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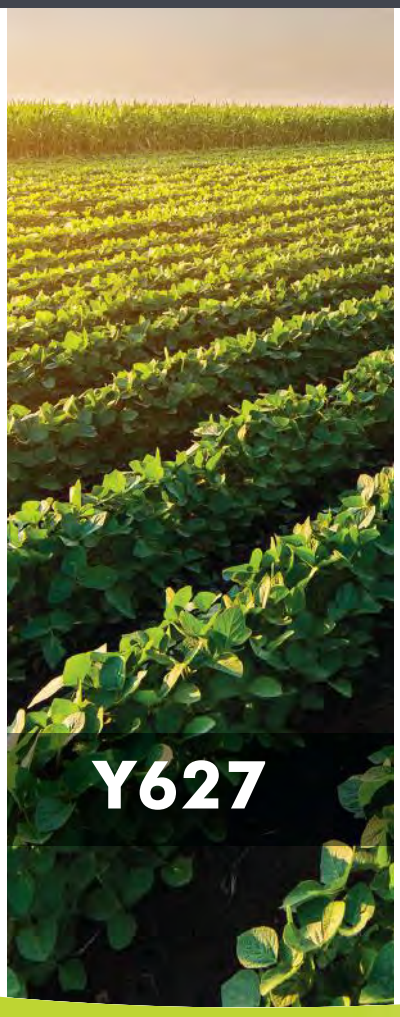

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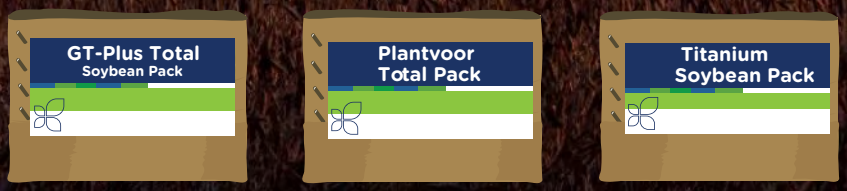

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There's safety in the **countercyclical oilseeds sector**

By Wessel Lemmer, general manager, Agbiz Grain

You do not often read newspaper headlines about the state of the oilseeds industry, as journalists mostly report on current events to which the public can relate. Although keeping up to date with the news is essential, you cannot allow yourself to be overcome by negativity, especially if you are an active stakeholder in the oilseeds industry and a reader of *Oilseeds Focus*. In their reporting on the oilseeds value chain and its role in the South African economy, publications such as *Oilseeds Focus* sustain hope in these troubled economic times.

The joint nett export value of the primary agricultural sector and the food and beverages manufacturing sector, is second only to mineral exports. The sector's performance is sustainable even during times of recession, which makes it countercyclical. This means that the sector's performance does not decline when the rest of the economy is in recession.

When a recession strikes, the demand for consumer goods tends to decline. However, food is a necessity, and the demand for food does not diminish when the demand for luxury and non-essential items decreases.

On the road to recovery

There are positive signs that the economy is recovering as the economically active part of our population begins to function again. It is encouraging that Lesetja Kganyago, governor of the South African Reserve Bank, rejects the idea that large-scale, quantitative easing is a necessary policy for South Africa at this time.

It is also a good sign that the mining sector input in June increased by 59% (up from May) and that retail sales volumes increased by 75% over the same period. The monthly sales of new vehicles have almost recovered to their usual level. This means that consumers' economic activity and consumption are improving despite the COVID-19 measures that were implemented earlier this year. It is important to take note of these developments as they ultimately support the consumption of oilseeds and oilseeds products.

The most recent economic data indicates that wholesale dealers in agricultural raw materials and livestock were the main contributors to the year-on-year (y/y) recovery in wholesale trade sales. In June this year, wholesale trade sales of agricultural raw materials and livestock increased by almost 20% y/y, in sharp contrast to the overall wholesale sales decrease of 6% y/y. In comparison, sunflower seed prices increased by 10% y/y in June and that of soya beans by 23% y/y.

For now, the increase in the prices of oilseeds strains crushing margins and contributes to the expected increase in food inflation, but overall agriculture still performs well.

A vote of confidence

The oilseeds industry should be more confident about the prospects of the next twelve months. The rand is expected to trade at similar levels a year from now. Private consumption is expected to increase by 3% y/y, while food inflation is likely to increase from the current 4,2 to 4,6% y/y.

This is not bad news, especially since the Brent crude oil price will increase by approximately 10% a year from now as the global economy recovers. It is important to note that South Africa is self-sufficient in terms of food and does not track the imported inflation of our largest imported item, namely crude oil.

Interest rates should only begin to increase a year from now by approximately 25 basis points, which should support producers' current investment in infrastructure to boost productivity. The expected year-on-year economic growth is likely to reach almost 9% in the second quarter of 2021 and 5% in the third quarter of the same year.

The way forward

All in all, we can look forward to a less volatile business environment and operations need to be geared to make the most of the economic recovery that lies ahead.

It was evident in a recent conversation with a service provider about the latest laboratory equipment that determines the oil content of sunflower seed and soya beans that role-players in the sector are equally upbeat about the future. They are much better off than their counterparts in the mining or water sanitation sectors.

We are fortunate to be stakeholders in agriculture, seeing that the sector responds differently to current challenges. In addition to the countercyclical nature of agriculture, an excellent rainfall year supported the current marketing year's output.

We are part of the best sector in South Africa. Keep it up and let us make the best of the opportunities that come our way.

For enquiries, phone the author on 071 354 2948 or send an email to wessel@agbizgrain.co.za.

The global environment **remains precarious**

No one can deny that producers worldwide have been experiencing headwinds over the past few months. Following heavy rains, flooding prevented livestock producers in South China from restocking after the devastating impact of African swine fever on the pig population over the past two years.

In addition, China's fear of a second wave of COVID-19 infections has resulted in its government implementing strict regulations to prevent the reintroduction of the virus from other countries. Controversial certification systems have also blocked exports to China. However, the country is committed to buying produce to the value of US$36 billion from the United States (US) in the trade deal between these two countries.

Elsewhere in the world

Meat processors in Germany came under the spotlight after it was revealed that subcontracted labourers, mainly from Romania, were to blame for repeated outbreaks of COVID-19 in processing facilities – it is difficult to implement and enforce social distancing in meat processing plants, which makes it a high-risk environment. In the US, the closing of processing plants to help reduce the spread of COVID-19 caused a significant drop in livestock prices. In contrast, retail prices rose considerably.

In Brazil COVID-19 outbreaks among workers in processing facilities have continuously interrupted operations, resulting in litigation between processors and unions. These outbreaks caused several Brazilian processors to be banned from exporting to other countries. Argentinian processing plants also hit a roadblock when China's COVID-19 safety measures for beef and pork imports suspended exports from several of the country's facilities.

In some countries the restrictions on tourism resulted in major hotel groups reducing operations and cancelling orders for poultry and eggs. This, in turn, meant that producers had to significantly reduce production, in some cases destroying millions of day-old chicks.

On the one hand, higher productivity in crop production is expected to mitigate the rising demands of the growing global population while on the other, the current reduction in global demand for certain food groups, together with sufficient supply, could see world food prices decrease in the short term.

Local oilseeds supply chains

In light of the global situation, the importance of communication across supply chains in a bid to promote the best interests of the South African oilseeds industry, has come to the fore once again. The objective of effective communication in the industry is to ensure that bottlenecks and constraints are addressed timeously and to make government aware of these challenges as well as opportunities.

South Africa's scarce resources must not be wasted on duplicated efforts, and available funding must not be spent on initiatives that do not contribute to the success and growth of the industry. That said, research and development, as well as investment in the industry, must be the core focus.

The Protein Research Foundation has played a pivotal role in initiatives to enhance the oilseeds industry's value chains and to determine the way forward. It will continue to do so with imperative objectives and goals.

Enjoy this issue of *Oilseeds Focus*.

Dr Erhard Briedenhann

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

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

Committee members
Gerhard Keun • 011 803 2579
De Wet Boshoff • 082 301 1035

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

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

Deputy editor: Danielle Barfoot
+27 12 664 4793 • danielle@plaasmedia.co.za

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

Advertising
Craig Wagner
+27 62 794 0910 • craig@plaasmedia.co.za

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

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

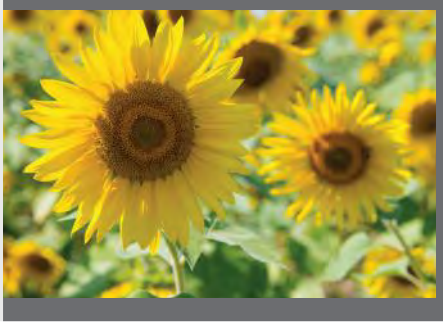
Esmarie Moodie
+27 76 330 0745 • esmarie@plaasmedia.co.za

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

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

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

Printed and bound by: Typo
+27 11 402 0571



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

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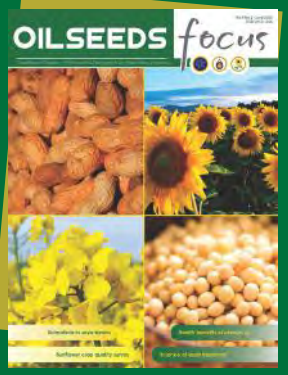

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NEWS

Novel strains of bacteria in legumes

Recent developments in the study of symbiotic interactions between legumes and rhizobia, particularly those related to the emergence of novel strains of bacteria that nodulate and fix nitrogen in legumes, are evoking much interest.

A review by Dr Ahmed Hassen of the Agricultural Research Council (ARC) Plant Health and Protection Research Institute focuses on the emerging beta rhizobia, which is isolated from the indigenous papilionoid legumes in the Cape Floristic regions in South Africa. The nodulation of the indigenous South African papilionoid legumes, including that of *Aspalathus linearis* (rooibos), is discussed.

Previous reports indicated that the slow-growing *Bradyrhizobium* spp. nodulated *A. linearis*. The review highlights that nodulation is no longer restricted to the traditional 'rhizobia' group, following the emergence of the new beta rhizobia as potential nodulators of various indigenous legumes. This provides new insight and challenges the long-held view on host specificity of the legume-rhizobia symbiosis. – *ARC Plant Health and Protection newsletter*

Syngenta Seeds completes acquisition of Sensako

Syngenta Seeds announced that it has completed the acquisition of Sensako, a South African seed company specialising in cereals. The acquisition will lay the foundation for growth and help accelerate Syngenta Seeds' entry into the South African seeds market in wheat, maize and sunflower.

"We're excited to connect Sensako's talented team with our growing global seeds business," said Jeff Rowe, president of Syngenta Seeds. "This strategic investment opens the door for us to bring more choice, innovation and technology to help growers thrive in the region. Most importantly, we will have the opportunity to bring our leading Viptera trait technology to growers to address the permanent, rapidly spreading threat of fall armyworm in South Africa."

Sensako is currently a distributor of Syngenta's sunflower seeds. – *Press release, Syngenta*

Demand for Canadian canola soars

Canadian canola prices recently soared to the highest it has been in nearly two years, despite a diplomatic dispute between Ottawa and Beijing, as exporters find roundabout ways to reach top oilseeds buyers in China. Chinese authorities have been blocking canola shipments by two Canadian exporters since March last year.

However, the dispute has not spoiled China's appetite for canola, which is mainly processed into vegetable oil. Although China buys less canola directly from Canada, the country has bought canola oil from Europe and the United Arab Emirates, with some of that oil made from Canadian canola. – *Global News*

Bayer resolves Roundup lawsuits

In June this year, Bayer announced a series of agreements that will substantially resolve major outstanding Monsanto litigation.

The main feature is the United States (US) Roundup resolution, which will conclude nearly 75% of the current Roundup litigation involving approximately 125 000 filed and unfiled claims overall. The resolved claims include all plaintiff law firms leading the Roundup federal multi-district litigation, and those representing approximately 95% of the cases currently set for trial, and establish key values and parameters to guide the resolution of the remainder of the claims as negotiations advance. The resolution also puts in place a mechanism to resolve potential future claims efficiently.

The company will make a payment of between US$8,8 billion and US$9,6 billion to resolve the current Roundup litigation. Bayer's Management and Supervisory Board unanimously approved the resolutions with input from its Special Litigation Committee. The agreements contain no admission of liability or wrongdoing. – *Farm Progress*

Export ban baffles groundnut traders

Sudanese groundnut traders are reeling after a government export ban was put in place without warning, resulting in the loss of important markets.

According to the United Nations, Sudan is the fifth-largest groundnut producer (14% of global production) in the world. The country has been a top producer of groundnuts for so long that a nutritious variety, called the 'Sudani', has been named after it. Sudan produced 1,5 million tons in 2019, worth US$205 million, according to central bank figures, up from US$59 million earned in 2018. The two main buyers of Sudan's groundnuts before the ban were China and Indonesia.

