life on earth.

Disruption of electron flow in the photosynthetic pathway results in these 'freed-up' electrons combining with free oxygen (O_2), which is also formed in chloroplasts of plant cells, to produce toxic active oxygen species, including superoxide, hydrogen peroxide (H_2O_2), singlet oxygen and hydroxyl radical.

These reactive byproducts of disrupted electron flow are strong oxidising agents that attack proteins and lipids, first in the chloroplasts where photosynthesis occurs, with the result that chloroplast membranes and chlorophyll (green pigment of plants) are destroyed – symptoms of this type of plant injury is chlorosis (yellowing) of green plant parts.

These destructive effects of the reactive oxygen species are rapidly followed by destruction of cell membranes, with the result that cell function ceases and cell content is lost – a symptom of this type of plant injury is necrosis (browning and death) of affected plant parts.

Herbicides that inhibit photosynthesis, i.e. triazines (e.g. atrazine, terbuthylazine), bipyridyliums (e.g. paraquat, diquat), bromoxynil and bendioxide all cause disruption of electron flow in the photosynthesis process, exactly in the same way as chilling stress, heat shock and water stress. The reactive oxygen species is what really causes the death of plants that are susceptible to these herbicides, and injury symptoms are chlorosis of green plant parts, followed by necrosis.

Obviously, this correspondence in effects of herbicides and climatic stresses can cloud the diagnosis of causes of plant injury. This fact demands the involvement of 'people skilled in the art' when cases of crop injury are investigated. Because the causative factors in such cases are likely to be multi-factorial in nature, the investigative team ideally should be multi-disciplinary in terms of the skills contributed by team members.

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

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Using fungicides to control Alternaria leaf blight in sunflower

Sunflower (*Helianthus annuus L.*) is an important oilseed crop in South Africa that can be economically produced in low-input farming operations and under marginal cropping conditions. Sunflower is a crop that can achieve reasonable yields under drought conditions and, as it tolerates a wide planting window, is an attractive option for dryland producers, especially in more arid regions.

There are many diseases that can cause problems for sunflower producers. Some of these diseases are prevalent in every season and will affect plantings to a greater or lesser extent, depending on temperature, humidity and rainfall.

Sunflower disease threats

Alternaria leaf blight is a major fungal disease threat to sunflower production in South Africa. It presents as circular, dark brown to black lesions with concentric rings on leaves (*Photo 1*), stems and heads. Each lesion has a chlorotic circuit that grows increasingly larger until the lesions coalesce, causing extensive necrosed areas.

Alternaria symptoms can be confused with Septoria leaf blight and bacterial leaf spot, neither of which are generally economically damaging. In contrast, Alternaria leaf blight significantly reduces the head diameter and number of seeds produced per head. It can cause plants to defoliate prematurely, which affects seed set and seed fill, leading to seed and oil yield losses of up to 80% and 33%, respectively (Kgatle *et al*., 2017).

Alternaria leaf blight on sunflower leaf and stem.

On the left is sunflower treated with preventative control AMISTAR®. On the right is untreated sunflower with no fungicide applications. (Photos by Jo-Ann Warren.)

Alternaria species generally overwinter on diseased stalks in sunflower fields, but can also be seedborne, causing germination losses and infecting seedlings. The disease usually starts when plants are flowering and reaches maximum intensity during senescence, or plant aging. It can also proliferate when the sunflower plant is subjected to any form of stress.

The Alternaria fungus develops optimally at temperatures of between 25°C and 30°C with high levels of humidity. Extended periods of wet weather or heavy dew are needed to start the infection. The pathogen can re-infect plants until harvesting, whenever environmental conditions are favourable for disease development.

Disease control

Cultivation practices such as crop rotation, destruction of crop debris, and deep tillage can be used to control Alternaria. The planting of more resistant or tolerant cultivars can also help to manage the disease. However, chemical control, either as a seed treatment or in a spray programme, remains the most effective way to combat the disease. The use of fungicides to manage Alternaria leaf blight in sunflower has become inevitable and is worth the investment.

Given the cost of high-quality products, fuel, labour and the environmental impact, it is vital that growers get as much benefit from a fungicide application as possible. Applied correctly and under the right conditions, the cost of fungicides is worthwhile, especially when seen in the context of the benefits of effective crop protection and increased yields.

Time applications correctly

Syngenta's AMISTAR® is a registered fungicide that provides preventative control of Alternaria leaf blight on sunflower (*Photo 2*). With AMISTAR®, as with all fungicides, timing is the most important application consideration. If the fungicide application misses the window during which the plant can be protected against disease, yield will be lost.

The first application in a sunflower field can be done at the R1 stage, 46 days after planting when the bud forms. Depending on disease pressure, a follow-up application will be needed approximately 45 days before harvest, at the R6 stage when flowering is complete.

To make the right decision about appropriate disease management strategies, it is important to recognise the environmental conditions conducive to disease development, to know when the crop is most susceptible, and to identify disease symptoms correctly. Add to this appropriately timed applications of the correct fungicide, and the grower's sunflower yield is virtually guaranteed.

For more information or a list of references, contact Adri Anthonissen on 083 445 0481 or adriana.anthonissen@syngenta.com, or Hanlie Geldenhuys on 082 609 1520 or hanlie.geldenhuys@syngenta.com.

South Africa's trade balance:
The potential for food and feed extrusion

By Prof LJ Grobler and Dr Christo Joubert

An opportunity ideally suited to Africa may emerge through the agro-processing technique of extrusion, to help alleviate increasing poverty and support food security.

South Africa is a net importer of products such as wheat and rice, although the country's trade balance for primary agricultural products is still positive. However, it has a negative trade balance for several processed products such as soya bean oilcake, soya bean oil, palm oil, processed cereal products, and others. If some of these products could be manufactured in South Africa, it would substitute imports, meaning better economic growth and lower unemployment.

Several of these processed products can be manufactured with a technique called extrusion, which is a technology with huge potential, especially since the demand for extruded ready-to-eat products is growing in Africa, and therefore also the potential for exports of the equipment and manufactured products.

Agro-processing technique

Extrusion is a continuous agro-processing technique used to produce pre-cooked or ready-to-eat products made from mainly agricultural grains and pulses. The process adds value to cereal, oilseeds and legumes.

The technology forms the heart of the integrated value chain, from the production of agricultural products by farmers through agro-processing with extrusion to finished beneficiated pre-cooked or ready-to-eat products for the consumer market. The technology therefore creates jobs, in contrast to most other technologies that replace jobs.

The process entails the flow of ingredients under pressure, with food or feed ingredients the final product. This is done with a combination of moisture, pressure, temperature and mechanical shearing. Extrusion changes the characteristics of the underlying products through texture alteration, thermal treatment, partial dehydration, homogenisation, protein denaturing, gelatinisation, grinding, hydration, expansion, shearing, mixing, destruction of micro-organisation, destruction of some toxic compounds and shaping.

A typical extrusion plant.

Built in Africa for Africa

The North West University in Potchefstroom started an extrusion development research project in 1998. The aim of the project was to develop and manufacture local twin-screw extruders for the food, feed, plastics and polymer processing industries.

The extruders were developed and commercialised successfully, which resulted in the establishment of CFAM Technologies (Pty) Ltd, a North West University spin-off company, in 2007. Today CFAM's extruders and other processing technologies have earned a reputation as 'built in Africa for Africa'.

Development and marketing

There are opportunities in the market for the development and marketing of extruded food products. The potential of using extrusion to add value to agricultural raw materials is largely untapped in Africa, but the demand for ready-to-eat, stable and nutritious food exists and is growing. This is mainly due to the short preparation time, ease of consumption, new tastes and nutritious content of these types of food.

This demand can be met by producing extruded food – using extrusion processing technology to add value to local raw ingredients while providing for the growth of food security in South Africa.

Useful in several areas

- The flexibility and wide range of applications of extrusion in food

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production make extrusion technology ideal for producers who want to add value to raw materials or otherwise wasted materials.
- Extrusion technology that is used as a 'ready-to-eat' cooking process is particularly suitable for Africa, as it is relatively inexpensive, energy-efficient and produces long-lasting food.
- It is also environmentally friendly as it produces minimal waste products.
- Extrusion technology can be applied in different environments and can process a variety of unique products using one machine. Generally underutilised ingredients can therefore be used before they go to waste.

The size and layout of extrusion plants depends on the required production rates and type of products to be produced. The capacities can vary from 100kg to ten tons per hour.

A unique opportunity

The need exists for the medium-scale manufacturing and distribution of affordable, protein-enriched, long-lasting maize, soya, legume, pulse and grain food products for local and regional markets, using locally designed and manufactured twin-screw extrusion equipment.

Faced with increasing poverty and the need for food security in South Africa and Southern Africa, affordable, highly nutritious and long-lasting food sources serve to tackle this challenge.

Extruded wholegrain white maize.

The National Development Plan recognises food security as a high priority. This strategy was implemented through financial backing given to the North West University to develop food extrusion technologies.

The developed twin-screw extrusion technology enables the following:
- Processing of protein-enriched maize and/or soya snacks.
- Fully balanced porridges made with maize, soya, grains, legumes and pulses.
- Wheat-free breakfast cereals.
- Lower-cost equipment.
- Smaller and more compact plants.
- Flexible product mix, while still economical.
- South African developed and supported equipment and recipes.

An established integrated extrusion value chain will provide the following social, health, environmental and economic benefits:
- High and balanced protein content product for everyone, including the poor.
- The potential to create job opportunities in the formal and informal sectors and BEE businesses.
- Low effluent and waste, and non-hazardous waste.
- The use of semi-skilled operators and labourers.
- Ease of operation with fail-safe procedures for less qualified operators.
- Low-cost, yet high-precision equipment and engineering.
- Quick changeover time between various products.
- Easy to clean.
- Low maintenance requirements and fast repair times when necessary.
- Low operating costs.
- Small space requirements.

Twin-screw food extruders

The processing of maize, soya, grains, legumes and pulses into pre-cooked or ready-to-eat finished products is mostly done on imported single-screw and twin-screw extruders. However, protein ingredients are viscous and extremely difficult to process in single-screw machines.

CFAM Technologies (Pty) Ltd has developed and built a series of twin-screw extruders, which can easily process these hard-to-handle ingredients. This makes the processing of protein-enriched, pre-cooked or ready-to-eat maize, soya, legume, pulse and grain food products possible, while still affordable.

The locally developed extruders and plants enable smaller-scale manufacturing, which enables profitability on a regional scale by using existing distribution channels or even new BBBEE channels.

Value proposition

Extrusion processing of cereals is a well-known application; most breakfast cereals are products of extrusion. Several varieties are possible, namely:
- Variation of shapes.
- Variety of colours in the mix.
- Processing of various grains and legumes such as maize, sorghum or millet (*mahangu*), etc.
- Processing of oats and soya beans.
- Producing snacks.
- Recreating traditional meals such as porridge, a staple of the South African diet, or other traditional meals such as *oshifima* (porridge made from *mahangu*).