Sudanese minister of industry and trade, Madani Abbas Madani, defended halting exports to maximise the market value of groundnuts and the added value of Sudanese products in light of climate change that affects the quality of the product. For the government, the hope is that Sudan can earn more money through selling products from processed groundnuts, such as oil or butter. – *Arab News*

Report on soya bean row width and plant population

By Dr Jan Dreyer, Protein Research Foundation

There is still no clarity as to how soya bean producers should best approach the aspects of row width and plant population. To aid in this endeavour, it is important to touch on a few physiological drivers that can either increase or decrease yield (only those aspects that have a bearing on row width and plant population will be discussed briefly).

Successful soya bean production requires the integration of a great many production inputs other than only row width and plant population. Planting depth, soil fertility, and weed, pest and disease control should also be optimised to reap the benefits of well-adjusted row widths and plant populations.

Key physiological aspects

Soya beans, like all plants, need leaves with optimal photosynthetic capacity to produce the maximum yield for a specific environment. It is thus clear that the leaves should cover the area it is planted on as soon as possible to capture the maximum amount of sunlight. Under normal yield conditions, this is a gradual process as soya beans are planted in rows.

As soon as the first leaves appear, a multitude of complex physiological processes and cycles will start to operate. Roots transport all the necessary elements and water to the leaves, which in turn produce the building blocks required by the plant to grow and produce seeds.

Growth phases of the soya plant

The soya bean plant moves through three different growth phases:

Phase 1: The basic structures, such as leaves and roots, of the plant are formed. These structures enable the soya bean plant to capture sunlight (leaves) and extract water and nutrients (roots). Nitrogen (N) fixation will supply nitrogen to the plant through the root system.

> Soya bean production in South Africa is dominated by what is achievable within the limitations of climate, soil and farming practices.

Phase 2: Reproduction starts with the formation of flowers. This phase can sometimes be stretched to include active pod set. During this phase, some structural growth may still take place, but the assimilates (products of photosynthesis) will be directed towards pod development. Yield potential is set during this phase and the plants

should perform at their peak in order to ensure the best possible yield for the specific environment. Excess flowers are dropped and pod set is in full production; seeds also start developing and can be felt when the pod is squeezed.

Phase 3: The yield potential set during phase 2 will now be realised based on environmental conditions and the potential assimilates that can be translocated from mainly the leaves. The plant will start dropping its leaves (the 'factory' of the plant) and will go into self-destruction mode for the benefit of a higher yield. However, as with all biological processes there are exceptions. Leaves may stay on longer and thus actively supply the kernels with assimilates – this is even more likely in indeterminate cultivars.

When striving for higher yields, producers need to consider the plant community and not just individual plants. To optimise yields it is therefore imperative to establish ground cover (full canopy) before the reproductive stage (phase 2) commences. This process requires adequate moisture and effective disease and pest control.

Leaf cover is normally expressed as leaf area index (LAI), which is the ratio of total leaf area to the ground area covered. The LAI may vary substantially, but LAI+3 is generally considered sufficient (depending on row width, cultivar choice, disease incidence, etc.)

Another physiological aspect that needs to be considered is the competition for light among individual plants. Work done by Wessel van Wyk of the Protein Research Foundation clearly shows that plants planted in close proximity (closer than 4cm) will have a noticeable effect on the plants in the row (some will be barren with no contribution to grain yield).

Examples from abroad

Judging from the previous information it can be inferred that it might seem easy to determine the optimal row width and plant population for soya beans. But let's consider international test results.

Quite a few experiments have been conducted in the United States (US). Results from these trials in the northern (cooler) part of the country showed a tendency towards narrow rows. Row spacings of 19 to 114cm were tested in different localities.

> Choose a plant population and row spacing that will cover the soil when the plants enter the reproductive phase.

Results indicated that soya bean yields were optimal in row spacings of 38 to 50cm. In another study, when row width was reduced from 114 to 76cm (unspecified plant population), it resulted in an increase in yield as well as the harvest index – the latter refers to the ratio between grain harvested and the plant's total biomass. Yields tend to be higher as row width decreases. Trials in the southern (warmer) part of the US were inconsistent.

In an elaborate study in India, six different planting geometries were used with 30 and 45cm rows. The best combination was 30cm rows with a plant population of 333 000 plants/ha; however, at comparable plant densities, there were no significant differences in yield between the 45 and 30cm rows.

Increased plant populations

Growth habits differ considerably when plant population is increased. A plant density of 666 000 plants/ha produced a plant height of 59cm as opposed to only 46cm at a density of 148 000 plants/ha. This will influence lodging; the higher the plant, the higher the likelihood of lodging. The harvestable crop will also be decreased.

Maturity grouping (MG) may well have an influence on row width and plant population. Early maturing (MG 4) cultivars respond positively to higher plant populations and narrower rows. This is especially applicable to late plantings. Longer growing (MG 5) cultivars tend to be less sensitive to plant population and row width.

The growth habit of a cultivar has a profound effect on row width. Cultivars with a bushier canopy will fit wider rows better than upright types. Row width will also influence the amount of yield carried on the main and side branches. In a study where widely different spacings (19 vs 97cm) were used, the main stem carried 45% of the seed yield in plants in the wide row as opposed to 69% in plants in the narrow row.

Results from Argentina indicated that plant population tends to be lower – plant population was down from more than 300 000 plants to 250 000 and fewer. Row width varied but tended to be on the narrow side (less than 50cm). In Brazil, row spacing of less than 40cm resulted in the highest yields.

The local scenario

Soya bean production in South Africa is dominated by what is achievable within the limitations of climate, soil and farming practices. Fortunately, the producer still has a wide choice of well-adapted cultivars to choose from.

Before any informed decision on row width or plant population can be made, the cultivar choice should be considered:

- MG 4 cultivars generally respond positively to narrow rows and higher plant populations.
- Late plantings normally result in higher plant populations.
- Where yield potential is high (more than 2,5 tons), yield increase is possible with narrow rows and higher plant populations.
- Soya beans under irrigation usually benefit from narrow rows and relatively high plant populations if disease pressure is low.
- Minimum or no-till may imply an upward adjustment of plant population. This will depend on ground cover and the planter used.
- Where narrow rows are possible, it will help to suppress weed growth, especially during the early growing season.

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Wider rows and lower plant populations will be of benefit to the producer under specific conditions. The following must be considered:

- The type (growth habit) of cultivar will dictate the planting geometry. A bushy type will excel in wider rows and at a lower plant population.
- Low soil moisture at planting, as well as low expected rainfall for an area, imply a lower plant population.
- The plant population needs to be adjusted when rows are widened. Keep in mind that 4cm is about as close as soya beans can be spaced within the row. Closer spacing means that some of the plants will have no pods, effectively transforming them into weeds.
- Moisture consumption increases as plant population increases.
- Disease pressure, especially *Sclerotinia* infections, sometimes forces producers in high yielding areas to adjust their plant population lower in wider rows to prevent a favourable microclimate for the development of disease.

Farming operations will also dictate the row width of crops, including soya beans:

- Crop rotation is vital for sustainable soya bean production. This also implies that soya bean row width should generally fit in with the main crop, in most cases maize.
- The financial impact is often key when deciding to move from one operating system to a new one.
- Soil type is associated with crust formation, which necessitates some form of cultivation under conventional tillage. Similar operations are needed where wind damage may occur.
- Keep in mind that for the past season, producers throughout the soya bean production area had bumper crops with an average row width of over 90cm – in some cases with a plant population of 220 000 plants/ha.
- In all cases the cultivar is of paramount importance. Determinate and indeterminate cultivars need to be considered, with the latter more suitable for drier areas.

Table 1: The choice of plant density at certain row widths.

	Density					
	150 000	**200 000**	**300 000**	**400 000**	**500 000**	**600 000**
Rows	**Number of seeds per metre; (…) distance between seeds (cm)**					
38cm	6 (16,6)	8 (12,5)	11 (9,1)	16 (6,25)	19 (5,3)	23 (4,38)
45cm	7 (14,3)	9 (11,1)	14 (7,14)	18 (5,55)	23 (4,35)	27 (3,70)
52,5cm	8 (12,5)	11 (9,1)	16 (6,25)	22 (4,55)	26 (3,85)	32 (3,13)
60cm	9 (11,1)	12 (8,33)	18 (5,55)	24 (4,17)	30 (3,33)	36 (2,78)
76cm	11 (9,1)	15 (6,67)	23 (4,35)	30 (3,33)	38 (2,63)	46 (2,17)
90cm	14 (7,14)	18 (5,55)	27 (3,70)	36 (2,77)	45 (2,22)	54 (1,85)

Recommended | Maximum/Minimum | Problem | Not recommended

The amount of seeds per running metre must preferably not exceed 30 and not be less than 10. Seeds planted closer than 3cm from each other will cause excessive intra-row competition while further apart than 12,5cm will hamper emergence. Row width therefore determines the choice of plant density.

Variables to consider

From the aforementioned experimental results, it is clear that quite a few variables should be considered before a producer can decide on a strategy. A few basic principles are important:

- Choose the best cultivar for your specific area.
- Make use of all available cultivar information, including MG, growth habit, pod height, disease and pest tolerance, yield, and yield stability. Start with the Agricultural Research Council's cultivar recommendations.
- Adjust the crop spacing to the time of planting. Late plantings will result in narrow rows and an increase in plant population. The optimum planting date is mid-October until the end of November (climate plays a dominant role). Early planting with the right cultivar results in higher yields.
- Use long-term data to decide what the yield potential is for your area or even for a specific field.
- Choose a plant population and row spacing that will cover the soil when the plants enter the reproductive phase. Keep in mind that excess plant density may deplete soil moisture before the critical reproductive phase.
- Consider your own farming operations before deciding on a specific row width and plant population (*Table 1*). Remember, no plants closer than 4cm in the row.
- A narrow row implies 45cm or less, while a wide row is 90cm or more. High plant populations constitute 300 000 plants/ha or more, while low values are over 200 000 plants/ha. These values will change with different cultivars, time of planting and the production season in general.

For more information or a list of references, phone Dr Jan Dreyer on 082 462 6651 or send an email to janmar.dreyer@gmail.com.

South African *Sclerotinia sclerotiorum* research in the age of genomics

By Dr Markus Wilken and Sikelela Buthelezi, Forestry and Agricultural Biotechnology Institute (FABI), Department of Biochemistry, Genetics and Microbiology, University of Pretoria

Sclerotinia sclerotiorum is a fungal pathogen of many crop species that needs no introduction to anyone working in the agricultural industry. In South Africa, *S. sclerotiorum* causes disease on many economically important crop species including canola, soya bean and sunflower.

The persistent occurrence of this fungus in the field is attributed to its ability to form hardened, long-term survival structures called sclerotia, a trait it shares with other plant pathogens (e.g. *Claviceps purpurea* that causes ergot on cereal crops) and even some mushroom species (e.g. the psychedelic mushroom *Psilocybe Mexicana*). Sclerotia of *S. sclerotiorum* form the basis for its infection cycle, with severe outbreaks leading to significant yield losses.

Pathogenicity of S. sclerotiorum

Its notoriety as an economically important pathogen has led to *S. sclerotiorum* being a well-researched fungus. Although much is known about its infection cycle, its ability to cause disease in a range of plants is still not well understood, which is a rather typical property among plant pathogens. This has led to many studies focusing on the way in which *S. sclerotiorum* causes disease and identifying a wide array of biological molecules that affect its pathogenicity, as well as ways to control it in the field.

For example, viruses and antagonistic fungal species that adversely affect *S. sclerotiorum* have been identified. These studies have boosted our understanding of the pathogen significantly, but as is commonly the case, the elusive 'silver bullet' has not yet been found.

Unravelling its genome sequence

Research is intricately linked to technology and following the development of so-called next generation sequencing platforms, we now have access to the full genome sequences of many living things. A genome sequence is a copy of all the genetic instructions present in a cell – it essentially represents the blueprint on what makes a species what it is.

The availability of full genome sequences has thus impacted all aspects of biology, including modern plant pathology where it has provided a plethora of new tools for enhancing plant health. For *S. sclerotiorum* (strain 1980), a high-quality draft of its genome sequence was produced in 2005 and, by using newer sequencing technologies, was completed in 2017.

The *S. sclerotiorum* genome has 38,7 million nucleotides, which is approximately 1,5% the size of the human genome. Despite its small size, the *S. sclerotiorum* genome contains roughly 50% as many genes as found in humans. However, the functions of most of these genes are not yet known, highlighting the complexity that underlies the functioning of something seen as a 'simple' fungus.

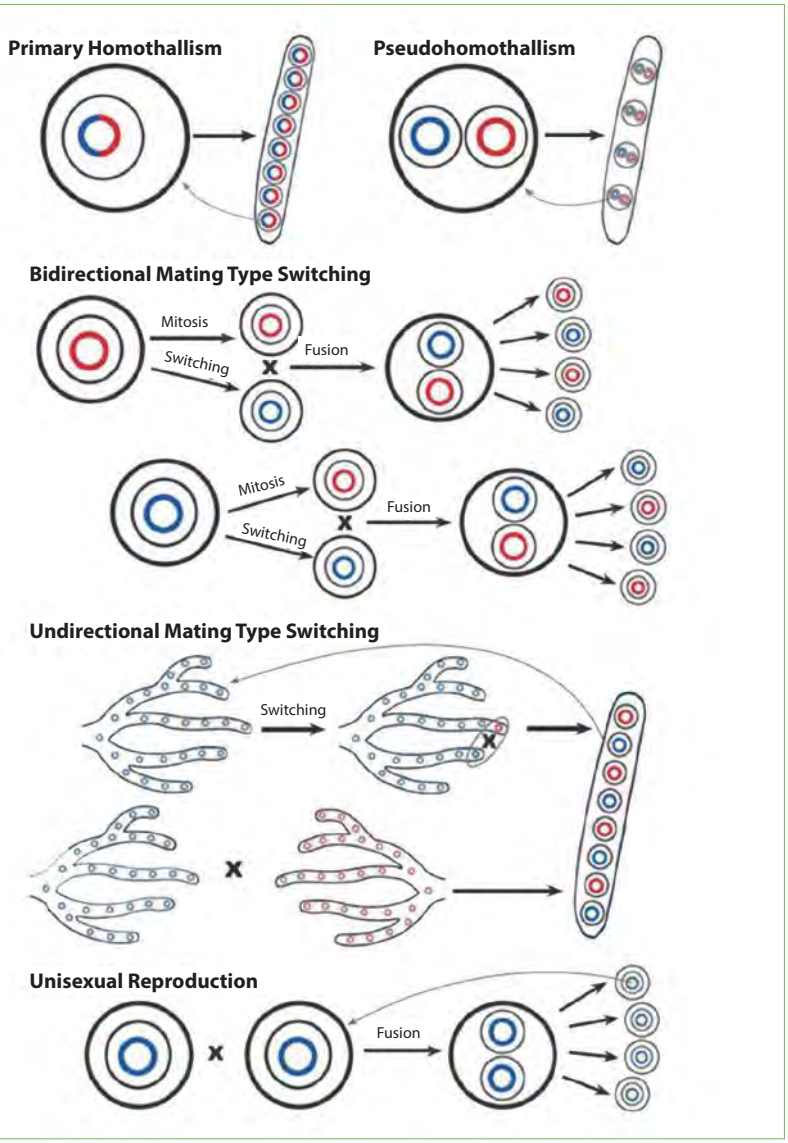
The tools provided by a genome sequence is useful for many studies related to fungal pathogens. Genomes offer the chance to develop population-level markers specific to a target species. This has significant benefits for epidemiological studies in that it allows estimation of genetic diversity and modelling of future infection risks. A genome sequence also provides a catalogue of the history of a species that can be picked apart for clues as to the origin and biological functioning of the fungus. Although it sounds very simple, these are complex tasks that require huge contributions from many scientific fields.

Reproduction ability of fungi

One study area that has benefitted from the availability of genome sequences is research into the reproductive strategies of fungal pathogens. The sexual process in fungi is controlled by genes present at a

Sclerotinia sclerotiorum on soya beans. (Photograph by Ken Wise, NY State IPM Program at Cornell University)

Figure 1: A representation of the various genetic mechanisms of homothallism in fungi. Red and blue circles represent haploid genomes of opposite mating type; large black circles represent single fungal cells; and small black circles within black ovals represent ascospores within asci. (Taken from Wilson et al., 2015)



specific location in the genome. Knowledge of the structure of this region provides insight into how these fungi reproduce, which in turn has important implications for the population dynamics of a species.

A species that employs an exclusively outcrossing or heterothallic reproductive mode (*Figure 1*) will need to find a compatible mating partner and subsequently produce genetically diverse progeny that can increase the adaptability of a species. In these fungi, if a compatible mating partner is not available, sexual reproduction will not occur, which could have a sizeable impact on the population genetics of the fungus.

By contrast, in homothallic species (*Figure 1*), mating can occur in the absence of a partner. Here, an isolate can initiate solo sexual reproduction and produce thousands of sexual progeny by itself, resulting in a population of clones – individuals that are genetically identical. However, they retain the ability to outcross, and can thus benefit from outcrossing and the generation of variation similar to heterothallic species.

Reproduction of S. sclerotiorum

S. sclerotiorum is homothallic and can therefore reproduce in the absence of a mating partner. During this process, the fungus produces the characteristic mushroom-shaped apothecia, which releases sexual spores that can establish an infection on the plant.

As expected, many field populations of the fungus show high levels of clonality due to homothallism. However, some population studies show moderate levels of genetic diversity and the genetic signatures of outcrossing, putting the reproductive strategy of this fungus under the microscope. From a molecular viewpoint, the sexual process is even more bizarre as it incorporates a change at the DNA level that structurally and functionally influences the sexual process. This leads to questions on the link between the DNA rearrangement process and the occurrence of unexpected levels of genetic diversity in the field.

Research on the local front

Our project aims to establish a South African-specific genomic resource for studies on *S. sclerotiorum*. The availability of a high-quality draft genome from a South African isolate of the species will prove invaluable for expanding our current understanding of the pathogen in a local context.

It would allow us to design genetic markers catered specifically to the South African population and target suitable regions for developing diagnostic tools, while at the same time providing insight into the evolutionary history of the pathogen in the country. With the genome information, we will also be able to study the reproductive strategy used by South African populations of the pathogen.

Insights gained from these studies will not only add to the growing debate around the population genetics structure of the fungus, but also contribute meaningfully to efforts aimed at combating this important pathogen in the field.

For more information or a list of references, send an email to Dr Markus Wilken at markus.wilken@fabi.up.ac.za or Sikelela Buthelezi at sikelela.buthelezi@up.ac.za.

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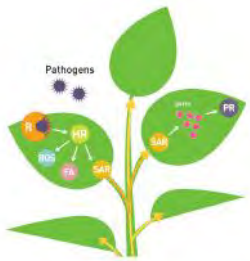

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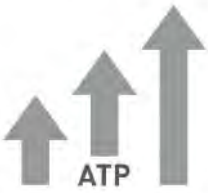

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Soya bean seeds: Does size really matter?

By Claudi Nortjé

Seed size has often come into question when its effect on the yield and overall performance of a plant has been raised. Since positive correlations between seed size and yield in a variety of crop species have been reported, researchers have conducted similar studies on soya beans. According to a study conducted by the American Society of Agronomy, which was published in *Agronomy Journal*, seed size has little to no effect on a soya bean plant's mortality, lodging, or the size of harvested seed.

The study found that when larger and smaller soya bean seeds were planted in the same row, the progeny from the larger seed produced more yield compared to that of the smaller seed. Ultimately it was found that the impact of seed size on progeny performance was a response to relative seed size within a population, and not a response to seed size per se.

Seed weight vs count

Another study done by the University of Missouri found that soya bean seed size does not affect yield performance at all. According to the study, this finding may prompt industry role-players to restructure the way soya bean seed is sold. While discussions about selling soya bean seed by count, as opposed to weight, have been doing the rounds for years, the study points out that this practice is not yet the norm.

Seeing that soya bean seed is usually sold in bulk and priced according to weight, variations in seed size translate into changes in the number of seeds per bag. For instance, if soya beans were a little bit smaller than normal and equalled 3 200 seeds/pound, instead of the average 2 800 seeds/pound, a 50-pound bag would contain 160 000 seeds. This translates into 20 000 more seeds compared to the average 140 000 seeds per 50-pound bag. Seed size can vary according to seed variety, but is also impacted by various environmental factors.

According to the study, farmers may deliberately choose soya bean varieties with a smaller seed size as they would end up purchasing a lot more seeds at no extra cost. By doing this, producers can lower seed costs per acre if they calibrate their planters by seed count and not weight. For this reason, soya bean producers may be reluctant to purchase seed by count instead of weight.

Although neither method is promoted in the study, it does highlight one advantage of buying soya bean seed by seed count: If planters are calibrated according to the number of seeds instead of their weight, farmers can determine exactly how much seed they need to purchase of each soya bean variety. This can help producers to save on soya bean seed costs and can reduce the amount of seed that needs to be returned after the planting season. Treated seed is more difficult to return due to its usage limitations. However, protecting seeds with seed treatments is becoming more common as the price for soya bean seeds is increasing.

The University of Missouri states in their study that if the seed industry were to purchase seed by count instead of weight, it may shift the focus to the characteristics of the different soya bean varieties.

Selecting the right cultivars

When it comes to choosing between soya bean varieties and determining the profitability of soya bean production, resistance to diseases and pests, as well as yield potential should outweigh the importance of seed size.

The study states that in most cases the size of soya bean seeds does not affect emergence percentage, seedling vigour or

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

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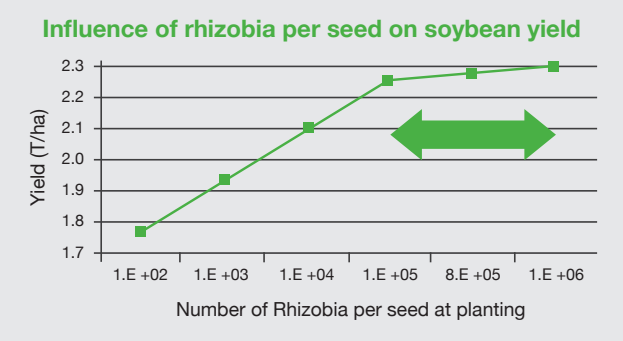
What is the shelf life of a soybean inoculant?

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

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

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

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



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

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

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

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

What is the importance of soybean inoculant packaging?

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

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

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

BASF caters for various farmer preferences including the offer of peat or liquid based products, same day treatment and plant solutions as well as on-seed survival inoculants.
HiStick® – Peat based inoculant for treatment and plant within 24 hours.
Rhizoflo™ – Liquid based inoculant for treatment and plant within 24 hours.
Rhizoflo™ Professional – Liquid based inoculant for up to 21 days on-seed survival when stored below 20 °C.

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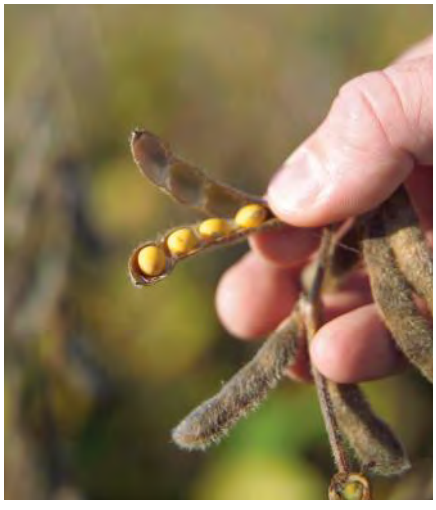
yield potential. One thing that producers should keep in mind, though, is that smaller seeds have less stored reserves, which means that planting depth can play a key role in successful germination and ultimately crop yield. If soya bean seeds are small due to early maturity, they may be less vigorous than normal; however, apart from these factors, seed size should not play a distinctive role in variety selection.

Causative factors

The seed size of soya beans is largely dependent on two factors, namely the genetic tendency of the seed variety and the growing conditions that seed are exposed to. Factors such as excessive stress or optimal rainfall conditions from the R6 growth stage onwards can have a huge impact on the size of soya beans.

According to a study published in *Journal of Seed Science*, the level of soil fertility also plays an instrumental role in the ability of seeds to express their potential vigour, which may ultimately influence crop productivity. In terms of essential soil nutrients, phosphorus is a key driver of various metabolic processes in soya bean plants. These processes include the transfer of energy, respiration, photosynthesis, synthesis and stability of cell membranes, synthesis of nucleic acids and glucose, and the activation and deactivation of various enzymes.

When seeds are exposed to optimal growing conditions with enough rainfall, it usually encourages the formation of more pods. Then again, if soya bean plants that already have above-average pod sets experience a decrease in rainfall during the R6 as well as subsequent growth stages, the resulting seeds are usually smaller or normal sized. If soya beans are grown in drought conditions, the size of the seed will be smaller with an overall reduced number of seeds per plant.



Studies found that the impact of seed size on progeny performance was a response to relative seed size within a population, and not a response to seed size per se. (Photograph: United Soybean Board)

The study found that some farmers deliberately choose soya bean varieties with a smaller seed size, ensuring more seeds at no extra cost, as well as lower seed costs per acre if they calibrate their planters by seed count and not weight. (Photograph: United Soybean Board)

If plants have already decreased their total number of pods due to drought exposure in the initial growth stages, seed sizes can become bigger if the plants are exposed to increased rainfall. In other words, plants can recover exceptionally fast if exposed to rainfall after experiencing initial moisture stress. However, due to an already-decreased pod set, the plant's normal photosynthetic capacity will then result in very large seed.

Seed size and yield potential

In extreme circumstances soya bean seed size can affect germination and emergence, but generally speaking seed size does not affect yield potential. In dry soil conditions, smaller soya seeds have better emergence than larger seeds as larger seeds need more energy to emerge from the soil. For this reason, larger seeds have a bigger energy reserve that can help them to successfully navigate adverse growing conditions for longer periods prior to emergence compared to smaller seeds.