Extended shelf life

The demand for nutritious food with shelf stability that requires no specialised storage is well established in Africa. Two main extruded product types are doing well in the current consumer market: snacks and instant porridge products. The latter is made from various staple ingredients such as maize, oats, soya and wheat.

Considering the popularity of soya and maize, the following extruded products were identified as some of the potential products for production in various regions of South Africa:
- Maize snacks.
- Soya-maize snacks (protein enriched).
- Maize porridge.
- Soya-maize porridge (protein enriched).

Other products

There is a long list of other products that can be manufactured from extrusion, including infant food, pasta, croutons, couscous, pre-cooked reformed rice, viscosity control flour, textured protein (meat analogues/meat alternatives and meat extenders), and fish and pet food.

For more information, contact Prof LJ Grobler on 082 452 9279.

Preventing Salmonella contamination **in oilseeds-based animal feed**

By Maja Sakkers, Kemin Industries

Oilseeds byproducts are invaluable sources of protein and energy in livestock rations. They contain critical nutrients, such as essential amino acids, and enable the formulation and production of high-density rations designed to meet animal production requirements.

Salmonella contamination is a problem that may be encountered in the utilisation of oilseeds byproducts in animal feed. Contaminated feed can transfer the *Salmonella* bacteria to livestock and then on to the end consumer.

There is no silver bullet solution to the problem of *Salmonella* contamination, as each site is unique and the variables may differ. Mitigation strategies to reduce the risks of contamination should be based on a number of step-wise processes and approaches. Adapting systematic procedures and control measures within a general framework offers the best possible route to a successful outcome.

Types of *Salmonella* contamination

There are many types of contamination that may be broadly categorised as follows:

- Microbial contamination via bacteria (e.g. *Salmonella*, *Listeria*, *E. coli*) and fungi (moulds and yeasts).
- Chemical contamination via dioxins, PCBs, mycotoxins, pesticides, PAH4/BaP.
- Foreign matter contamination via glass, wood, metal, soil, insects and mineral oil.

Sources of contamination

Salmonella is spread by vectors either living (e.g. humans, birds, rodents, reptiles, and insects) or non-living (water, soil, air, surfaces, and vehicles).

Salmonella risk in oilseeds byproducts

Oilseeds byproducts are among the highest risk raw materials for *Salmonella* contamination worldwide. Contamination can occur at any stage during the production process, from growing the crop to harvesting, processing, transport or storage. The European Commission assigns most oilseeds byproducts a level four risk classification (the highest risk level) for *Salmonella*.

South African statistics by the Animal Feed Manufacturers' Association (AFMA) indicate approximately 6 to 7% *Salmonella* contamination in local soya bean meal and 3 to 4% contamination in sunflower meal, with lower contamination levels in local cotton and canola meals.

Salmonella habitat

Salmonella is a genus of gram-negative bacteria that falls into the family *Enterobacteriaceae* (the same as *E. coli*). They prefer anaerobic (absence of oxygen) conditions but can survive in aerobic (oxygenated) environments. *Salmonella* bacteria are highly motile, using flagella around the cell body to move quickly and easily in a fluid environment inside a host.

The bacteria may be carried by a range of vectors, living and non-living, and have an extremely high survival rate and resistance level. There are serovars that can remain dormant at a site for more than two years before becoming detectably active. *Salmonella* is well distributed in the environment.

These bacteria are susceptible to heat, and contamination of oilseeds byproducts is primarily via recontamination after processing/production as the heat generated during extraction/extrusion is sufficient to ensure bacterial kill-off.

Salmonella bacteria may be split into two groups: *Salmonella enterica* that affect warm-blooded species such as humans, livestock and animals; and *Salmonella bongori* that affect cold-blooded species such as reptiles.

Salmonella enterica is the group of most concern in the food and feed industry, as zoonotic serovars in this group are pathogenic to humans and livestock.

Biofilm formation

Most bacteria, including *Salmonella*, can survive outside their hosts for extended periods of time in difficult environmental conditions. This is done through a mechanism known as biofilm production. When conditions are stressful (e.g. during times of low moisture or low temperatures) *Salmonella* will cluster together and form a protective barrier (biofilm) to prevent desiccation and death.

These biofilms are made from the aggregates of flagella and bacterial walls, composed primarily of water, proteins and polysaccharides. Channels in the biofilm allow for the flow of nutrients and water into the biofilm matrix, to sustain bacterial growth and replication. Biofilm has strong adhesive qualities to living and inert surfaces, allowing for bacterial attachment to various surfaces and sustained survival for reasonably long periods. Inside the biofilms, bacterial communities form, grow and sporadically release high concentrations of bacteria.

These communities can communicate with other bacterial communities via quorum sensing, signalling information about population densities and environmental risks and triggering specific gene activations for enhanced survival. The formation of biofilms also triggers stress gene activation for increased resistance.

Biofilms are highly resistant to antibiotics, antimicrobials, disinfectants, immune cells and environmental changes, making eradication extremely challenging. It is estimated that 80% of bacterial infections are related to biofilms. Biofilm formation facilitates systemic and recurrent *Salmonella*

contamination. Current research therefore focuses on compounds with the ability to break down biofilms, clearing a pathway for antimicrobials and disinfectants to reach and destroy the bacteria.

Figure 1: Biofilm lifecycle.

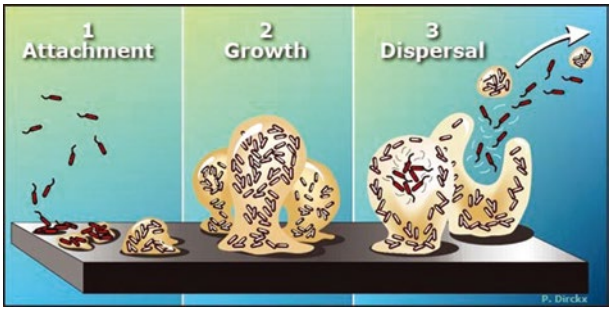


Table 1: Biofilm chemical composition.

Sample no	Components	Percentage of matrix
1	Microbial cells	2% to 5%
2	DNA and RNA	< 1% to 2%
3	Polysaccharides	1% to 2%
4	Proteins	< 1% to 2% (including enzymes)
5	Water	Up to 97%

Salmonella contamination

Salmonella detection in swabs, raw materials, final products and dust is generally split into three categories:

- Repetitive detection with two or more consecutive *Salmonella* positive results on a specific sample or sample type.
- Recurrent detection with two or more *Salmonella* positive results on a specific sample/sample type within the last six testing periods.
- Systemic detection with two or more *Salmonella* positive results in different samples/sample types/areas within a testing period.

Procedures after positive test results

Standard testing: Routine testing procedures and numbers, based on production volumes, when there are no positive samples detected or confirmation testing is negative.

Intensive testing: Positive sample detection necessitates sample retesting to confirm the result. A positive result for *Salmonella* on a retested sample requires intensive investigation. The historical data must be examined and if it has previously tested positive for similar/same sample type, the sample must be categorised as 1-repetitive, 2-recurrent or 3-systemic non-compliance. Ventilation, general management practices, maintenance and calibration, sanitation, employee traffic and flow and equipment must be evaluated. After the evaluation, an action plan should be written up and implemented.

In-depth testing: If, after intensive investigation, samples continue to test *Salmonella* positive, a more in-depth investigation and a full review of all processes are required. A hold-and-test policy is often put in place for all final products. To move out of this phase, there must be three to five consecutive days of testing showing negative results for *Salmonella*. Once the processes have been reviewed, the action plan is updated, implemented and regularly checked.

Hygiene protocols

Following a hygiene programme is critical to ensure the safest and best quality product is produced and maintained, until consumption. Hygiene programmes follow standard steps organised into sections. Other steps and changes can be taken to adapt to conditions, and raw material suppliers and feed manufacturers will often follow similar procedures and steps, with customised adaptations for individual variables.

Sanitation and cleaning: Scheduled and regular cleaning of buildings and equipment, to prevent dust and waste accumulation. Procedures should preferably involve dry cleaning (where possible) followed by disinfection, to prevent moisture accumulation and microbial growth.

Dust control and air flow: Ensuring good air flow and ventilation design is a recommended practice, especially to prevent contamination from high risk areas to final product areas. Dust control should focus on removal of accumulated dust in processing and storage areas. Dust and sweepings should be disposed of correctly, as they have a high risk of *Salmonella* contamination.

Pest control: Practical measures to control pests should be taken and documented. Ensuring good drainage and weed/vegetation control around the facilities helps control pests. Pest control companies are often used to manage these risks.

Materials handling: The receiving, handling, storage and processing procedures for raw materials and final products should be documented, including procedures for non-conformance, such as high-moisture materials and over/under-processed materials.

Moisture control: Roofs, ceilings and walls should be leak-proof and storage points kept dry. Moisture condensation points should be prevented as far as possible.

Disinfection: High risk areas (critical control points) should follow a documented disinfection programme to ensure microbial contamination risks are managed. Should any *Salmonella* positives be ascertained, additional actions and disinfection procedures may need to be performed and documented.

Test results should be kept on record to track trends and risk levels. Final product decontamination may also need to be performed in some cases, and products to prevent re-contamination of final products after production (e.g. formaldehyde and organic acid products) are often used.

The market

Buyers and traders increasingly require proof of a hygiene control programme from suppliers that have qualified as approved and preferred. Where this is not the case, having a good hygiene programme in place increases customer confidence in products and demonstrates product quality in the competitive market.

Export products often require validation by third parties, involving evaluation of the quality/hygiene programme in place. Accreditation (such as HACCP) may also be required. Having a quality and safety programme in place gives producers a competitive edge.

References available from the author. For more information, send an email to maja.sakkers@kemin.com.

Global importers demand more soya beans: **a US perspective**

By the United Soybean Board

Demand for product is vital in any business and soya beans are no exception. Despite trade disputes dominating the headlines in the United States (US), the international soya bean market is surging ahead. In fact, since 1990, global demand for soya beans has risen by 241%. In the same time frame, demand for corn and wheat rose by 130% and 37%, respectively.

Growing demand worldwide

"Globally, demand for soya beans is growing at a rate of 514 million bushels (±14 million tons) a year," says John Baize, economic consultant at the US Soybean Export Council (USSEC). "That is roughly the equivalent of the soya bean production of Iowa that is needed each year to meet increasing demand."

Increased demand means increased supply. In 2000, global soya bean production stood at just under 6,5 billion bushels (±177 million tons). The United States Department of Agriculture (USDA) estimates that the 2018/19 production season will yield nearly 13,6 billion bushels (±370 million tons).

Soya bean exports rise

"There are only so many soya beans in the world," Baize says. "Thanks to checkoff dollars funding marketing and education programmes across the globe, importers in new markets that may not have considered US soya beans might now consider them, due to China purchasing much more from South America."

Looking specifically at the value of US soya bean exports, that number has risen from $6,8 billion (±R90,4 billion) in 2000 to more than $28,5 billion (±R379 billion) last year. According to USDA data, the US is projected to be the largest soya bean-producing country this year, followed by Brazil and Argentina. In total, the US exports 64,8% of soya bean production as soya beans, soya meal and oil.