One study conducted by Agriculture and Agri-Food Canada (AAFC) found that while some field trials showed that soya bean plants originating from large seeds had significantly greater yield than those from small seeds, others indicated no correlation between seed size and yield if plots were grown at consistent population densities.

Most of the experiments in this study were conducted in greenhouses or in warm climates where the conditions at germination and the early development of plants were optimal. The results also showed that smaller seeds had a higher plant emergence in light-textured soils, while larger seeds had greater emergence in heavy-textured soils. Yet the differences in plant emergence did not produce significant yield differences.

Another study published in *International Journal of Agronomy* found that although researchers noticed improved germination of small- and medium-seeded varieties in laboratory settings, the inherent field moisture present when planting seeds may play a more important role than seed size when it comes to germination and emergence.

For a list of references, send an email to the author at claudi@plaasmedia.co.za.

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The Clearfield® Plus sunflower production system has grown by leaps and bounds due to its high level of performance and overall market acceptance.

Clearfield® Plus qualified seed

Before the sunflower cultivars can be classified and sold as Clearfield® Plus seed, BASF's seed partners undergo several years of internal development and stringent qualification trials. It is important to highlight that Clearfield® Plus cultivars are not genetically modified and contain a naturally occurring, herbicide-tolerant gene that is bred into the seed companies' existing sunflower seed cultivars.

Euro-Lightning® Plus herbicide

In addition to the high-performing Clearfield® Plus seed, BASF also offers Euro-Lightning® Plus, the Clearfield® Plus herbicide for sunflower.

Euro-Lightning® Plus boasts significant improvements, the main advancement being its improved formulation. The new formulation is designed for improved weed control in Clearfield® Plus sunflower fields through higher levels of herbicide adherence to target weeds. Euro-Lightning® Plus eradicates yield-robbing weeds, thereby delivering cleaner fields.

Under no-till conditions, excellent weed control has been observed during the growing season in fields where Euro-Lightning® Plus was applied. Subsequently, there has also been a decrease in difficult overwintered weeds, which cause challenges during the following season's pre-plant burndown applications.

Using Euro-Lightning® Plus

Euro-Lightning® Plus can only be used on Clearfield® Plus sunflower cultivars (original Clearfield® sunflower cultivars are also excluded). The following is recommended:

- Always clean spray tanks, hoses and nozzles with a suitable tank cleaning solution prior to mixing the Euro-Lightning® Plus solution.
- Always use flowable (50%) high-quality ammonium sulphate.
- Do not use any surfactants that contain acidifying agents.
- Applications must be made within 32 days of planting.
- To achieve good control, thorough coverage of the target weeds must be completed by the 2 to 6 leaf stage – take note that the weed must be actively growing.
- Do not add any other crop protection products to the solution.
- Do not mix Euro-Lightning® Plus with any organophosphate or carbamate insecticides and do not apply where these products have already been used as soil or foliar treatments.

Euro-Lightning® Plus label update

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

Bellis® on sunflower

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Table 1: New waiting periods for follow-up crops.

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

** BASF and its seed partners strongly advise and endorse the use of Euro-Lightning® Plus as the only supported herbicide. Additionally, it is vital to follow the label recommendations closely. If other solutions are used, neither BASF nor the seed company can support the producer if problems occur. Please read the Euro-Lightning Plus® label for full instructions and details.*

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Relationships between microbes, legumes, and chemicals demand astute agricultural practices

By Prof Charlie Reinhardt

Over the ages, virtually all microbial species have had the opportunity to be distributed worldwide in surface soils. However, regional (large scale) and site (small scale) differences in type and population size of micro-organisms show that they respond to specific environmental control factors and substrates.

The composition of soil microbial communities, which can consist of thousands of species per gram of soil, is the result of specific differences in their environment. Soil microbial species respond differently to factors such as crop rotation, soil tillage, type of crop, nutrition of the host crop, temperature, soil moisture content, soil pH, and substrate concentration (NH_4^+ [ammonium ion] concentration in the case of the nitrifier bacteria responsible for conversion of NH_4^+ to NO_3^- [nitrate]).

The rhizosphere

A multitude of phenomena occur at or near the root-soil interface, and the sum total of their effects has a great impact on both plants and soil biota. Hiltner, in 1904, coined the term 'rhizosphere' for the area of bacterial growth around the roots of legume plants. Later the rhizosphere was generally considered to be that zone of the soil in which plant roots occur and in which there is proliferation of micro-organisms due to the influence of plant roots.

Organic substances found in, on or in the vicinity of roots reveal a vast array of chemical compounds varying from simple molecules to complex, high molecular mass substances. Included among these compounds are microbial attractants and repellents, which are species (plant)-specific. Generally, plants contribute 2 to 16% of their photosynthate (carbohydrates formed during the photosynthesis process) to the soil carbon (C) and microbial biomass – for example, soya bean reportedly contributes 2% of net photosynthate production.

The majority of soil-living organisms are 'organotrophs' that obtain their C input from plant roots and organic residues supplied by living and dead plants; this and other essential elements for growth are obtained from the host in the case of a symbiotic relationship between microbe and living plant host, or are acquired by free-living (asymbiotic) microbes.

In addition to supplying soil microbes with C for growth, plant roots have numerous effects on soil biota – by far the largest effect is the lowering of soil moisture content due to water uptake, which in turn reduces leaching of nitrate (a positive effect).

Another important role of the plant root is mineralisation of soil organic matter (SOM) – moisture removal would decrease SOM mineralisation under dry conditions. Natural grassland with high root biomass is associated with humus-rich, or humic, soils with the highest SOM.

The humic soil group is typified by marked accumulation of humus, high degree of weathering, well-drained landscapes of high rainfall and cool temperatures, and dense grassland or forest cover. Such soils are easy to work, drain well despite high clay content, and possess a useful organic reserve of mineralisable nutrients.

Biological nitrogen fixation

Nitrogen (N) exists in solid, dissolved and gaseous forms. In rocks, i.e. the lithosphere, N occurs primarily as the ammonium ion (NH_4^+); the gas N_2 makes up approximately 80% of the earth's atmosphere; and the hydrosphere pool is represented by N_2 dissolved in water.

The content of N_2 in both the atmosphere and hydrosphere is around 10^6 (one million) times greater than in the biosphere (total complement of organisms). Therefore, from an evolutionary point of view, it makes sense that certain organisms have evolved specialised mechanisms for harnessing or harvesting the abundant supply of N in their surroundings. Even more telling is that organisms at the lower end of the food chain, i.e. micro-organisms and plants, has this ability.

Nitrogen fixed by microbes has the advantage over mineralised N in that the former process is less susceptible to N losses, at least until the microbe or host plant dies and decomposition releases fixed N. Symbiotic fixation of atmospheric nitrogen, the gas N_2, includes that which occurs in nodules on the roots of legume plants.

Beneficial effects of leguminous plants (legumes) on cultivated plants (crops) had been recorded in Roman times (approximately 2 000 years ago), and Chinese farmers knew that the water fern (*Azolla* sp.) in paddy rice boosted the crop's productivity. Today, we know that this true fern, *Azolla*, has a symbiotic relationship with the blue-green algae *Anabaena azollae* that occurs in the terminal lobe of each leaf and fixes N in the form of atmospheric N_2. From ancient times to the present, *Azolla* has been tolerated in paddy rice because, as 'green manure', it supplies N to the crop, and it is used as protein-rich fodder for pigs and ducks.

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Even though the mechanisms behind those beneficial effects of legumes may not have been fully understood in ancient times, the knowledge grew to such an extent that in the nineteenth century "legumes used in rotation (with other crops) provided the agricultural stability that allowed the industrialization of western Europe". In 1813, Sir Humphrey Davey was the first to suggest that legumes had the ability to obtain N from the atmosphere, and moreover, that this characteristic benefited subsequent non-legume crops.

Bacterial infection in plants

Rhizobia is the collective name given to a group of soil bacteria that is responsible for symbiotic N fixation in legumes. The genera *Rhizobium* spp. and *Bradyrhizobium* spp. is best known for this characteristic. N fixation is under the control of the nitrogenase enzyme that occurs in nodules that form on root hairs as a result of infection by these bacteria.

Infection occurs in response to chemical signalling that reportedly involves flavonoids (secondary plant metabolites) secreted by the root hairs of legumes, and lipopolysaccharides released by the bacteria. The latter attaches to root hairs by secreting recadhesin, a bacterial protein, which interacts with plant-secreted lectins. Infection of root hairs progresses to curling of root hairs, and infection thread formation that releases bacteria into the cytoplasm of plant cells, which prompts the formation of specialised symbiotic cells that develop into nodules in which N fixation occurs.

Fixed N in the form of ammonia (NH_3) is supplied to the plant symbiont, and the bacterial partner acquires certain energy-rich carbohydrates and inorganic elements, which are required in high concentration, from the host plant.

Effects of chemicals

Much research has been done to assess whether pesticides applied directly to soil can be harmful to soil micro-organisms. Less research has been focused on the impacts of pesticides targeting the foliage of plants, i.e. post-emergence applied herbicides in the case of weeds, and insecticides, fungicides and bactericides in the case of crops.

The majority of research findings point to non-harmful effects on soil microbes, or impacts of transient nature, provided that pesticides are used at standard (registered) field rates. The nitrification process in soil, i.e. the bacterial-driven process of oxidative transformation of NH_4^+ to NO_3^-, appears to be particularly sensitive to certain pesticides, obviously those toxic to the bacteria involved, namely *Nitrosomonas* and *Nitrobacter*.

In cases where pesticides have direct harmful effects on legume crops, as occasionally happens where herbicides are applied to a legume crop, or when a susceptible legume crop is exposed to herbicide spray drift, injury of the crop is likely to negatively affect nodulation, nodule numbers and N_2 fixation. Because the harmful effects of all herbicides involve disruption of physiological processes in plants, the type and amount of root exudates will be affected, which in turn affect microbial populations in the rhizosphere.

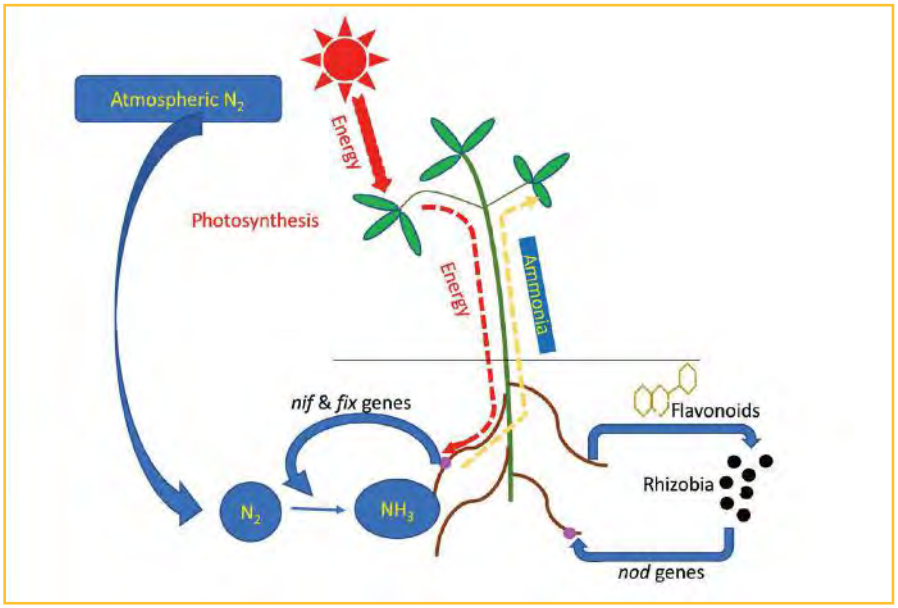
Much greater disruption of soil biota is caused by soil-applied fungicides, bactericides and especially the drastic practice of soil fumigation (chemical sterilisation), but again, adherence to registered products, dosages and frequency of application ought to prevent long-term harmful effects.

Almost any fertiliser, especially when applied in a concentrated band, can cause local inhibition of microbial activity due to osmotic stress, i.e. the lowering of water potential that prevents water uptake by the organism, and damage caused to cell membranes. Injections of ammonia can produce biocidal concentrations in the centre of the injection zone, and band-placed urea can have a similar effect.

Such effects of fertilisers are transient in nature, and if label recommendations for products are followed and registered rates applied, any negative effect should be short-lived. Fortunately, soil biota are extremely resilient and can recover rapidly from negative impacts, irrespective of whether they are chemical (e.g. pesticides and fertilisers), physical (e.g. soil tillage, extremes in temperature and moisture), or biological (e.g. monocultures) in nature.

However, we must be ever alert and show responsibility by embracing astute agricultural practices. This endeavour is dependent on awareness and knowledge of the Big Truth, i.e. that for every action exerted by humans in nature, the latter will respond in the form of several reactions – most of those reactions will initially be surreptitious and will only fully exert itself in the long run when it might be too late to reverse the damage done.