China is a huge soya bean importer but demand for US soya beans exists worldwide. "Brazil's soya beans have a premium due to increased buying from China. Because of this, US soya beans are seeing an increase in practically every other market in the world," Baize says.

"This year, different markets will see the quality of US soya and this may continue in future, resulting in a much more diversified market – a scenario that could benefit US soya bean producers in future.

Southeast Asia and the Middle East

"We're seeing spectacular demand in Egypt, Pakistan, Bangladesh and Southeast Asia," Baize adds. Pakistan increased soya bean imports from just over 20 million bushels (±544 320 tons) in 2014 to 85 million bushels (±2,31 million tons) in 2018. Bangladesh's imports have risen from 20 million bushels in 2013 to more than 42 million bushels (±1,14 million tons) in 2018.

"Countries with private sector importers such as Iran are increasing its US soya bean imports as well, which is likely due to less supply from South America," Baize says. One important market is India, a country that was a net exporter of soya beans only five years ago. However, India's domestic demand for soya beans is currently around four times more than its exports.

"Soon India will probably be the most populous country in the world and domestic consumption of soya beans is rising fast," Baize says. "Checkoff marketing programmes have been promoting the use of US soya beans to India's poultry and fish sectors to show the advantages of using soya meal in feed."

In a dynamic global marketplace, relationships remain key to building trust in US soya beans. "Being there to work with customers is a vital function USSEC performs on behalf of US soya bean farmers," Baize says. "Importers are looking for information and USSEC can often provide data that's not available to importers in many countries such as Indonesia, Myanmar and Burma."

Commodity checkoff programme

Checkoff marketing efforts also make foreign importers aware of how they can add value to their businesses by buying US soya beans through the US Soy Sustainability Assurance Protocol (SSAP). The SSAP designation allows in-country purchasers to know that the US soya beans they are buying have been produced through sustainable production practices.

"Importers are partial to US producers' use of sustainable practices such as no-till and cover crops," Baize says. "Thanks to less energy being used in transporting US soya beans via an efficient barge and rail system, importers also like to source US soya beans to reduce pollution – this is especially important in markets such as Europe and Japan, as well as Colombia where import companies want to build a brand name and a public image."

The changing global marketplace makes the brand reputation of US soya beans pivotal. As an additional way to build trust, USSEC hosts buyer conferences that importers can attend to learn about importing best practices as well as the benefits of using US soya beans.

"It is important to note that when USSEC hosts conferences or speakers, they're not selling anything," Baize concludes. "By providing helpful, informative information your checkoff dollars effectively build the brand of US soya beans that will lead to greater demand."

This article was originally published on the United Soybean Board's website, *www.unitedsoybean.org*.

International market overview

By Dr Dirk Strydom, Grain SA

The 2018/19 season will be known as one marked by difficulties in trade due to the trade war. Demand did not rise to soya bean supply levels, causing world soya bean stocks to rise as production outstripped consumption.

High soya bean stock levels

Most of the global soya bean stocks can be found in the United States (US). The trade war between the US and China depressed soya bean exports from the US during the 2018/19 season. China's soya bean meal consumption dropped this season along with the country's imports. This brought South American and American soya bean prices closer. Recent adverse weather conditions in Brazil led to a slight premium between Brazilian and American prices.

At the beginning of February, China started buying American soya beans for the first time in a while, which is a positive sign for trade between the two countries. However, trade agreements have not been settled and discussions are ongoing. This will continue to be a key issue in the international soya bean market over the next few months.

The USDA released the *World Agricultural Supply and Demand Estimates (WASDE)* report in February (the first time since last December). In this report, the global soya bean stocks were revised downwards to 106 million tons from the December forecast of 115 million tons. Global production is down by 9 million tons, with the largest declines reported in Brazil and the US. Despite the reduction in global production and closing stocks, it is still at record high levels of stock, ending at 115 million tons.

Sunflower seed

Global sunflower seed oil exports are on the rise, mainly due to record sunflower seed production and processing in the largest producing countries. Sunflower seed oil exports from Russia were very limited until November last year, but have since started to pick up, contributing to the increase in global exports. The Ukraine has the largest export share of sunflower seed oil among the three biggest exporters, accounting for 72% of total exports from October to December last year.

Table 1: Stock to usage ratio given different scenarios.

		Area planted (ha)						
		-20%	-15%	-10%	CEC estimate	+10%	+15%	+20%
		594 880	632 060	669 240	743 600	817 960	855 140	892 320
Yield (ton/ha)	1,40	11%	15%	19%	27%	35%	39%	43%
	1,55	18%	22%	27%	36%	45%	49%	54%
	1,70	25%	30%	35%	45%	54%	59%	64%
	1,85	32%	37%	43%	53%	64%	69%	75%
	2,00	39%	45%	50%	62%	74%	79%	85%
	2,15	46%	52%	58%	71%	83%	89%	96%
	2,30	53%	59%	66%	79%	93%	100%	106%
	2,45	60%	67%	74%	88%	102%	110%	117%

Canola

Canola stocks in Canada were 680 000 tons more than expected in December, and total stocks increased to a new high of 14,55 million tons. This was mainly due to an upward adjustment in the old season's stocks, announced in the latest report. Canadian canola prices are under pressure due to the huge inventory, and prospects for processing and exporting are poor. Australian canola stocks are around a third lower than the previous season's stock. This is due to the sharp decline in production for the season.

Groundnuts

There are currently many uncertainties in the international groundnut market, and stakeholders in international markets are struggling to make informed decisions. The major role-players, mainly international traders, are reported to be buying mostly from hand to mouth rather than taking up large quantities.

There is still plenty of stock available in the world market at present, although carry-over stock for the season should be lower than that of the previous season. It is also expected that US production for the season will be lower than initially expected. The last 20% of the US harvest was subjected to wet conditions that caused quality problems.

Local market

The soya bean industry made excellent progress during the last five years. Local production doubled and local soya bean processing increased materially, which led to an improvement in the trade balance, with less imports of oilcake into South Africa. Currently, the soya bean industry is in a situation where there are substantial amounts of local supply and yet oilcake is still imported.

The Soya Bean Forum called an industry meeting in December last year between key stakeholders, including crushing plants, the Animal Feed Manufacturers' Association (AFMA), the South African Cereals and Oilseeds Trade Association (Sacota), Grain SA, the Protein Research Foundation, the Department of

Trade and Industry and the Department of Agriculture, Forestry and Fisheries (DAFF), to discuss some industry bottlenecks and to strategise the industry's future.

Local sector maturing

Under discussion were five categories: supply and demand balance, pricing structures, quality, infrastructure, and imports and exports. All those present acknowledged that despite the industry's significant growth during the last five years, it is still a relatively young industry in a maturing phase. However, the industry has been identified as one that can expand with ample future opportunities.

In terms of supply and demand, processing capacity was confirmed at 2,1 million tons that can, at 80% utilisation, provide 1,68 million tons of crushing capacity. Full-fat capacity is at 450 000 tons with 360 000 tons at 80% utilisation. Given the increase in production of the last few years, this is sufficient for the next two to three years. During the past two seasons crushers experienced numerous breakages and hold-ups, which severely affected crushing capacity.

In terms of replacing imported oilcake, animal feed manufacturers confirmed their commitment to local consumption and to self-sufficiency in the inland market. However, the coastal areas will always be a challenge due to logistics and import competition. South Africa has good quality beans and oilcake, but this quality should be combined with reliable and consistent supply to build confidence in the product.

In terms of supply, exports that will provide relief is deemed important. DAFF has had bilateral meetings with China and is in the process of applying for market access to that country. Entry to China's protocol market takes time. However, it is important to ensure that local quality provided to export markets is above the required minima. Although local quality is in place, systems must be developed to provide guarantees and consistency.

It is expected that high ending stocks will decrease this season. The planting season was very late, and the majority of the soya bean crop was planted outside optimal window periods. According to the Crop Estimates Committee, 743 600ha are expected, which is 5,5% lower than the previous season. Based on four year averages the expected stock to usage ratio is 55%. Nevertheless, a yield decrease has a large impact, and at a national yield average of 1,4 ton/ha the ratio is 27%.

Crushing increased considerably at the end of last year; total monthly processing figures from June last year were more than 100 000 tons. Crushing figures for oil and oilcake also increased, with figures above 100 000 tons for October, November and December. This is always good news for the local industry, but it should be asked whether these numbers can be maintained.

Eskom's load shedding will certainly put pressure on processing plants and may affect expected figures for the next few months.

Figure 1: Soya bean crushing margins. (Source: Grain SA)

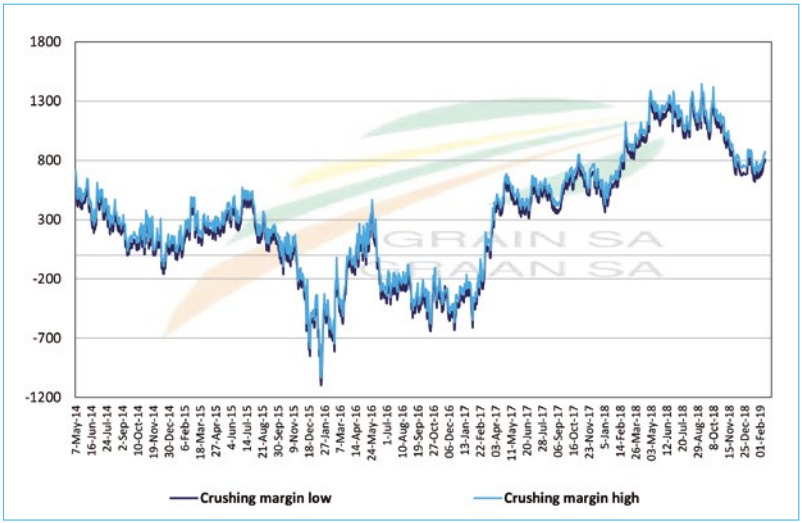
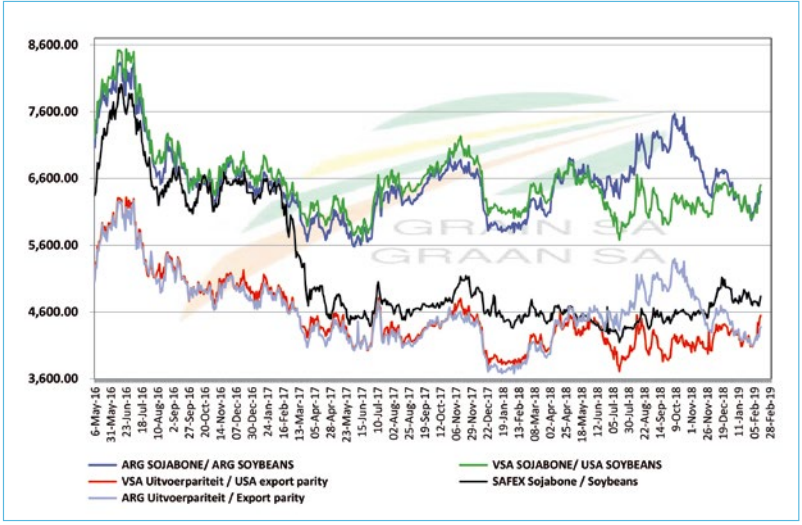


Figure 2: SAFEX import and export parity prices. (Source: Grain SA)



Crushing margins are still at relatively superior levels, which can contribute to good prospects for crushing figures.

In terms of prices, the soya bean market is currently trading above export parity prices. The market reacted positively in terms of the increase in processing figures. However, local prices are still R1 300/ton below the derived price levels.

This season is going to be an interesting one. It will be important to monitor developments in the trade war between the US and China. On the local front, expected yield and oilcake imports will be key variables to monitor in terms of possible new ending stock levels.

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

An overview of sunflower production **in the Balkan region**

By Yalcin Kaya, Trakya University

Agriculture is the main source of income for people living in the countries that make up the Balkan region of Southeast Europe. The region is traversed by many rivers whose broad, fertile plains offer the potentially high yields of quality crops.

The Danube, Sava and Kupa rivers, described in some literature as forming the northern boundary of the Balkans, are the lifeblood of regional agriculture, while the rugged terrain of the Southern Balkans is not suitable for grain production. But despite this, the Balkan region has a land use rate twice as high as that of the rest of the world.

The regional economies of countries such as Albania, Macedonia, Serbia and Bulgaria depend heavily on agricultural production and trade. Although animal production and horticultural cropping of fruit and vegetables are practised in most parts of the Balkan Peninsula, including the mountainous areas, the primary agricultural income for farms in rural areas comes from grain production. Cereals such as wheat, barley and corn are cropped throughout the Balkans.

On a commercial scale crops such as sunflower, potato and tobacco are also cultivated in the Balkan countries. Sunflower and rapeseed are the dominant oilseed crops, while olives are common in the coastal Mediterranean areas.

Sunflower production in the Balkans

There have been many new developments since sunflower production during the Soviet era. These include development of the first hybrids by the Fundulea Institute in Romania and the first commercial hybrid production.

Sunflower is the most important oilseed crop in the region. It is the second biggest area planted with sunflower other than the Northern Black Sea region, with almost 20% of global sunflower production and planted area (*Table 1*). Romania, Bulgaria and Turkey are among the world's top ten sunflower producing countries and Moldova and Serbia are also important regional producers of the crop.

The following is a short summary of sunflower production in key countries in the region.

Romania

Romania is the leading sunflower producing country in the European Union. As a traditional crop in Romania, sunflower is the primary crop in a rotation system with corn and wheat. Due to higher profitability and higher export demand in recent years, sunflower production increased by 60% with record production in 2013. Romania exports sunflower seed, sunflower meal and unprocessed oil.

Table 1: Area under sunflower harvested and production by season in the Balkan region.

Country	Harvesting area 1 000ha				Seed production 1 000mt			
	2013	2012	2010	2007	2013	2012	2010	2007
Romania	1 095	1 088	810	830	2 196	1 260	1 285	570
Bulgaria	860	680	692	520	1 937	1 348	1 380	525
Turkey	630	570	500	475	1 450	1 100	1 020	690
Moldova	275	295	252	230	505	295	382	170
Serbia	188	167	169	155	513	366	378	295
Croatia	41	33	26	21	131	90	80	54
Greece	77	65	56	12	336	82	85	19
Macedonia	6	5	4	4	9	9	8	5
Albania	2	2	2	2	3	3	3	2
Bosnia	1							
Herzegovina		1	1	1	1	1	1	1
Montenegro	-	-	-	-	-	-	-	-
Kosovo	-	-	-	-	-	-	-	-
Balkan total	5 188	4 918	4 522	4 257	9 094	6 566	6 632	4 338
World total	25 892	25 451	23 923	21 305	40 190	35 976	33 605	26 430
%	20,04	19,32	18,9	19,98	22,63	18,25	19,74	16,41

Figure 1: Map of the Balkan region of Southeast Europe.

Bulgaria

In Bulgaria, boosted by high demand from Turkey, sunflower production has grown to a record harvest of two million tons. Expanded planting areas and favourable weather during the growing season in 2013 made these yields possible. The country's proximity to Turkey, one of the world's major importers of sunflower, gives it a logistical advantage in terms of exports. Bulgaria exports mainly sunflower seed to Turkey and to other European countries, but with recently increased crushing capacity Bulgaria has been able to start exporting unprocessed oil and meal.

Turkey

Turkey is the largest country in the Balkan Peninsula – taking up almost 50% of the land surface of the region – and has the biggest population. The Trakya region, which is the European part of Turkey, has more level topography and productive plains and is Turkey's primary production area, with more than 50% of total sunflower production and planting area. Turkish sunflower production and planted areas have increased almost 50% in recent years due to higher prices and increasing production, mainly in the mid-Anatolian region.

Known as one of the main sunflower import destinations worldwide, Turkey imported sunflower seed, unprocessed oil and meal to the value of roughly $3 billion in 2013. Turkey is well positioned to supply countries in the Middle East and North Africa and its oilseed crushing capacity is four times greater than what would be required for domestic consumption. Despite regional instability, the demand for sunflower oil is high and Turkey exported $1 million worth of processed oil in 2013.

Other countries

Sunflower production is growing in Moldova, Serbia, Greece, Croatia and other countries in the peninsula. Serbia, a top producer, leads the way in research, and Moldova has a long historical association with sunflower cultivation. In Greece, sunflower is a primary crop in rotation, especially in the northern part of the country.

Production problems in the region

Sunflower is generally well adapted to a range of climatic conditions. It is easy to mechanise with a consequent low labour component. These advantageous adaptations make it possible for sunflowers to be cultivated in many parts of the world. But it is here, in the Balkans and Europe, that sunflower seed oil is widely preferred as a vegetable oil.

With a spring and summer growing season, this crop is negatively affected by seasonal drought and higher temperatures. Production and yield therefore depend on good summer rainfall and favourable climatic conditions.

Sunflower tends not to have as many diseases as other commercial crops. However, there are diseases such as downy mildew, *Macrophomina, Phomopsis* and *Sclerotinia* that affect the crop severely in some years in various areas in the Balkans, as well as in other parts of the world. Apart from disease and abiotic stress, the main problems affecting seed and oil yield in sunflower are broomrape parasitic plants and weeds. Broomrape (*Orobanche cumana Wallr.*) is the greatest limiting factor for sunflower yield in the region, with new breeds of the parasite appearing every 20 years against resistant cultivars.

Hybrid cultivars are generally used in sunflower production in all the Balkan countries. In addition to the oil type of sunflower, confectionery sunflower (black seed in the Balkan area; white and grey seed in Turkey) is also produced.

While further chemical control is not an option, genetically disease-resistant hybrids are available. Genetically resistant sunflower cultivars against new breeds of broomrape are developed and used widely in production. Imidazolinones (IMI) herbicide resistant hybrids control key weeds and broomrape together if applied post emergence. Known as the Clearfield production system, this non-GMO system has been successfully used in sunflower production for the past decade.

Future of sunflower production

Sunflower production will continue in the Balkan Peninsula, satisfying high export and domestic demand as the primary and preferred source of vegetable oil, and as the main crop in rotation due to its higher profitability. New cultivars should be genetically resistant, since virtually the entire region is infested with new breeds of parasitic broomrape and downy mildew.

Herbicide resistant cultivars – to both IMI and Sulfonylurea (SU) herbicides – that provide non-GMO solutions will be popular since they provide efficient control of broomrape and the key weeds in sunflower production. Pre-emergence herbicides, mechanical weeding and hand-hoeing are not preferred methods of controlling weeds due to the shortage of labour in the region. Hybrids with IMI, SU herbicide, broomrape genetic and downy mildew resistance will give farmers options, enabling them to select and apply the right herbicide for their specific conditions.

Higher oleic type sunflower, perceived as a healthier frying oil, has recently gained global popularity. In the Balkans there has been some growth in the production of this type of sunflower, which will expand due to higher consumer demand.

Sunflower is therefore an important crop of this region, providing agricultural trade and production and opportunities for expansion, and meeting domestic consumers' needs for vegetable oil. Production in the Balkan region looks set to increase, supported by strong demand and the development of new technology.

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Drought survey reflects hardship on farms

By Marike Brits and Ursula Human

In December last year, Agri SA conducted a survey to assess the effect of the severe, extended drought on the sector, job creation and the general economy. The survey considered the financial status of farmers, mental health of the farming community, local area water maintenance status, job creation and job losses.

"The sector has shed 31 000 jobs in provinces severely affected by the drought and an estimated R7 billion has been lost due to the drought," said Christo van der Rheede, deputy executive director of Agri SA. "People are losing their jobs and farms are closing down at a time when we need to strengthen food security and create more employment."

Key findings

- 70% of respondents said they struggled financially and were in a weak financial position.
- More than 50% of respondents said they had to retrench farm workers due to the drought.
- More than 66% of respondents reported severe to critical levels of ground and surface water.
- The lack of maintenance of water infrastructure was a major concern. There was no proactive drought planning in towns that rely on boreholes for water.

The survey indicated that 62% of South Africa's municipalities were affected by the drought. This included 27 municipalities in KwaZulu-Natal, two municipalities in Limpopo, 15 in Mpumalanga, 17 in the North West, 25 in the Western Cape, 16 in the Eastern Cape and 15 in the Free State. Agri Gauteng did not specify affected municipalities but commented on delayed planting and hail damage.

Impact on the grain industry

Jannie de Villiers, CEO of Grain SA, said farmers in the eastern parts of the country had planted most of their planned crop, despite a difficult start to the season. "The problem is in the western regions where between 60 and 70% of the crop has been planted, with only around 20% planted early," said De Villiers.

"Early plantings were holding up well and average yields could be expected if it rained, but late plantings were struggling, with below average yields expected even if there was rain. Maize prices caused some concern, with a price increase of 60% for white maize and 40% for yellow maize," said De Villiers.

This increase might impact on the red meat, poultry and dairy sectors. "It is likely that the trickle-down effect will reach the consumer's plate soon enough, putting the consumer under even more pressure."

The future of grain farming in the drought-stricken western areas looks uncertain and De Villiers said he expected structural changes in the type of agribusinesses in the region. "If grain production in this region declines dramatically, it will be important that other areas of the country start producing grain to ensure food security.

"Here we refer to the communal areas of the Eastern Cape, as it has considerable potential in terms of available land and water for grain production development," De Villiers said. Regional development in the Eastern Cape was stifled due to a lack of funding and the difficulty of accessing finance without a title deed.

The impact of inflation

"Grain products, meat, poultry and dairy make up 75% of the consumer's food basket. If the grain contribution, as the base contribution to this basket, sees a price increase of 50%, the whole food basket will become more expensive and food inflation will rise," De Villiers explained.