Figure 1: Summarised model for symbiotic nitrogen fixation in legumes by rhizobia. (Source: Microbial Biotechnology, December 2019)



Prof Charlie Reinhardt is lecturer and researcher in the Faculty of Agriculture at North-West University, Potchefstroom campus, and research leader in the South African Herbicide Resistance Initiative (SAHRI) at the University of Pretoria. For more information and references, send an email to dr.charlie.reinhardt@gmail.com.

Potassium deficiency in soya beans

By Fred Miller, FarmProgress

Potassium is the most important yield-limiting nutrient in soya beans, and the plants can suffer a deficiency at multiple stages of growth.

A new video produced by the University of Arkansas System Division of Agriculture explains the importance of potassium, also called potash, and how growers can make certain they are providing the fertiliser their crops need.

Potassium aids in water regulation in plants, says Trent Roberts, associate professor of crop, soil and environmental sciences for the Division of Agriculture. "It is essential for a lot of the pathways tied to water and water regulation, including transpiration, canopy temperature, carbon dioxide capture, and others."

Nitrogen fertiliser is often the focal point of most row-crop systems. However, soya beans are different in that they are legumes, which absorb nitrogen from the air and convert it into a nitrogen metabolite through a symbiotic relationship with soil microbes. The process is called biological nitrogen fixation.

Since soya beans essentially make their own nitrogen fertiliser, Roberts says, potassium becomes the most limiting fertiliser nutrient for yields.

Deficiency in light-textured soil

Light-textured soils – sandy, sandy loams and silt loams – tend to be potassium deficient. Clay soils normally have adequate soil test potassium levels, which makes soil sampling key to successful potassium management.

"The first step to detecting and correcting potassium deficiency is soil testing," Roberts explains.

Decades of research by the Arkansas Agricultural Experiment Station, the Division of Agriculture's research arm, have resulted in calibrated soil test-based data that allow the Soil Testing and Research Laboratory to provide accurate fertiliser recommendations. Soil testing, available from the Division of Agriculture's Soil Testing Program, can help growers know how much potash they need to apply before planting their crops.

"This is the first step to ensuring that potassium will not be limiting and helps get the crop off on the right foot," Roberts says. Farmers should contact their local extension offices to obtain soil testing information, supplies and services.

Growers should follow up during the growing season by scouting their fields to look for symptoms of potassium deficiency. In the video, Roberts shows where to look for common symptoms and what they look like.

Hidden hunger for potassium

But beware of 'hidden' hunger, he says. "I think there is the potential that hidden potassium hunger may be robbing soya bean yields on our lighter textured soils." Hidden hunger refers to nutrient deficiencies that can reduce yields before visible symptoms appear in the plants.

In the video, Roberts shows where and how soya bean tissue samples should be taken to make sure the plants have sufficient potassium throughout the growth and reproductive stages. Current interpretations of tissue-sample data are based on the R2 growth stage. However, research data from the Arkansas Agricultural Experiment Station permits nutrient interpretations across a broader range of plant growth, from the vegetative stages through the end of the growing season.

Roberts says that data was used to develop the Dynamic Critical Concentration Threshold, a graphed curve that indicates the ideal potassium concentrations as they change throughout a soya bean plant's vegetative and reproductive stages. Tissue samples can show whether potassium concentrations fall above or below the curve at every stage.

Greater flexibility and accuracy

"Our system allows greater flexibility and accuracy to identify possible potassium deficiencies and corrective measures that can be taken, to assure maximum yield potentials," Roberts says.

This means that farmers can adjust potassium concentrations with applications of up to 60 pounds (around 27kg) per acre (0,4ha) of potash through the R5 stage, or to about nine weeks past the R1 stage.

These soya bean plants show symptoms of potassium deficiency in the upper canopy.

The video can be viewed online at the following link: *https://youtu.be/s9aKOfcc4UE.*

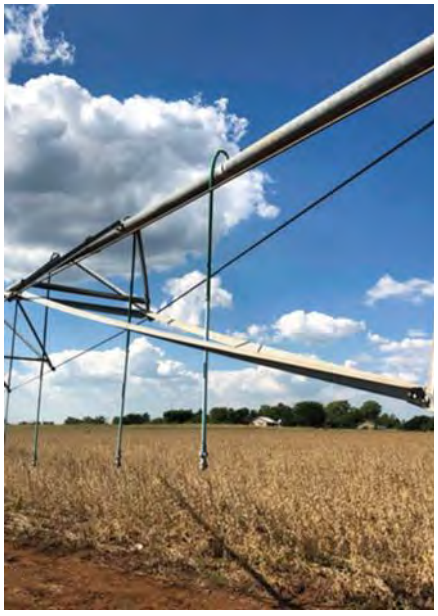
For more information regarding potassium management for soya beans and other crops, visit *www.uaex.edu/farm-ranch/crops-commercial-horticulture.*

Remedial measures technique for increased yield

By Dr Steve Oosthuyse, general manager, HortResearch SA

During the past three years, Dr Steve Oosthuyse of HortResearch SA in Tzaneen, has researched the application of the Remedial Measures (relationship determination) Technique (RMT) on soya bean – this three-year project was funded by the Protein Research Foundation.

Work was carried out on two soya bean stands: one in Rustenburg on the farm of Ferdie Meyer, and the other in Bothaville on the farm of Johan Botma. The primary aim was to identify key relationships between plant performance and soil conditions in order to gather empirical data that can be used to determine fertilisation measures, which in turn will enhance plant performance.



Centre pivot at the Rustenburg stand.

It is all in the relationship

Interactions in soil relating to nutrient uptake are generally complex and difficult to understand. The technique is entirely empirical (it does not rely on assumption) and reveals specific yield limiting and promoting factors of an area of land. Application of the technique is not limited to soya bean and can be applied to any crop grown in soil.

The power of RMT to determine soil conditions having a favourable or unfavourable effect on plant performance, has been demonstrated. In some instances, measures to improve productivity are obvious; in others, the knowledge of the interpreter may be significant in recognising remedial measures. Some cases may not allow for the practical implementation of modifications, or it may require a longer implementation period. Irrespective of the situation, an understanding of favourable and unfavourable factors is gained.

The analysis indicates actual target levels as well as how significant the effect of a factor is in a particular situation. The coefficient of multiple determination (R2) indicates the percentage by which the data variation is accounted for by the variation in the independent variables designated as being significant.

RMT is unique since performance variables are a component of the analysis. The basis of the technique is not complex, and it diverges from other methods in that it reveals the relationships between plant performance and soil variables. Variation always exists between locations in a cultivation block, affording the interpreter the opportunity to determine these relationships. The absence of any relationships indicates that none of them has a bearing on performance.

Table 1: Recommended amounts (kg/ha) of fertiliser (spray at every opportunity, i.e. when applying fungicide, with a TE cocktail).

	21% N	15% Super P	51% K	18,6% Ca
	AS	Granular P	KCl	Gypsum
Quadrant 1	156	52	1 201	33 104
Quadrant 2	158	139	773	65 834
Quadrant 3	164	150	455	58 974
Quadrant 4	163	29	1 183	38 842

Site-specific information

The following was deduced while carrying out the technique at the Rustenburg site during the 2018/19 and 2019/20 growing seasons. The plants at this site are grown under irrigation and the soil is a clay-loam (the area under centre pivot was divided into quadrants).

Removal of samples from the untreated and treated quadrants.

Target soil analysis values:

- Potassium (K) saturation: 3,2 (from an average of 2,5).
- Iron (Fe) concentration: 77,5mg/kg (from an average of 95).
- Sodium (Na) saturation: 0,5% (from an average of 0,6).
- Phosphorus (P) (Bray I) concentration: 20mg/kg (from an average of 14,6).

Fertiliser recommendations

Carry out your agronomist-recommended fertilisation programme, but also consider the following and adjust when necessary:

- Increase K saturation to 3,2% by applying potassium chloride (KCl).
- Discontinue any applications of Fe.
- Consider improving water quality, if possible, by reducing the quantity of especially Na.
- Apply additional phosphate to increase P concentration from 15 to 20mg/kg.

Quantifying performance variables

Just prior to harvest in April this year, ten plant clusters and soil, in which the roots were imbedded, were removed from the treated quadrant, as well as the adjacent untreated quadrant. After collection, plant performance variables were quantified.

Figure 1: Cluster bean yield (g) of each of the samples.

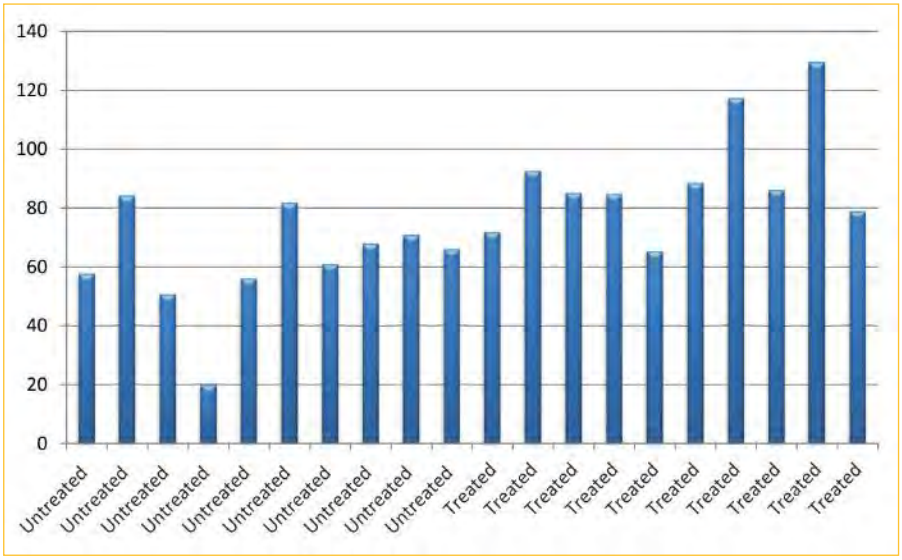
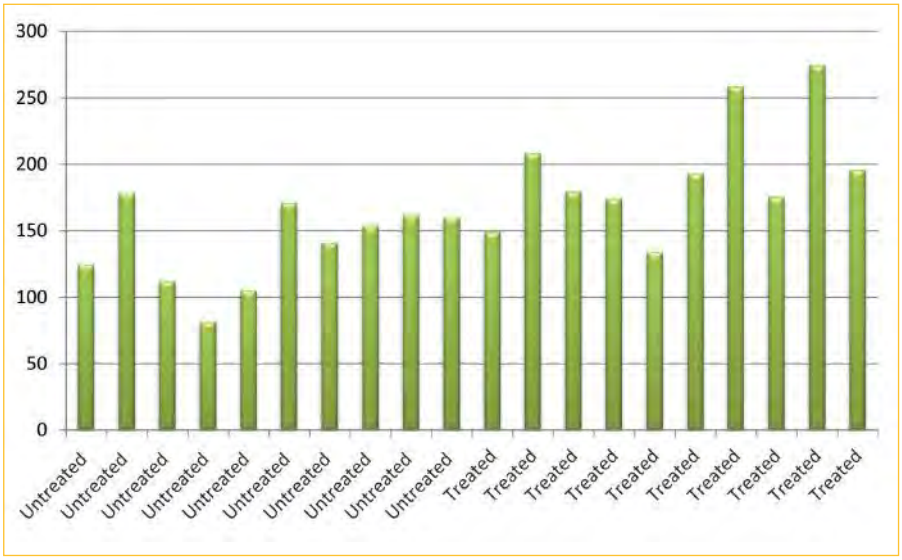


Figure 2: Total dry weight of each of the plant clusters (g) sampled.



The plants from the treated quadrant were 40% heavier (generally larger) and yielded 46% more in terms of bean weight; solitary bean weight was 16% greater. Individual values for bean and plant weight are shown in *Figure 1* and *2*.

Beans and pods of a sampled cluster.

The power of RMT lies in its ability to use uncomplicated techniques to identify yield limiting and promoting factors in a situation that is naturally complex. Dealing with a multi-factorial, natural situation is facilitated, and the indication of remedial measures is straightforward.

Those interested in having the method applied to stands on their farms can email Dr Steve Oosthuyse at hortres@pixie.co.za.

(Source: R.Bamberger, Bayer SA)

Sclerotinia *on Sunflowers*

Overview

During the last few seasons, the amount of *Sclerotinia* cases have increased on oil seed crops, including soybeans, beans and canola and has heavily struck sunflower plantations in the North West and Free State which has led to notable yield losses. Epidemic cases are less in drier seasons but can be devastating in wet seasons where 100% infestation is often seen at the soil surface and can result in total yield losses. The disease causes stalk rot (Fig. 3) and ear rot symptoms (Fig. 4) on sunflowers. In South Africa, the early crops that flower under cool, wet conditions are at a higher risk for ear rot. This disease is a real threat for sunflowers and increases the use of soybean crops as a crop rotation option to maize.

Disease infection on sunflowers

This disease on sunflowers, is caused by the pathogen *Sclerotinia sclerotiorum* and is a challenge to control because of its wide hosting spectrum, robust survival structures in the ground and the effective way in which it spreads. The resting structures, sclerotia (Fig. 2), may survive in the soil over a period of 5 to 10 years. The sclerotia germinates under cold, wet conditions and develops spore-producing structures (apothecia) in the top 3 – 5 cm of the soil (Fig. 1). These structures produce spores that are released into the air during the next 10 to 12 days after rain. The spores infect plant sections in the top soil level within two days of being released and especially infects the sunflower head during flowering (Fig. 4). The spores of the *Sclerotinia* fungus are spread by the wind but do not have a very long life cycle. The sclerotia can also germinate in the ground and infect the roots and stems of sunflower crops (Fig. 3).

Fig. 1: Spore producing structures (apothecia) (Source: Bayer Pty Ltd)
Fig. 2: Resting surviving structures (sclerotia) (Source: Bayer Pty Ltd)
Fig. 3: Sclerotinia stalk rot (Source: R.Bamberger, Bayer)
Fig. 4: Sclerotinia ear rot (Source: R.Bamberger, Bayer)

The control of Sclerotinia?

There is currently no silver sword that can stop the disease in its tracks, but there are control options and practices which can be applied to decrease the intensity of the infections and to improve the health of the soil over time. The basis of the management strategy of *Sclerotinia* lies in the breaking down of the life cycle (Fig.5).

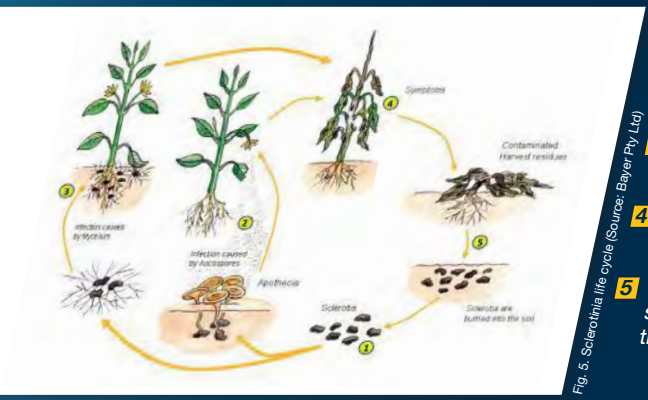


Fig. 5: Sclerotinia life cycle (Source: Bayer Pty Ltd)

1. *The sclerotia survives in the soil for many years.*
2. *Germinating sclerotia forms Apothecia that releases spores.*
3. *Sclerotia germinates, infects roots and causes stalk rot.*
4. *Mycelia threads colonise the plant and causes its death.*
5. *New sclerotia form and survive for many years in the soil.*

The sclerotia is without a doubt the most important phase to target in the life cycle and thanks to **Bayer**'s fungicide **Contans®**, there is an answer to destroy the resting structures (Fig. 6 – 8). The product contains $1x10^{12}$ active spores/kg of the organism *Coniothyrium minitans* that parasitise on the sclerotia and destroys it within 8 – 12 weeks of application. It prevents the sclerotia from developing, infecting roots, forming apothecia and releasing spores. With every application of **Contans®**, 80 – 95% of the sclerotia can be destroyed. It is still important to apply an integrated strategy together with registered fungicides during the early flowering stages in order to fight the disease during all the stages of the life cycle. Rotation and resistant cultivars form an important part of the integrated management strategy.

What are the ideal conditions for Sclerotinia development?

1. Cool and wet conditions at the soil surface (11 – 15 °C) activate the germination of sclerotia and spore release after 10 – 14 days.
2. Constant wet conditions and high humidity, especially during flowering (>25 mm rain) with temperature 15 – 20 °C promote infection of plant sections in the top level of the soil.
3. Infection will stop in drier conditions.

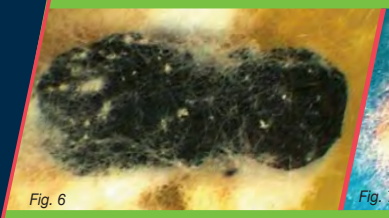


Fig. 6


Fig. 7

*Fig 6: Sclerotia before treatment with **Contans®** (Source: © Prof. Tiedemann, University of Geottingen, Germany)*
*Fig. 7: Sclerotia after treatment with **Contans®** (Source: © Prof. Tiedemann, University of Geottingen, Germany)*

This is what a suggested spray programme looks like:

BEFORE PLANTING

Application on the soil controls sclerotia

Contans

AFTER HARVEST

Treatment and incorporation of crop residues

Contans

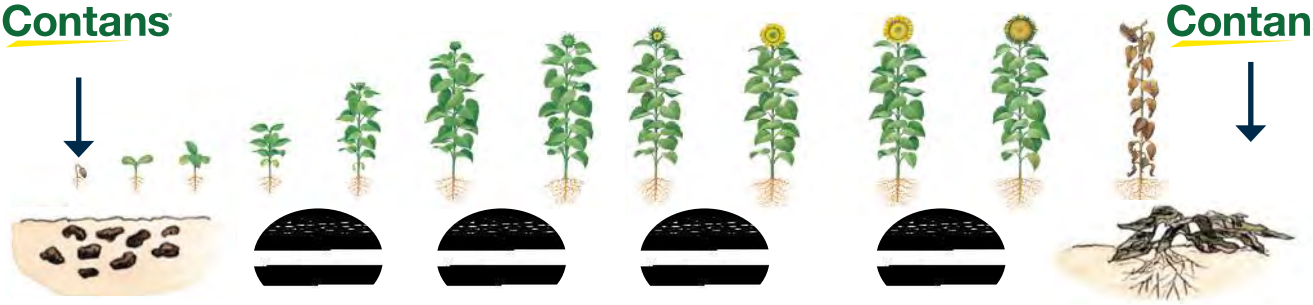


Fig. 8: Sunflower growth stages

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PO Box 143, Isando, 1600,
Tel: +27 11 921 5002

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'n Unieke kombinasie van **Organiese sure**, **Aminosure** en **Ensieme**, vir die verbetering van grondgesondheid,versterking van wortelgroei by plante en saailinge.

Boor(B)...2g/Kg, Magnesium (Mg)...1g/kg

B5089
COA FERTIGATION

'n Unieke kombinasie van spesifieke **Humaat** en **Fulvien** samestellings vir grond en groeimedium aanwending. Spesifiek geformuleer vir optimale ondersteuning van plante-voedingstowwe in die wortelsone.

Stikstof (N)...56 g/kg N, Stikstof (S)...5 g/kg

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CCM

'n Ultrafyn gemikroniseerde **MG/Ca** bron in die **Karbonaat** vorm gemiddelde partikel grootte van 5 – 15Mikron

(1 000 x kleiner as die 80% van Konvensionele Landbou kalk)

Ca...190g/kg, Mg...110g/kg, Organies...30g/kg

B4990
COMPLEX CALSUL

'n Ultrafyn gemikroniseerde **Ca** bron in die **Sulfaat** vorm gemiddelde partikel grootte tussen 5 – 15Mikron

(1 000 x kleiner as die 80% van Konvensionele Landbou kalk)

Ca...230g/kg

B4682
COMPLEX CALSUS

'n Ultrafyn gemikroniseerde **Ca** bron in die **Karbonaat** vorm gemiddelde partikel grootte tussen 5 – 15Mikron

(1 000 x kleiner as die 80% van Konvensionele Landbou kalk)

Ca...400g/kg, Mg...30g/kg, Organies...30g/k

Kontak ons

082 452 8983 | 083 542 3106
admin@worldfocusagri.co.za

Address: 9 Silver Crescent, Delmas, 2210

The role of integrated plant energy management

By World Focus Agri

The best producers are those who deliver the type of produce consumers expect and are willing to pay for. These producers use fewer chemical treatments and opt for more natural products to keep pace with the world's nutritional needs. They concentrate on development and environmentally friendly products that promote human health. Consumers expect producers to produce healthy, affordable food using acceptable and sustainable practices.

Producers can count on the support of World Focus Agri's technology and natural solutions for crop production and subsequent wealth creation through sustainable agronomy practices.

World Focus Agri uses natural products enriched with mineral nutrients to get the best of both worlds. This can only be achieved if it is commercially viable and yields an acceptable return on investment for the producer. This is where integrated plant energy management (IPEM) comes into play.

Why do plants need IPEM?

At certain points in the growth cycle of a crop, the energy demand is greater than the available energy reserves. This phenomenon occurs in cereals at initiation and during the transition from the vegetative to the reproductive phase. In the case of vegetables, perennial plants and trees, it occurs during blooming, fruit set (cell division) and fruit fill.

If this unique energy requirement is not met, the plant can experience an 'energy crisis', also known as metabolic stress. When a plant experiences metabolic stress, it is more susceptible to pathogens and insect attacks because it lacks the energy to drive the plant's enzymatic and hormonal system. These functions are responsible for optimal metabolism and defence against pathogens.

How to optimise plant energy

Producers can optimise plant energy by focusing on the following essential plant and crop components:

- Enzymatic systems.
- Calcium and its functional components.
- Functional and available carbon (-COOH).

With the addition of excellent natural organic metabolites such as functional carbon (-COOH) and Ca++, the plant's energy curve regains its balance.

This more active and balanced metabolism leads to the following biological outcomes in the plant:

- Increased enzyme activation for metabolic changes and nutrient uptake.
- An increase in hormone activity due to this enzyme activation.
- Continuous regrowth of root hairs (crucial for optimal Ca++ uptake in plants).
- Increased concentration of plant sugars/nutrients (Brix).
- Increased balance of abscisic acid and an increase in plant sap conductivity (EC).
- Increased photosynthesis activity.
- Buffering of the pH of the soil/medium, and protection of seedlings and young plants from the high salt index of chemical fertilisers.
- Increased production of transporter enzymes, leading to better growth and robustness.
- Optimal balance between photosynthesis and respiration.

Owing to these changes in the plant's metabolism, there is a substantial increase in glucose, sugar, starch and amino acid production. These are excellent conditions for optimal blooming and fruit set, and ultimately improved yield and prolonged shelf life.

Recommended solutions

To obtain the best results in IPEM, the use of the following products by World Focus Agri is recommended:

- Enzymatic systems: Gliogrow, Gliosense, Glionut.
- Calcium: CCM, Complex Calsus, Complex Calsul and Complex SuperCa (ultrafine lime/gypsum).
- Functional and available carbon (-COOH): Complex SuperCa (organic chelated Ca).

For more information, contact At van Schalkwyk on 082 452 8983, send an email to at@worldfocusagri.co.za, or visit *www.worldfocusagri.com*.

The potential of soya bean drying in South Africa

By Dr Erhard Briedenhann, Protein Research Foundation and Oilseeds Advisory Committee

Drying – forcing dry air through material to remove moisture – is an age-old method of preserving food and feed, and it certainly plays a notable role in the soya bean value chain. Soya bean drying can be an effective way of reducing the moisture content to 12%, which is deemed safe for long-term storage of soya beans.

One of the main benefits of harvesting at high moisture levels is the reduction of losses during harvest. It is also expected that delivering at higher moisture levels could help extend harvest time. Earlier harvesting could assist in the sale of the commodity and add to the flexibility or extension of the marketing period.

However, soya beans with a moisture level above 12% should be dried to the desired moisture level as soon as possible, in order to maintain quality. The most common method used is blowing dry air through the grain and producers and storers may be interested in either on-farm drying and storage or formal storage facilities.

When opting for on-farm drying, installed driers do not necessarily have to be used for soya beans only; it can also be used for other grains. However, dryers that recirculate or stir grain should be avoided, and soya beans that will be used for seed should not be dried with supplemental heat.

Although drying could be beneficial for the South African soya bean industry, it is not yet common practice in the country. Producers who are interested in adding this process to their farming operations should evaluate the benefit of drying in relation to the cost of the energy input required.

Equilibrium moisture content

Passing sufficient air through soya beans at a given rate, air temperature and humidity will result in the soya beans achieving a moisture level at which it will not gain or lose any more water. This moisture level is known as equilibrium moisture content (EMC) (*Table 1*).

Requirements for airflow

Air transports moisture away from the soya beans, and the quality and quantity of the air are essential factors in determining the soya beans' final moisture content.

The quantity of air the drying fan can deliver should also be considered. This quantity is expressed in cubic meters per minute, while the quality depends on the temperature and relative humidity. Increasing the air temperature will increase the drying capability, but soya beans can be damaged if the air is too hot or dry.

The larger the volume of air passed through the soya beans, the faster the drying time. Airflow rates need to be adjusted depending on the reduction in measured moisture required – the higher the initial moisture content, the more airflow is required. Reducing moisture from 20 to 18% requires three times more airflow than a reduction from 15 to 13%.

It is therefore expected that it would be much more efficient and cost effective to reduce the moisture level of soya beans by 3 to 4% to reach the optimum moisture level, than to dry soya beans with very high moisture levels.

Table 1: Soya bean equilibrium moisture content.