Rapidly inflated food prices will have a disastrous effect on the entire economy. "The moment food inflation gets too high, it starts pushing up interest rates. This leads to a drop in GDP growth, which will lead to soaring unemployment rates."

The drought has had, and continues to have, a negative impact on the country's agricultural sector. The ripple effect is at work and other sectors are equally affected, which deepens the impact.

Table 1: Drought status outlook for the first quarter of 2019 as reported by Agri SA affiliates.

Province	Current drought status	Rainfall status	Runoff status	Dams status	Groundwater status	Drought outlook
Eastern Cape	Severe	Very low	Very low	Low	Moderately low	Critical
Free State	Severe	Very low	Very low	Low	Moderately low	Critical
Gauteng	Stable	Normal	Normal	Moderately high	Moderately high	Stable
KwaZulu-Natal	Below normal	Moderately low	Low	Moderately low	Low	Conditions to worsen (if future rains are insufficient)
Limpopo	Moderate	Moderately low	Moderate	Moderately low	Moderately low	Conditions to worsen (if future rains are insufficient)
Mpumalanga	Moderate	Normal	Normal	Normal	Normal	Stable
Northern Cape	Severe	Very low	Very low	Low	Very low	Critical
North West	Severe	Very low	Very low	Moderately low	Very low	Critical
Western Cape	Below normal	Low	Very low	Low	Moderately low	Conditions to worsen (if future winter rains are insufficient)

For enquiries, contact Agri SA on 012 643 3400.

Structural stability criteria in grain handling

By Pieter Fourie, Eko Design

Grain handling poses challenges in various disciplines and cost-effective operations involving capacity optimisation, minimum product damages, safe storage and compliance with market demand. There are also legislative requirements ensuring that health and safety standards are met.

Regulation Gazette 10113, Vol 584 of February 2014 states:

- Inspections of structures are carried out periodically by competent persons in order to render the structures safe for continued use.
- The inspections contemplated in the sentence above are carried out at least once every six months for the first two years and then yearly.
- The structure is maintained in such a manner that it remains safe for continued use.
- The records of inspection and maintenance are kept and made available on request to an inspector.

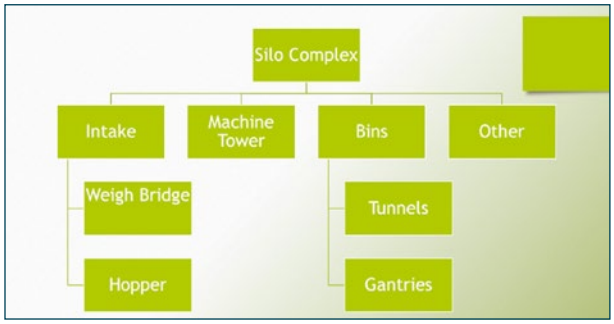
This presents the industry with challenges regarding what a structured inspection entails and what form records should take. The best way to approach the problem would be to establish the cause of structural failure. Experienced silo designers will take the relevant variables into consideration in the analysis process (*Figure 1*).

Variables to consider

Drainage: Proper drainage ensures that reinforcement is not compromised by the ingress of water. Base plates and steel structure bolts subjected to ponding will corrode and weaken. Grain quality could be affected by water penetrating bins.

Consolidation: Understanding site geology is critical to identify potential problems that may occur, such as the presence of dolomite or collapsible sand and clay. During the investigation special attention must be paid to possible movement, which will manifest itself in cladding and cracking of structural elements.

Figure 2: Sequence of a typical storage facility.

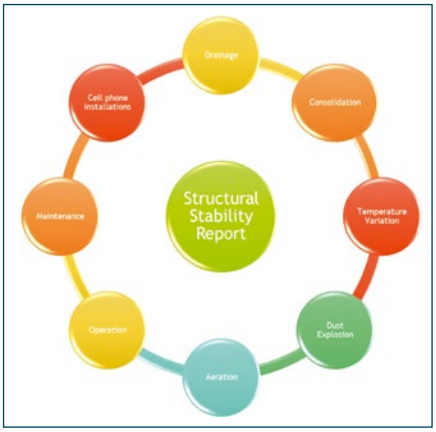


Temperature variation: Higher temperatures will expand steel silo walls, allowing grain to settle in the newly created space. When the temperature drops the silo wall will try to compress the grain, causing additional circumferential stresses in the thin shell. The common term for this action is ratcheting.

Dust explosion: It is important to zone areas properly to ensure that the right equipment is used for specific zones. Insurance companies will demand management of this risk.

Aeration: Incorrect aeration design can lead to roof failure, which will cause gantry collapse. The balance between airflow in and out should be understood, together with the resistance that the grain mass will give.

Figure 1: Variables to consider when establishing cause of structural failure.



Operation: The safe storage of grain at the right moisture content and temperature will ensure the free flow of product without the risk of bridging and subsequent collapse causing additional stresses. The new trend is to refrigerate grain to temperatures below 15°C, which eliminates the necessity for expensive fumigation. Spontaneous combustion in oilseeds is a risk that can be managed by proper aeration and seed conditioning via the combination of temperature and relative humidity.

Maintenance: This is always the area where costs are cut first if the bottom line is under pressure. This is to the detriment of assets and safety standards. The answer lies in a structured approach that prioritises action. This approach should clarify non-negotiable corrective actions and items that can be postponed to the following year's budget.

The first distinction to be made will be the identification of primary and secondary structural elements. Primary elements include the main frame that keeps the installation stable and safe, such as gantry supports, foundations, bins, etc. Cladding and paving are typical of secondary elements.

Typical inspection procedure

The first step will be to group the complex into operational areas to analyse stability specifics applicable to that entity. *Figure 2* illustrates the sequence of a typical storage facility. Taking the hopper as an example, the criteria in *Figure 3* will apply.

Operations will typically look at aspects such as the effect of increased loads on supporting beams and grids. On the maintenance side, the steel members will be checked for level of corrosion that will impact on thickness of webs and flanges, affecting the allowable safety factor. Other areas will be the integrity of the beam connections, cracks and wear and tear. This will be documented in an orderly manner. A good method of presentation is to classify it as green, yellow and red with an index classification as indicated in *Table 1*.

Figure 3: Criteria for structural stability report.

Table 1: Index classification for silo maintenance.

Category	Description	% Original strength	Action needed
1	New construction or excellent condition.	100%	None
2	Slight service deterioration. Strength of members not affected.	100%	None
3	Slight reduction in strength due to rust or minor spalling.	95% to 100%	Repaint, patch or tighten bolts.
4	Some reduction in strength. Repair should be included in maintenance schedule.	75% to 95%	
5	Severe deterioration with major reduction in strength.	50% to 75%	Repair or replace members.
6	Member strength compromised. Not safe for operation.	< 50%	Replacement

The red category requires immediate attention, while green can be placed on the three- to five-year budget. Each industry will have specific criteria. An example of this would be an edible oil refinery with specific classifications for a high-risk installation such as the hexane unit.

The improper mounting of dishes and other devices poses a safety hazard due to possible accidental falls from a height onto people or assets. Common areas of non-compliance are anchoring on safety rails, drilling of holes in the roof for cable entry, and not sealing the area properly, which causes corrosion of beams and reinforcement. Another area of concern is proper earthing. If a spark is transferred into the machine tower it may lead to a dust explosion.

One can conclude from all this that a standard operation procedure should be in place for each silo complex to ensure that regular inspections are carried out. This will assist in optimising the budget process for maintenance and ensure that the complex complies with legislation. The structured process set out here will simplify the investigation and will lead to good recordkeeping, which can be compared on an annual basis. It will result in a history of records for the complex.

For enquiries, send an email to pieter.fourie@ekodesign.co.za or visit *www.ekodesign.co.za*.

Soya and health – **the basics**

By the British Dietetic Association (BDA)

Soya foods are a staple in Asian diets and have become part of the mainstream British diet. In Asia, both unfermented soya foods (soya milk alternatives, tofu and soya meat replacements) and fermented soya foods (tempeh and miso) are eaten. Unfermented soya foods are more commonly eaten in the UK.

What do soya foods provide?

The soya bean contains a range of essential nutrients, including high-quality plant protein, fibre, essential fatty acids and a variety of vitamins and minerals. Soya foods are readily available in formats that make them easy to incorporate into the British diet.

Commonly consumed soya foods include soya meat replacements and related products such as burgers and sausages, tofu, dairy alternatives to yogurts, milk and desserts (fortified with calcium as well as vitamins B12 and D), and ice cream. The plant protein of both fermented and unfermented soya foods is high in a range of essential amino acids and is similar to animal protein. Soya is also the main dietary source of isoflavones (*Table 1*).

Table 1: Nutritional profile of commonly consumed soya foods.

Soya mince/chunks (textured vegetable protein)	• High-quality plant protein. • Low in saturated fats. • Source of fibre.
Milk alternatives: unsweetened, sweetened and flavoured	• Low in saturated fats. • Source of essential fatty acids – omega-6 and • omega-3. • Source of high-quality plant protein ~3g/100ml. • Usually fortified with calcium and vitamins B12 and D.
Yogurt alternatives: plain, vanilla and fruit flavours	• Low in saturated fats. • Some are a source of fibre. • Some versions are now high in plant protein providing 5-6g plant protein per 100g. • Usually fortified with calcium and vitamins B12 and D.
Desserts and custards: in a variety of flavours	• Low in saturated fats. • Source of high-quality plant protein. • Often fortified with calcium and vitamins B12 and D.
Tofu	• Low in saturated fats. • Source of essential fatty acids – omega-6 and omega-3. • High in high-quality plant protein. • Source of calcium.

Isoflavones

Soya beans are the main dietary source of isoflavones. A large glass of soya drink (250ml) will provide approximately 25mg isoflavones. Yet not all soya foods contain isoflavones, with some processing methods removing 80-90% of the isoflavones (e.g. isolated soya protein).

Isoflavones are often termed as phytoestrogens as they have a chemical structure similar to the human hormone oestrogen. However, it is now well established that isoflavones in the human body do not behave like the human hormone oestrogen: they are weaker, they only have effects on some body tissues, and in some situations they can have the opposite effect to oestrogen. Isoflavones may help reduce the symptoms of menopause.

There is scientific agreement that the controversy around isoflavones' potential to have bad side effects in humans is fuelled only by findings from laboratory or animal studies using pure isoflavones or high doses. It is well established that animals metabolise isoflavones in a different and much more efficient way than humans, and results from such studies cannot be compared to any human outcomes.

In addition, using high doses of pure isoflavones cannot be compared to consuming isoflavones from whole soya foods as they provide lower quantities and are a combination of many biologically active molecules. Comprehensive reviews by the European Food Safety Authority, World Cancer Research Fund and the World Health Organization all conclude that soya foods as part of a healthy, balanced diet are safe.

Absorption of nutrients

Some of the other plant chemicals found in soya beans, such as oxalate and phytates, have the potential to impair the absorption of minerals such as iron, zinc and calcium.