	Relative humidity							
		30%	40%	50%	60%	70%	80%	90%
Temperature	4˚C	6,4%	7,7%	9,3%	11,3%	14,2%	18,9%	28,7%
	10˚C	6,3%	7,6%	9,1%	11,1%	14,0%	18,6%	28,2%
	16˚C	6,2%	7,4%	8,9%	10,9%	13,7%	18,3%	27,8%
	21˚C	6,1%	7,3%	8,8%	10,7%	13,5%	17,9%	27,3%
	27˚C	5,9%	7,1%	8,6%	10,5%	13,2%	17,6%	26,9%
	32˚C	5,8%	7,0%	8,4%	10,3%	13,0%	17,3%	26,5%
	38˚C	5,7%	6,9%	8,3%	10,1%	12,7%	17,0%	26,1%

Soya bean shrinkage

Soya beans are purchased for their oil and protein content, while the water content has no value. Consequently, some adjustment needs to be made from a moisture content baseline. According to grading regulations, the acceptable maximum moisture level for soya beans in South Africa is 13%.

Buyers will not pay for excess moisture, which can be regarded as shrinkage, and producers who deliver low-moisture soya beans to buyers would be at a disadvantage. As marketing soya beans with a moisture level above or below 13% decreases the profit, producers should be doing everything possible to maximise returns.

The drying cost should be kept stable to optimise return on investment. It is

An on-farm grain drying bin can be used for soya beans, but careful consideration must be given to temperature and humidity levels. (Photograph: United Soybean Board)

important to monitor the total kilograms of water that will be removed per ton of soya beans and the cost of the energy inputs required to extract the moisture.

Drying methods

Drying systems used to dry other grains can dry soya beans, but only after the temperature and relative humidity levels have been carefully considered. Avoid drying systems with extremely high temperatures (above 60°C), which could cause seed coats to crack.

In-bin drying systems with natural airflow and low temperatures are the most suitable for soya beans, while continuous flowing or batch systems are less desirable. Natural air-drying passes natural air through the soya beans until the moisture content reaches the EMC level.

The moisture content will adjust according to the quality of the air used, which is why it is crucial to consider the soya beans' starting moisture content as well as the temperature and relative humidity. Natural air drying is effective under favourable weather conditions. As a rule, air temperature should be above 15°C and the humidity below 75%.

Natural air-drying typically involves a bin with a perforated floor and a drying fan, grain spreader, sweep auger and unloading auger. An external energy source, such as fossil fuels, can supply electricity to the fan. This method is the most energy efficient, but it is slow and can lead to spoilage, particularly in poor weather conditions.

Soya bean drying tips

- Harvest soya beans at the lowest possible moisture level.
- Load soya beans into clean bins immediately after harvest. Clean and sanitise these bins prior to harvesting to avoid insect problems.
- Monitor the moisture content of each load of soya beans as it is placed in the drying bin.
- Open the air vents and start the fan as soon as the grain depth reaches approximately 30cm on the perforated floor.
- Add soya beans to the drying bin in shallow layers until the moisture content decreases.
- Use a spreading device to continuously keep soya beans level inside each drying bin to avoid coning.
- Monitor the moisture content daily. The beans must be cooled to avoid night-time condensation on the inner walls.

Soya bean storage tips

- Cool the grain as soon as possible. The target temperature should be 15°C.
- Continue to aerate and uniformly cool grain to avoid internal moisture migration and insect activity.
- Monitor grain and aerate monthly to maintain uniform temperature and moisture levels.
- Keep the grain cool for as long as possible.
- Cover fans and openings when not in use.
- Monitor the bin carefully and fumigate if needed.
- Inspect the soya bean surface at least every week.

Safety precautions and practices

Soya bean producers and storers should always prioritise safety when drying and storing grains, as grain suffocations can occur. This includes wearing an effective dust mask. As grain handling and drying can be dangerous, power should be disconnected before entering a bin, and safety harnesses must be used.

The way forward

It was recommended at a soya bean supply chain indaba that the feasibility of drying soya beans in South Africa be investigated. It is highly likely that producers could see a significant benefit should the study be successful.

Information used in this article was obtained from the University of Arkansas and adapted for use in *Oilseeds Focus*. For more information, send an email to the author at erhardB@netactive.co.za.

Soya bean market overview

By Ikageng Maluleke, agricultural economist, Grain SA

Prospects are looking good for the 2020/21 soya bean production season, although a robust recovery in world economic growth seems necessary to meet higher consumption demand. This against the backdrop of the COVID-19 pandemic, which has had a significant impact on various economies – it is still unknown how long the world will continue to battle this health crisis.

Although the world is still 'under siege', many economies are trying to adapt to this new situation. One highlight is that the Chinese seem committed to honouring their phase one trade agreement with the United States (US) before the end of the year.

Global soya bean production

It is anticipated that world soya bean production for 2020/21 will recover strongly when compared to the 2019/20 season (*Table 1*). This is due to improved production prospects in the US, which emphasises demand over the next year. Potential gains are also expected in the southern hemisphere.

Brazil is expected to increase production above the five-year trend. The incentive comes from the economic downturn caused by the COVID-19 pandemic, which led to a sharp depreciation of the Brazilian real, pushing domestic soya bean prices to record levels. This allowed producers to be well capitalised from the 2019/20 revenue, and they are eager to reinvest those profits.

China's domestic production is expected to increase by 0,7 million tons to 18 million tons in 2020/21 in response to a stable government subsidy rate and higher soya bean prices during the sowing months of 2020.

Global soya bean consumption

The COVID-19 pandemic affected global soya bean consumption, which was evident in a dip in processing for countries such as Argentina. Despite declining consumption in the 2019/20 marketing year, it is expected that global consumption will expand by 3% to reach a new peak in 2020/21 (*Table 1*). The anticipated increase will come from Asia, and especially China, due to the expected expansion of meat production.

The Chinese lost approximately 40% of their swine herd to the African swine fever outbreak, and production has not recovered since the outbreak was detected in 2018. Recent updates from the World Organisation for Animal Health (OIE) indicate that the disease continues to appear in Asia and parts of Eastern Europe, and a vaccine seems unlikely in the near future – recent cause for concern was a report of a resurgence in infections in parts of Southern China due to flooding.

Slaughter rates in the US livestock sector continue to improve, meeting crush projections. However, weak livestock prices have a serious impact on herd levels, and ample vegetable oil supplies may inhibit crush demand for the new marketing year.

Global soya bean trade

Projections for the last few weeks of 2019/20 show that US soya bean exports remain in pace with the United States Department of Agriculture (USDA) estimates. The

Table 1: Global soya bean supply and demand in million tons. (Source: IGC)

Million tons	2017/18	2018/19 (estimates)	2019/20 (forecast)	2020/21 (projected)	Year-on-year change
Opening stocks	47	48	61	47	-23%
Production	344	363	339	365	+8%
Total supply	**392**	**411**	**400**	**412**	**+3%**
Total use	**344**	**349**	**353**	**364**	**+3%**
of which: Crush	302	307	311	319	+3%
Food	19	19	20	21	+5%
Feed	14	14	12	15	+25%
Closing stocks	**48**	**61**	**47**	**48**	**+2%**
Major exporters (Argentina, Brazil, US)	17	32	20	16	-20%
Trade (October/September)	**153**	**152**	**158**	**161**	**+2%**

strong pace of the new marketing year's sales is on par with levels seen before the trade war with China. Chinese buying under the phase one trade deal remains crucial to realising this forecast.

It seems that soya bean demand will rely on China over the next year. According to the USDA, China's projected 2020/21 imports from the US stand at 9,6 million tons. However, this figure depends on the country's ability to recover its pig and poultry numbers. The potential for an increase in China's soya bean imports from the US looks certain, but the size remains the question.

Although this is a positive sign, geopolitical tensions between the US and China persist, which creates uncertainty for potential trade flows over the next year. In addition, South American production is expected to increase by 4,7% in 2021 to 196 million tons. China's continued purchases of Brazilian soya beans will create a highly competitive export environment for the US in 2021.

Global soya bean stocks

According to the International Grains Council (IGC), the outlook for global stocks in 2020/21 is expected to be marginally higher year-on-year. This is partly due to high carry-ins from the previous season and prospects for larger purchases (*Table 1*).

Global soya bean price movements

Soya bean crop potential continues to be a significant factor in soya bean price movements. Higher soya bean prices rely on demand prospects over the next year, while increased demand is linked to economic recovery. Nevertheless, recent developments have provided limited support for economic growth prospects.

The potential for higher yields in the US and growth in South American production might put pressure on soya bean prices.

> The 2020 soya bean crop is off to a good start, but the yield will depend on weather conditions, while demand depends on global economic recovery.

Soya bean prices thus need projected consumption levels to be fulfilled in order to remain higher. A continuation of the recent strength in soya bean prices remains focused on the export potential for the next marketing year.

Local soya bean market

According to the Crop Estimates Committee, the sixth production forecast for soya beans remained unchanged from the previous forecast at 1,261 million tons. This represents a 7,7% increase compared to 2019. The estimated area planted to soya beans is 705 000ha and the expected yield is 1,79 tons/ha.

Soya bean processing for the 2020/21 season is looking good and trailing higher than the previous season by approximately 10%. At this rate it could put pressure on stock levels, which will support prices. Compared to the previous season, the total projected demand for processing is expected to decrease by approximately 3%. The amount of processed soya bean thus far for 2020/21, compared to the total demand for processing, is trailing at 35% compared to 25% last year.

Figure 1 illustrates domestic supply from imports and demand for exports for soya bean to date. The majority of soya beans were imported in March, mainly from Brazil, due to a late local harvest, which led to late deliveries. Soya bean oilcake imports are trailing by 26% compared to the same period last year, while exports are trailing higher by 26%, mainly due to the increase in demand and availability of stock.

Since the beginning of the 2020/21 season, local soya bean prices have increased considerably due to the depreciation in the rand caused by COVID-19. Compared to the past two years, September futures prices increased by approximately 22 and 33% y/y, while December futures prices increased by 20 and 32% y/y.

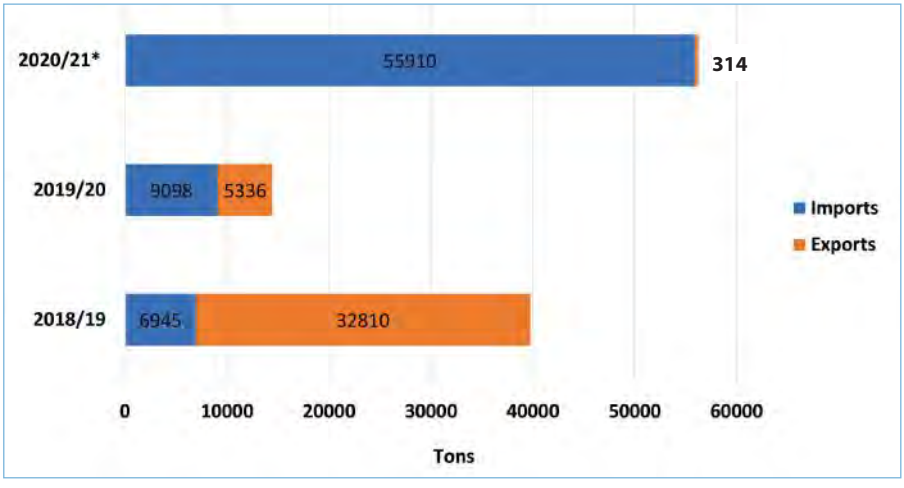
A parting thought

The 2020 soya bean crop is off to a good start, but the yield will depend on weather conditions, while demand depends on global economic recovery. The recent sales of US soya beans to China provide some hope for a robust demand recovery in the new marketing year.

However, US-China relations and uncertainties associated with the pandemic are likely to linger over the markets for the remainder of the year. In the short term, prices are expected to remain steady unless there is a significant event. Local demand is faring well, with prices supported by the depreciating rand.

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

Figure 1: Local soya bean imports and exports. (Source: South African Grain Information Service)



**March to July 2020.*

Photograph: United Soybean Board.

Long-term world soya bean outlook

By Alan Barrett, director of research and consulting, Higby Barrett LLC

Doane's economists recently updated the *International Agriculture Outlook* report, which includes ten-year forecasts of harvested area, yield, production, utilisation, per capita consumption and net trade of coarse grains, maize, soya beans, wheat, cotton and rice for 17 countries or major global regions. The report distils and conveys big-picture trends found in the global data on a semi-annual basis, and the following is focused on the world soya bean market.

In general, the international forecast is based on United Nations-sourced estimates of past yearly global censuses of populations, combined with long-term trends for per capita consumption, to estimate world demand growth.

Over the long term, world production lines up with world consumption and world net imports approximate world net exports. In addition, the supply side (production plus net imports) of any country or region eventually lines up with the demand side (consumption plus net exports). The projections are designed to provide a plausible scenario for the sectors covered, but not the actual outcomes in any particular year.

China is handled differently because Chinese government officials are balancing domestic farmer needs, very large ending stocks, tariff rate quotas, and other political concerns. The baseline assumption is that China's rising consumption levels will allow it to simultaneously increase imports while reducing ending stocks or returning to a more normal stock level.

Population growth and consumption

Resting in the background of the analysis are the past estimates of global population growth. As a starting point, world population is projected to increase with 9% over the next decade, which will drive consumption increases.