However, studies show these minerals are usually well absorbed from soya foods when eaten as part of a mixed diet, and the human body adapts to absorb more of these minerals when reserves are low. In addition, the phytate content can be significantly reduced during the processing of soya foods. Many soya foods in the UK are fortified with additional calcium and vitamin D, meaning calcium content and absorption compares favourably with dairy foods.

Soya and plant proteins

The British government's new dietary recommendations, the *Eatwell Guide* (2016), clearly recommends a significant shift towards more plant-based eating, both for the nation's health as well as a more sustainable planet.

Over 75% of the *Eatwell Guide* is dominated by plant foods, with the most notable change to the protein section, where plant-based proteins are recommended over animal proteins. As soya provides a high-quality protein source, this is an ideal option for the nation.

Soya and heart disease

A major risk factor of heart disease is having too much 'bad' low density lipoprotein (LDL) cholesterol. Soya foods are naturally low in saturated fats and often replace high saturated foods in the diet. It is also thought that the soya protein itself helps to lower the body's natural LDL cholesterol producing capacity in the liver.

Soya and menopausal symptoms

Many women undergoing menopause experience 'hot flushes'. Consuming 40mg of isoflavones daily, equivalent to two glasses of soya milk or 100g soya mince, may help to reduce hot flush frequency by 20,6% and severity by 26,2%. In addition, during menopause women's risk of heart disease is doubled, and consuming soya foods can help lower the risk.

Soya and cancer

A review by the American Institute for Cancer Research, the American Cancer Society and the World Cancer Research Fund all indicate that soya foods as part of a healthy, balanced diet are perfectly safe for women with or without cancer diagnosis, and there is a potential for soya food consumption to reduce breast cancer recurrence. Moreover, the protective effect of soya against breast cancer seems to be related to consuming soya foods as a child or teenager.

Soya and bone health

Some studies have shown that people who regularly eat soya appear to have higher bone density and lower rates of fracture than those with low intakes. However, more evidence is needed.

Phytoestrogens and men's health

Studies consistently show that eating soya foods does not raise oestrogen levels, upset hormonal balance or reduce testosterone concentrations in men; no adverse effects on fertility or sexual health have been reported. Controversy around this has been fuelled by animal and laboratory studies, which as stated cannot be compared to any human outcomes, and just two case studies where the men consumed high doses of soya foods and followed an unbalanced diet.

Phytoestrogens and thyroid function

A review of 14 studies has confirmed that soya food consumption has no harmful effect in healthy humans with a normal functioning thyroid gland. Soya foods do not interfere with thyroid function, but they can interfere with the absorption of the thyroid medication Levothyroxine. For this reason, thyroxine medication is always advised to be taken on an empty stomach. Soya should not be excluded by those with an underactive thyroid gland as their medication dose can easily be modified.

A dairy-free diet

Soya alternatives to milk are dairy and lactose free and therefore suitable for children over six months of age and adults with lactose intolerance and with other adverse reactions to cow's milk. Choose soya products that are fortified with calcium to replace dairy foods from the diet.

Research on soya foods is ongoing, but it is clear that soya is a nutritious, safe and palatable part of the diet, which fits well with healthy eating guidelines, and may have multiple health benefits.

For more information, visit the British Dietetic Association (BDA) website, *www.bda.uk.com*.

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Structural aspects of the oilseeds industry explained

By Gerhard Keun, Oil and Protein Seeds Development Trust

The Oil and Protein Seeds Development Trust (OPDT) and Oilseeds Advisory Committee (OAC) and Forum were established in a bid to develop and assist the South African oilseeds industry. The primary commodities of this industry are sunflower, soya beans, groundnuts and canola. Some important structural aspects of this complex industry are explained in this article.

It must be noted that the Protein Research Foundation (PRF) is a separate trust with its own bodies and industry objectives and should not be confused with any of the structures mentioned here.

The OPDT

The main objectives of the OPDT are to promote and develop the oilseeds industry in South Africa. This is achieved in many different ways, one of which is through the financing of research projects that focus on the genetic improvement, production, storage, processing or marketing of oilseeds.

Projects that inform and advise the industry regarding oilseed production and marketing conditions are also earmarked for financial assistance. Similarly, the financing of market access or of any conduct in the interest of the oilseeds industry can be done as long as it is in accordance with the objectives and purposes of the *Marketing of Agricultural Products Act, 1996* (Act 47 of 1996).

Razak Moosa is the current chairperson and De Wet Boshoff the current vice-chairperson of the trust. The OPDT is made up of eight trustees:

- Two representatives of the minister of agriculture, forestry and fisheries.

- One representative of commercial oilseeds producers.
- One representative of developing oilseeds producers.
- One representative of the oilseeds processors industry.
- One representative of consumers of oilseeds and their products.
- One representative of labour involved in the oilseeds industry.
- One representative of the oilseeds trading industry.

The OAC

The main objectives of the OAC are to render advice to the trustees of the OPDT in respect of the application of its funds for the benefit of the oilseeds industry. It also makes recommendations to other interested parties in the industry. The OAC appoints trustees to the OPDT and to other institutions the committee deems necessary to investigate, promote and report on matters relating to the oilseeds industry.

Dr Erhard Briedenhann is the committee's current chairperson, with Jan Botma the current vice-chairperson.

Oilseeds industry forums

There are two main industry forums in the oilseeds industry, namely the Sunflower and Soya Bean Forum and the South African Groundnut Forum. These forums discuss industry related matters including crop estimates, information from the South African Grain Information Service (Sagis) and regulatory issues. The forums also identify research projects that could be to the advantage of the industry. Resolutions are taken on a consensus basis and no resolutions with financial implications may be taken without prior approval of the OAC and the OPDT.

Jozeph du Plessis is the current chairperson of the Sunflower and Soya Bean Forum, with Jan Botma the current vice-chairperson. Adri Botha is currently the chairperson of the South African Groundnut Forum and Lourens de Kock is the vice-chairperson.

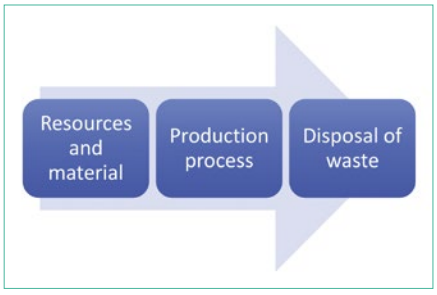
For enquiries, contact the Oil and Protein Seeds Development Trust on 011 234 3400/1 or visit *www.opot.co.za.*

Circular economics

By Nicolette Matthews, University of the Free State

Traditional economics takes a one-way linear flow approach to production. Companies harvest and extract resources or materials and use it to manufacture a product that is sold to a consumer. The consumer later discards the product once it no longer serves a purpose (*Figure 1*). This type of economy relies on high-intensity exploration and consumption of resources, and at the same time high-intensity damage to the environment.

Figure 1: Linear flow of traditional production systems.



Although linear systems have increased the focus on recycling and reducing the impact of waste, it has not been effective, with increased levels of waste not being recycled.

Waste becomes a resource

Circular economics, on the other hand, uses theories and principles from industrial ecology to adopt a closed loop system. Circular economy means reusing, repairing, refurbishing and recycling existing materials and products (*Figure 2*). What was once considered waste becomes a resource.

In circular economics resources are therefore kept in use for as long as possible, with the maximum value extracted by recovering and regenerating material and resources at the end of their service life.

The focus is therefore on the use of renewable energy, the removal of toxic chemicals that cannot be reused, and reuse of waste through improved material, product, system and business model designs.

Objectives of circular systems

The development of a circular economic system has a few aims. Firstly, the natural capital, which is the natural resource endowment, must be preserved or enhanced, thereby ensuring sustainable use of natural resources. This is achieved by controlling finite resource stocks and balancing renewable resource flows.

Secondly, resource yields must be maximised by circulating products within the system. Maximum resource yields can be achieved through recycling and ensuring that the products produced are of the highest quality possible.

Thirdly, waste must be eliminated through the design of products that can be disassembled and reused. Elimination of waste from production systems means that it becomes more important to ensure that consumables are non-toxic or could potentially be beneficial when returned to the biosphere.

Alternatively, durable goods such as engines and cellphones that typically contain metals and plastics unsuitable for return to the biosphere must be designed to ensure successful reuse. Redesign to eliminate waste does not have to be limited to the design of products, but could also be extended to the production processes used.

Lastly, the energy used to drive the cycle should be renewable to ensure that resource dependence is decreased, and the resilience of the system is increased. Circular economic models therefore evaluate issues of biomass and energy production, waste management, fertiliser and water use, and food wastage.

Circular economics in agriculture

Agriculture is unique in the sense that the sector is reliant on natural resources and cycles as primary inputs for crop and livestock production. High levels of reliance on natural resources and cycles can undermine the sustainability of the natural systems that support agricultural production. Resource usage efficiency and the reuse of consumer products are a way of making agricultural business models more sustainable.

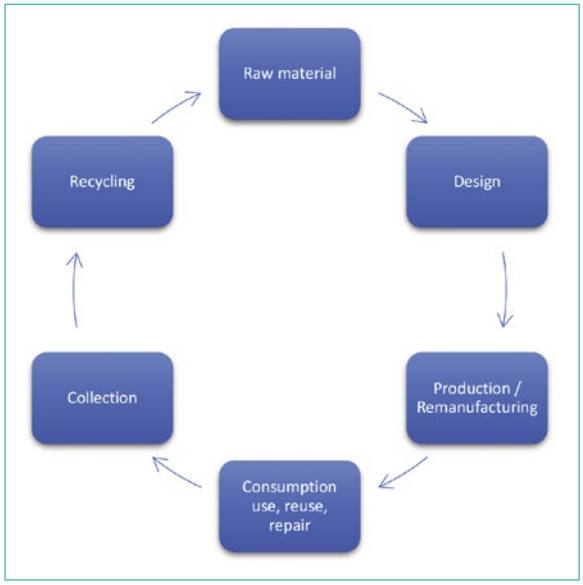
The transition towards a circular economy within agriculture requires a move away from the use of technical nutrients toward the use of biological nutrients. This movement to biological nutrients can be seen in Europe with the increased focus on the development and use of biogas and organic fertilisers.

Bio-economy vs circular economy

Dr Ben Allen, a senior policy analyst at the Institute for European Environmental Policy (IEEP), wants to take the circular economy to the next level. He is calling for a transition towards a circular bio-economy, in which a traditional circular economy is integrated with bio-economic models. The circular bio-economic system will ensure that production and utilisation of renewable bio-resources and their conversion into value-added products (reuse at the end of their life cycle) are linked in one system.

Bio-economic systems are renewable since the bio-economy is based on

Figure 2: Flow of a circular economic system.



biological resources. Although biological resources can be renewed, it is possible to use the resource faster than it can be reproduced, and as such the bio-economy can be quite linear in practice, even if circular in principle.

Circular agricultural system

Several opportunities exist for the development of a circular agricultural system. The first opportunity lies in the establishment of a regenerative agricultural system that preserves the integrity of the natural system. The system uses practices such as crop rotation, minimum till and cover cropping. Livestock and crop production are often combined to create additional nutrient loops.

Regenerative agriculture is based on principles such as retaining soil health, minimal use of pesticides and inorganic fertiliser, and combining crop and livestock production. As a result, some of the major risk factors faced by current commercial agriculture due to the degradation of natural capital, climate change vulnerability, volatile input prices, and the resulting long-term pressure on yields are mitigated.

Precision farming can increase the efficiency of conventional agricultural systems and has shown good potential for combination with regenerative practices. The use of agricultural IT, remote sensing and real-time environmental data can optimise crop yields, while reducing environmental externalities.

Bringing food production and consumption closer together through peri-urban and urban farming reduces food transport and associated costs (such as food waste, fuel, and environmental externalities). Specialised urban farming techniques (vertical farming, hydroponics and aquaponics) can be more resource efficient while saving energy, water and fertiliser.

Biological nutrients should be returned to nature and agricultural systems through composting and anaerobic digestion. An estimated 30% of food produced in South Africa is wasted. The CSIR reported that the cost to society associated with this waste is equivalent to 2,1% of the country's GDP. The bulk of this food waste is generated in the pre-consumer stages of the supply chain with only 5% of food waste generated during the consumption stage.

South African household food wastage seems to be lower compared to international trends. Dutch households are reported to waste 13,6% of edible food, while UK households waste nearly 20%. However, international trends suggest that food waste at household level is on the increase as countries become more developed. Changes in the South African food consumption patterns due to a growing middle class is already being reported.

Biogas in the bio-economy

Since the introduction of biogas by John Fry in 1957, nearly 700 biogas digesters have been installed within South Africa. South Africa thus has the potential to produce 2 500MW of electricity. Considering that South Africa produces more than 40 million tons of organic waste annually and that energy costs are increasing drastically, biogas energy presents a strong case. Moreover, recent changes in environmental legislation creates an incentive for bio-energy generation.

There is also a movement within the sugar industry to argue for the use of biomass to produce ethanol and butanol from sugar cane. Development of biorefineries could result in the self-sufficiency of the industry. Current literature on biorefineries in the sugar industry indicates that some support from government is necessary for the development of biorefineries. The economic returns on the test scenarios are not sufficiently large to attract private investment.

Transition to a circular system

In the EU, the US and China, the development of models and strategies to move towards a circular agricultural production approach has gained significant momentum over the last decade. Although South Africa has adopted some elements of a circular economy, the adoption of a truly circular economy is still a long way off. Currently, the inefficiently low cost of disposal is hampering the development of and transition to circular systems.

The transition to a circular system requires the collection and sharing of data, innovative investments and facilitation of business collaborations. Although individuals can transition, it is essential that transition takes place at the supply chain level rather than at individual company level, due to the over-arching system development required. This over-arching system development calls for systems thinking in terms of which we understand how parts influence one another within the whole, and what their relationship is in terms of the whole.

The *Towards the Circular Economy* reports published by the Ellen MacArthur Foundation provide evidence that circular systems offer a successful alternative to highly wasteful linear systems. The documents also discuss at the hand of case studies how industries or companies can transition.

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Oilcake imports persist despite local soya bean supply

PRF press release

The soya bean industry is currently facing a situation where the supply of soya beans is substantial, yet oilcake is still being imported. On 6 December 2018 the Sunflower and Soybean Forum called an industry meeting between key stakeholders to discuss this matter.

Stakeholders included representatives of the Animal Feed Manufacturers' Association (AFMA), South African Cereals and Oilseeds Trade Association (SACOTA), Grain SA, Protein Research Foundation (PRF), South African Cultivar and Technology Agency (SACTA), the Department of Trade and Industry (dti), the Department of Agriculture, Forestry and Fisheries (DAFF) and oilseed processors.

The planning session was facilitated by the PRF, Prof Ferdi Meyer of the Bureau for Food and Agricultural Policy (BFAP), and Dr Erhard Briedenhann of the PRF. Five priority categories were discussed: Supply and demand balance, pricing transparency, soya bean quality, issues with infrastructure, and imports and exports.

Overview of the soya bean industry

During the last five years, the soya bean industry has made excellent progress. Local production has doubled and processing of local soya beans has increased substantially. This led to an improved trade balance with significantly less oilcake imported into South Africa, which was a positive step for everyone in the value chain.

De Wet Boshoff, executive director of AFMA, indicated that the soya bean industry is the cornerstone of various other industries, such as the livestock industry, and it is important to ensure industry growth. "It is time to create an entire value chain plan to generate additional value for our consumers," Boshoff said.

Those present acknowledged that although the industry had experienced substantial growth during the last few years, it was still relatively young and in a maturing phase. However, the industry has been identified as one that can expand, with ample future opportunities.

Confirmation of processing capacity

In terms of supply and demand, processing capacity was yet again confirmed at 2,1 million tons, which at a level of 80% utilisation would result in crushing capacity of 1,68 million tons. The full fat capacity is 450 000 tons and 360 000 tons at 80% utilisation. Given the production increase during the last few years, this is still sufficient for the next two to three years.

In a radio interview on *RSG Landbou* regarding the industry meeting, Gerhard Keun, CEO of the PRF, said soya represents 46,6% of all protein sources available in South Africa for the livestock industry. "Although we are not yet self-sufficient, the local industry has grown by leaps and bounds to provide soya oilcake to the local livestock industry."

During the past two seasons, crushers faced numerous challenges, including mechanical failure, which severely affected crushing capacity. Prospects for the new season are optimistic, with an increase in crushing numbers a possibility.

The expansion in production is predominantly in the western parts of the country and various role-players who took part in the meeting said there was opportunity for expansion in crushing capacity in this area. The dti indicated that existing incentive schemes may be able to assist with further expansion.

Infrastructure issues

However, local infrastructure is of great concern. Load shedding and constraints relating to access to water are creating substantial downtime in the processing industry. In addition, this directly results in large-scale wastage and losses, affecting crushing margins, which are a concern within all agro-processing industries.

Improved infrastructure in terms of logistics is needed if total replacement of imported oilcake is to be achieved, especially for the coastal regions. To transport oilcake from Argentina by sea costs in the region of $30/ton, whereas local transport from the soya bean/soya bean oilcake producing regions to the Western Cape is more than $55/ton, making it difficult to compete with sea freight.

In terms of the replacement of imported oilcake, animal feed manufacturers confirmed their commitment towards the consumption of locally manufactured products and self-sufficiency of the inland market.

The coastal areas will always be a challenge due to the logistics system and competitive imports. It was reconfirmed that South Africa has good quality beans and oilcake, which must be combined with reliable and consistent supply to build confidence in the sector.

An industry norm is to be developed and published in respect of oilcake quality, in order to manage and coordinate the quality of oilcake in South Africa. Imports of Zambian oilcake into South Africa was also raised as a concern, given the price levels of imports.

Soya bean quality

The industry makes use of an annual soya bean quality survey carried out by the South African Grain Laboratory (SAGL) to ensure that the country's produce is of the highest quality. To build on this, the industry will investigate best practices in comparison with international standards and quality handling.

This is important if consistency and a reliable supply of soya beans is to be created. Part and parcel of this is the development of additional information and quality monitoring to facilitate and fast-track the maturity process and to create export markets.

A futures contract in the making

In order to develop better transparency in the market, the industry is in the process of developing an oilcake futures contract that will be listed on SAFEX. This will afford buyers and sellers of oilcake the opportunity to hedge local oilcake under local conditions, resulting in transparency in the oilcake market. Physical delivery of these contracts has been identified as a challenge that needs to be resolved before the contract can be listed.

In years of oversupply it is important to be able to export. DAFF is currently in the process of applying for access to markets such as China and has conducted bilateral meetings with the Chinese. However, a protocol market such as China is time-consuming to access.

A grain trade forum, including role-players from industry and DAFF, has also been established to facilitate communication and cooperation in this regard. The industry is furthermore collaborating with DAFF in order to find additional markets. Then again, it is important to ensure that the quality of local products provided to export markets is above the required minimums. The quality of local products is in place, but systems need to be developed that will provide guarantees and consistency.

Jozeph du Plessis, chairperson of the Sunflower and Soybean Forum, stated: "The soya bean has a lot of potential to assist producers to remain financially viable, to boost the economy and create job opportunities in South Africa, as well as to create a positive trade balance. However, to do this we need the correct systems in place so that we can be proactive and create opportunities."

Eye on the future

The industry agreed that South Africa has good quality produce but that there is a need for better systems and information to create constant supply, reliability, minimal variability and confidence. It was also decided that a Grain and Oilseed Value Chain Indaba will be planned for this year to develop a five-year plan for the industry.

For more information, phone Gerhard Keun on 011 234 3400 or email gkeun@proteinresearch.net.

Global biofuels at the crossroads:

An overview of technical, policy, and investment complexities

By Kathleen Araújo, Devinder Mahajan, Ryan Kerr and Marcelo da Silva

Biofuels have been used for years to increase energy self-sufficiency, reduce import costs and strengthen agricultural development. More recently, biomass-based transport fuels have become a strategic focus for regions wanting to minimise vehicle emissions and increase sustainability.

These fuels are instrumental in a shift to low-carbon fuels, which would bring about sustainability in the transport sector. This potential is shaped by the transport sector, which accounts for a third of global energy utilisation, half of oil consumption, and nearly a quarter of CO_2 emissions from fossil fuel combustion.

Since 2000, the supply of global biofuels has increased by a factor of 8% to equal 4% of the world's transport fuels in 2015 (*Figure 1*). This significant increase is attributed to policies such as blending mandates, which foster greater utilisation and may insulate biofuels during times of oil price flux.

In aviation, marine transport and heavy freight industries, biofuels are deemed the only practical, low-carbon alternative to fossil fuel. Specific to aviation, total greenhouse gas (GHG) emissions were projected to increase by 400 to 600% between 2010 and 2050.

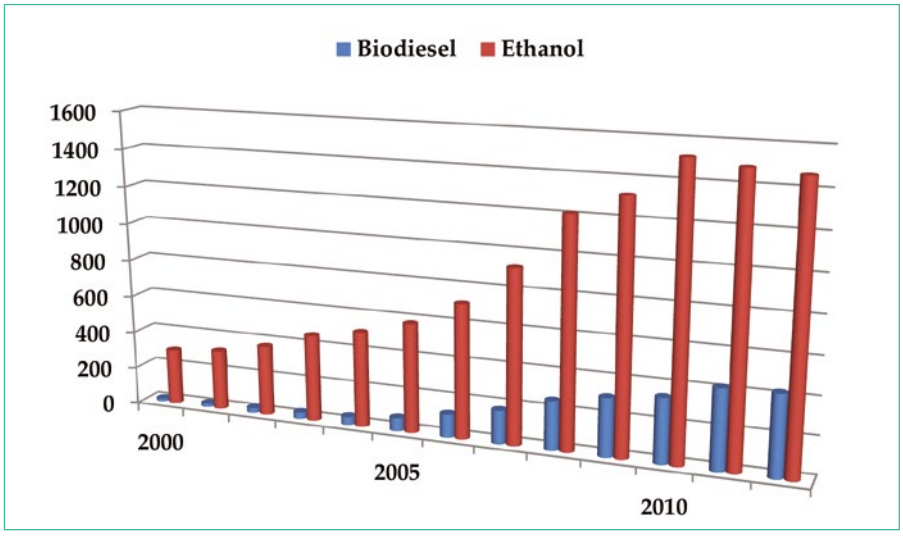
The aviation industry set targets for reducing CO_2 and flew their first commercial test flight with biofuels in 2008. As of mid-2015, approximately 22 airlines had completed more than 2 000 passenger flights with biofuel, which represented up to half the jet fuel mix. The recent signing of an agreement by 191 countries to curb aviation pollution underscores the substantial market potential for continued biofuel adoption.

Biofuel production pathways

In 2015, historical leaders Brazil and the United States (US) produced approximately 70% of global biofuel supply (mainly sugarcane-based and corn-based ethanol). Among the newer producing regions, the European Union (EU) focuses on bio-diesel from waste, soya, rapeseed and palm. This compares to production in Asia, which centres on sugarcane, corn, wheat and cassava, with investment also occurring in palm, soya bean, rapeseed and Jatropha. This regional and feedstock-based diversification may be conducive to the formation of an international biofuel commodities market.

Global biofuel supply equalled approximately 35 billion gallons (132 billion litres) in 2015, consisting roughly of a 3:1 breakdown of ethanol to biodiesel. Conventional biofuels produced from sugar, starch, vegetable oil or animal fat reflected the majority of the supply. In recent years, vegetable-based biodiesel nearly matched the ethanol supply produced from sugarcane.

Figure 1: Global biofuel production by fuel type (thousand barrels per day).



Primary fuel types

Conventional biofuels are produced from food- or feed-based crops, typically with hydrolysis and fermentation processes or esterification or trans-esterification. Ethanol and biodiesel dominate global biofuel production.

Ethanol is produced by fermentation of sugar from cane or beets, starch from corn or wheat, or root crops such as cassava. Ethanol is mostly used as a fuel additive (roughly 10%) in gasoline. Brazil is a notable exception with a fleet of flex fuel cars able to operate on any blend of gasoline and ethanol, or solely on ethanol. Vehicle design improvements could allow for mid-level blends of 20 to 40% to be used with enhanced efficiency.

Biodiesel is produced through an esterification/trans-esterification reaction of vegetable oils or animal fats with an alcohol, to generate fatty acid methyl esters (FAME) and a substitute or blend additive for diesel. Biodiesel is cleaner than fossil fuel-based diesel and attains a similar fuel economy. Biodiesel is prevalent in regions such as the EU and in Argentina and Colombia.

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Advanced biofuels are typically produced from non-food crops and residues or waste materials. Key conversion processes include hydrolysis and fermentation, hydrotreating, pyrolysis and alcohol fermentation from syngas. Common forms include drop-in fuels and biobutanol.

Drop-in fuels are renewable diesel and gasoline derived from lipids (vegetable oils, animal fats and algae) or cellulosic materials (crop residues and woody biomass) similar to petroleum-based gasoline and diesel fuels. These fuels do not have compatibility issues with engines or infrastructure and are easy to adopt in the supply chain. The technical ease and lower costs of integrating these fuels into markets is an advantage, since no major investment is needed for existing petroleum-based infrastructure.

Hydrotreated biodiesel produced from vegetable oils (HVO) or animal fats does not have some of the detrimental effects of ester-type biodiesel fuels, such as issues with increased NOx emissions, deposit formation, storage stability problems, more rapid aging of the engine oil and poor cold properties. As straight-chain paraffinic hydrocarbons, HVOs do not produce sulphur and have high cetane numbers, which allows higher speed diesel engines to operate more efficiently.

Renewable gasoline can be produced from the fermentation of sugars. Drop-in fuels can also be produced with processes such as catalytic conversion of sugars.

Biobutanol is a biomass-based fuel produced by fermenting the same feedstock as ethanol but mediated by different microorganisms. Its energy density is 10 to 20% less than that of gasoline. Relative to ethanol, biobutanol has a lower vapour pressure that translates into lower volatility and fewer evaporative emissions.

Key feedstocks for production

The diversity of feedstock options for biofuels is fairly significant, with local conditions typically framing the choice.

Lignocellulose

Lignocellulosic material is derived from non-edible crops. This abundant feedstock can be obtained from many different sources, including switchgrass, trees, and agricultural crop residues such as rice straw, wheat straw, corn stover and sugarcane bagasse. Take straw as an example: 2,3 billion tons of straw were available in 2011, with the theoretical potential of making 560 million tons of ethanol.

There is an incentive to utilise this non-food crop in lieu of traditional corn. The challenge is to produce the fuel economically as the process involves breaking down fibrous plant walls into sugars, which is an expensive step. Once sugars are formed, they can be fermented to produce cellulosic ethanol.

Algae

Algae has promising potential for biofuels in terms of high oil content, limited waste streams and minimal land requirements (compared to biomass). Water is essential for algae cultivation and can include fresh water, brackish, saline and wastewater types. Methods of cultivation and recovery vary, with implications for energy and environmental effects. As of 2011, current environmental impacts were deemed negligible, as scaled production had not been demonstrated.

Corn

Corn (or maize) is a fundamental food staple that can be grown in a range of climates from tropical to temperate. Fertiliser and pesticide needs are high for this crop. For feedstock and ethanol production, water needs are relatively low on the unit basis of ethanol produced. The US is a world leader in the production of ethanol for fuel from corn.

Jatropha

Jatropha is a non-food, perennial crop that can be grown on marginal land in a range of climate, soil and water conditions. It is highly resistant to drought. The largest production is currently in Guatemala, which has designated 25 000 acres (10 117ha) of land for Jatropha cultivation. Other countries investing in this crop include Mexico, Sudan, Ethiopia and India.

Palm

Palm, a prime feedstock for biodiesel, is produced for biofuels in Indonesia, Malaysia and other countries of Southeast Asia. Its oil is a fundamental food staple and the largest source of vegetable oil consumed worldwide. Palm trees require deep soil, a relatively stable high temperature and continuous moisture throughout the year. This feedstock grows in rainy and tropical land.

Soya beans

Soya beans are a prime fuel and food crop, accounting for 25 and 65% of the global consumption of oil/fat as well as meal/cake, respectively. The largest producers are the US and Brazil. This crop can be grown in tropical, subtropical and temperate climates.

Sugarcane

Globally, sugarcane is the second largest feedstock for ethanol production, and is a basic food crop grown in tropical climates. Sugarcane is grown in deep soil using fertilisers high in nitrogen and potassium, and low in phosphorous. Sugarcane requires a constant supply of water throughout the growing season. Brazil is the most notable producer of sugarcane-derived ethanol.

Sweet sorghum

Sweet sorghum is a high sugar sorghum variety mostly produced by the US, Nigeria and India. It can grow in tropical, subtropical and temperate regions. It is more versatile than sugarcane and can grow with limited water in poor/shallow soil. Compared to sugarcane and sugar beet alternatives, sweet sorghum is drought-resistant and has a much shorter growing cycle. Given its 70% water content, sorghum must be processed quickly post-harvest.

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Agbiz/BASA land reform proposal:
Commercial financing for NDP model on land reform

By Dr John Purchase

Following the release of the National Development Plan (NDP) in 2012, the South African agricultural sector – comprising government, organised agriculture, commercial lenders and agribusinesses in its widest context – realised the need for all parties to play an active and collaborative role in addressing land reform. To this extent government requested that commercial lenders most active in land financing propose a mechanism for the commercial financing of land reform.

The Banking Association South Africa (BASA) and the Agricultural Business Chamber (Agbiz) subsequently formed an Agbiz/BASA task team to respond to this request. Several workshops were held to arrive at the proposals contained in this article.

Agbiz/BASA task team proposal

- This proposal suggests a mechanism and process for the commercial financing of the land reform model as detailed in chapter 6 of the NDP.
- Tangible land reform results are the measure of success of the financing process.
- In this proposal, the task team representing the South African commercial banking and agricultural business sectors offers a commercial funding solution for an element of land reform.
- Land reform as per the NDP is a national imperative to ensure the country's stability, food security, rural development and security of tenure. The NDP model on land reform is essentially a proposed framework for land reform and not a 'one-size-fits-all' model or plan. It does, however, provide several principles for orderly land reform implementation. It is supported by both Agbiz and BASA, as it is underpinned by market principles that support the retention of commercial agriculture. At the same time, it does not undermine agricultural property values.
- The active participation of commercial farmers in the financing of land reform and establishment of a viable black commercial farming sector is a critical success factor. Commercial farmers offer commercial acumen and skills to enable the financing process. They will be responsible for originating commercially viable land acquisition transactions, with possible concomitant operational funding solutions.
- Commercial farmers need to be incentivised to participate in these joint ventures by making benefits such as access to grants, tax incentives, BBBEE ratings and recognition, etc. available. These incentives should be guaranteed by government and communicated to all parties involved.
- The proposal is premised on the retention of competition between lenders.
- Farmers must have the right to choose or select partner beneficiaries – the process must be demand driven, i.e. selection must be apolitical and voluntary.
- Normal commercial lending criteria principles will apply. Freedom of choice of financier is endorsed.
- This proposal is informed by the following principles:
    - Transfer of title into any legally accepted entity, for example a trust or company, in which the black-owned stake is deemed to be acceptable to government.
    - State-owned land, communal land and other land transactions not meeting normal commercial agricultural lending criteria are excluded. Separate funding models for such transactions will require development by government.
    - A land audit is an imperative and all available knowledge on who owns what needs to be consolidated and maintained in one database by the Deeds Office. This includes state and parastatal entities, as well as municipalities.
    - Speed of decision-making relating to the grant approval process is critical and should take place within 45 days to allow funds to flow within 14 days thereafter.
    - The Agbiz/BASA Assessment Committee will in principle vet the proposed land reform transactional framework for recommendation to the DRDLR. Agbiz/BASA representation will be specified by Agbiz and BASA. Assessment guidelines will be aligned with DRDLR conditions/criteria and this framework.
    - Incentivisation is required to ensure participation by commercial farmers.
    - Normal recovery processes under the *Insolvency Act* will apply.

Status update

In February 2015, the model was presented to minister Gugile Nkwinti and adopted by the DRDLR, but never implemented. President Ramaphosa, in the 2018 State of the Nation Address (SONA), indicated the importance of implementing exactly such a model. During his opening address of the Jobs Summit in early October 2018, the president explicitly referred to the importance of implementing the Agbiz/BASA Land Reform Model.

In the run-up to the Jobs Summit, DAFF and the DRDLR consulted with Agbiz and BASA on the implementation of the model and it was agreed that the model would be one of the initiatives that would qualify for blended finance from the facility at the Land Bank. This facility at the Land Bank, into which DAFF and the DRDLR have already injected R800 million for the current financial year (R2,5 billion over three years), is now functional and should be tested with applications. However, we are not aware of any successful applications to date.

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