The Asian growth centre (AGC), comprising China, India, Other Asia and East Asia, is experiencing great growth in food consumption, but has limited acreage available for cultivation. The current situation presents two key challenges: The first is how to meet the increase in food consumption, and the second how to deliver the food to the people.

The AGC accounts for 52% of the world's population. Although known for extreme poverty, the area is enjoying economic growth, which is vital for commodity consumption, especially in terms of food products. As income increases, a wealthy person responds by switching to high-end food products, eating at restaurants and maybe even hiring a chef. Although they are spending more money on eating, the volume of coarse grains, wheat, and protein meals consumed might not increase.

By comparison, as income increases a poor person responds by adding ingredients to a basic diet. Eating tastier food often requires vegetable oil, meat, fruit, and vegetables. Meat production requires feed rations of grains and

protein meals that are converted into weight gain. For example, if 1,6 pounds (0,72kg) of feed is required to add one pound (0,45kg) of chicken, switching or just adding chicken to the dish results in an increase in per capita consumption of grains and protein meals.

As meat consumption increases, backyard operations naturally evolve into commercial operations to gain economies of scale. African swine fever (ASF) is accelerating the trend towards commercial pork production, which will increase the use of commercial feed rations. Commercial operations are more efficient at converting feed rations into meat due to feed rations that are more scientific and precise in nature. Over the long term, ASF ought to benefit grain and vegetable meal consumption, as world-class operations feeding precise diets will increase consumption of these types of meals.

Adding additional acreage

Meeting the AGC's increasing demand for food requires a world effort. Yields have continued to increase as the quality of machinery, seeds, and irrigation improves. Yields are expected to continue to increase, but additional acreage will have to be added. However, the yields of marginal land will be lower than the average, which will pull the average yield gain down.

Total crop acreage in Asia, Australia and Europe is expected to replace some hay and fallow land. South America and Africa have the most land available for crop production, but South America is best suited to add the area required to meet the world's growing food consumption.

With food consumption increasing faster than production in the AGC, the area will continue to show a grain and soya bean deficit. As consumption increases over time, trade also increases. From 2009 to 2018, soya bean imports into the AGC increased by 72%, while imports are set to increase by 48% over the next ten years.

Investment in infrastructure

A tremendous amount of infrastructure investment has occurred in the AGC and Brazil. Examples of supply chain investment include new ports, deeper ports that can handle larger vessels, railroad tracks that service the ports, more sophisticated grain storage systems, and commercial animal operations.

For example, according to the National Association of Grain Exporters, the amount of grain exported out of Brazil's northern arc of ports were set to reach 35 million tons in 2019. Over the last five years, the amount of grain exported from Brazil's traditional southern ports increased 16%, while exports out of Brazil's northern ports increased more than 300%. With all the investments made, the northern arc of ports could in theory ship over 70 million tons.

However, one area of the supply chain that is often ignored is the route from the marketplace to the consumer's home. The expansion of commercial animal operations increases the amount of product flowing from one location, which requires more cold storage capacity and improved transportation that can maintain the cold chain.

In developed countries, the cold chain is fully developed but is often taken for granted. In contrast, marketplaces in developing and poor countries have wet markets – a wet market is when frozen meat is taken to a venue and left to thaw over the course of the day. All over Asia, marketplaces are moving away from wet markets to refrigerated storage. Homeowners are also increasingly investing in refrigeration, which allows them to buy more meat and produce on each trip to the market.

Consumption of soya beans

Global per capita consumption of soya beans averaged 43 pounds (19,5kg) in 1990. By 2000, this figure had increased to 62 pounds (28,1kg), up 42%. China's consumption grew strongly during that decade before the country began its massive soya bean import programme. However, China's per capita consumption was only 19 pounds (8,6kg) in 1990, compared to the 304 pounds (137,9kg) of the United States (US). By 2000, China was at 47 pounds (21,3kg), whereas the US was at 383 pounds (173,7kg).

Argentina and Brazil also saw outstanding growth in the 1990s. Argentina increased their consumption from 502 (227,7kg) to 1 091 pounds (494,9kg), while Brazil grew from 226 (102,5kg) to 310 pounds (140,6kg).

From 2000 to 2010 global per capita consumption increased from 62 (28kg) to 81 pounds (36,7kg), while the US's consumption decreased from 383 (173,7kg) to 344 pounds (156kg). The decline in US per capita consumption is linked with dried distillers' grains that competed on price with soya bean meal. Argentina's consumption jumped from 1 091 (494,8kg) to 2 135 pounds (968,4kg), while Brazil went from 310 (140,6kg) to 436 pounds (197,7kg). China advanced to 110 pounds (49,9kg) from 47 pounds (21,3kg) in 2000.

World per capita use from 2019 to 2028 is forecast to increase from 102 (46,2kg) to 120 pounds (54,4kg), or an 18% increase. For the same period, Argentina's forecast advances 10%, Brazil 14%, China 33%, and the US 5%. After decades of increases China's 2019 consumption declined due to the trade war and ASF, but is expected to bounce back quickly.

Figure 1: Soya bean per capita consumption. (Source: United States Department of Agriculture [USDA] and Doane)

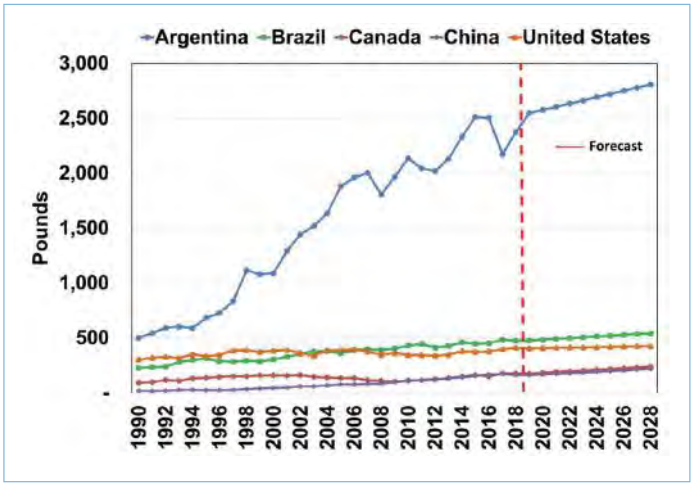
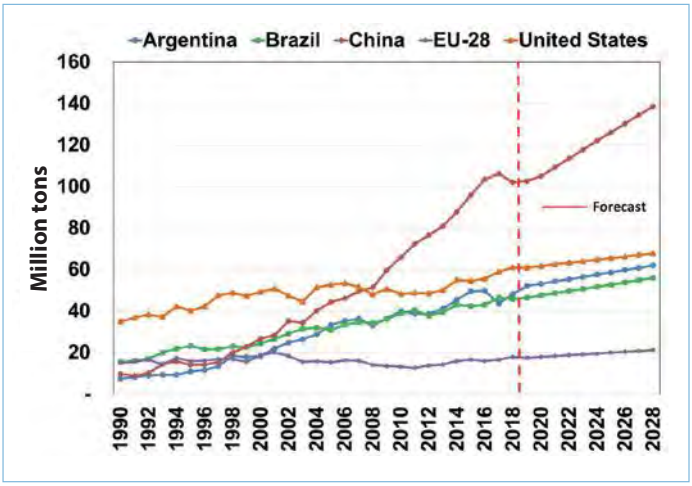


Figure 2: Domestic consumption of soya beans. (Source: USDA and Doane)



Expanding local operations

The much slower growth for Brazil can be attributed in part to the current trade conflict with China – Brazil has been sending most of its exportable beans to China to the relative detriment of its own crush. Meanwhile, the US crush is enhanced by soya bean meal export demand to partially offset the beans being diverted by Brazil to China.

In 2019, Ag Processing Inc opened a 60 million bushel per year soya bean crushing plant in Aberdeen, South Dakota and CHS Inc announced that it is expanding its facility in Fairmont, Minnesota, which is why per capita consumption continues to increase. As the US maize belt keeps expanding, more crushing plants will emerge. The northern and western maize belt expansion has resulted in farmers located in the areas receiving deeply discounted soya bean prices, while animal production operations receive expensive soya bean meal.

With soya bean crushing plants providing local consumption, soya bean prices should improve and encourage more local soya bean production. Likewise, the availability of local soya bean meal should lower the cost of animal feed and encourage an increase in animal production.

Soya bean utilisation

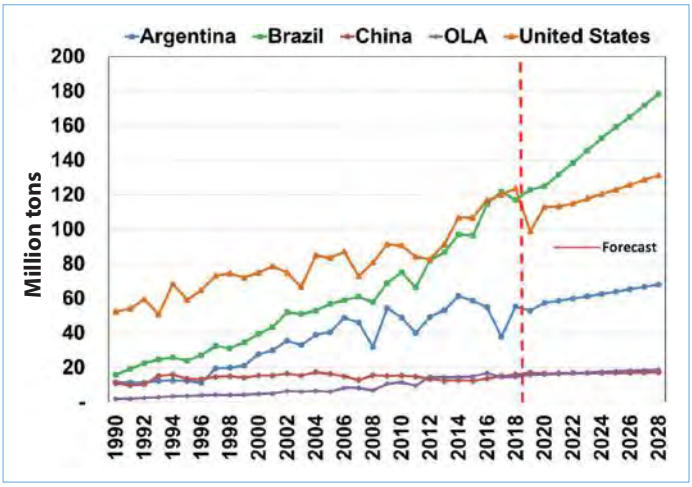
The domestic utilisation forecast is derived from population and per capita forecasts. As noted, the population is projected to increase by 9%. Africa's ten-year, 23% rate of expansion will make feeding its general population a challenge.

The increase in world meat consumption is the primary driver of the increased consumption of coarse grains and soya beans. As meat consumption increases, commercial operations become more advanced and efficient at converting feed rations into meat; top-quality feed rations typically require quality grains and soya bean meal. Currently, there is no reason to doubt that this trend will continue.

Global soya bean utilisation was estimated at 353 million tons in 2019. It should come as no surprise that China was the largest constituent of the total at 103 million tons. The US came in second at 61 million tons. Argentina and Brazil were nearly identical at 52 million tons and 47 million tons, respectively. These four countries made up three-quarters (263 million tons) of global utilisation. The world outlook for 2028 totals 453 million tons, which represents an increase of 28%.

In the forecast period, China remains the dominant user at 139 million tons, or a gain of 35%. For reference, between 2009 and 2018, China's soya bean use surged by 71%. The AGC experienced a 68% increase from 2009 to 2019 and is forecast to increase 38% over the next ten years.

Figure 3: Soya bean production. (Source: USDA and Doane)



Global soya bean production

The global soya bean yield averaged 1,9 tons/ha in 1991. By 2001, the yield was 2,3 tons/ha or an increase of 19% in the decade. As of 2018, the decade-to-decade comparison of the rolling three-year averages was up 17%. Global soya bean yields are projected to trend higher, with gains between the extremes of the past two decades – yields are set to reach around 3 tons/ha in 2028. The additional acreage from countries with lower soya bean yields than those of the US will moderate global soya bean yield gains. In addition, new land entering production generally has a lower yield, which is limiting Brazil's soya bean yield growth.

It is anticipated that this leading protein meal will continue to experience strong gains. The area forecast for 2019 was 123 million hectares. By 2028, the area forecast is expected to be 151 million, a gain of 23%. The increase in soya bean acreage between 2009 and 2018 was 22%. Brazil continues to expand its soya bean acreage at an aggressive rate.

From 2009 to 2018, world soya bean production increased to 362 million tons, or an increase of 38%. The projection between 2019 and 2028 is for production to top 455 million tons, or an increase of 35%.

The global soya bean trade is projected to reach 205 million tons in 2028 compared to 150 million tons in 2019.

For more information and to view the original article, visit *https://ussoy.org/long-term-world-soybean-outlook/.*

Considering the legal and IP implications of gene editing

By Chyreene Truluck, Spoor & Fisher South Africa

Global food security is increasingly challenging in light of population growth, the impact of climate change on crop production, and limited land available for agricultural expansion.

One solution has been presented in the form of gene editing, a technology – based on a natural process – that allows researchers to cut out certain bits of DNA in order to control traits. In practice, this can make a significant contribution to global food security, in part by improving so-called 'orphan' crops, which are regionally important to health, food security and rural incomes. But what are the intellectual property (IP) implications of gene editing?

Introducing genome editing

Traditional gene modification in plants involves modifying the genome of cultured plant cells by introducing new genetic material and then regenerating whole plants. These methods have been vilified by the anti-GMO (genetically modified organisms) movement for introducing foreign DNA from other organisms, with anti-GMO groups arguing that we do not know what the effect of introducing foreign genes into plants, nor the potential effect of consuming them down the line, will be.

But gene editing is different: It mimics the natural process of mutagenesis (changing or mutating DNA). It targets a single nucleotide in plant DNA to make it change advantageously, instead of waiting for nature to do so and hoping for advantageous mutations.

In my opinion, there is a significant difference between introducing foreign DNA into a crop that will eventually be eaten and changing a single nucleotide in the plant's DNA in much the same way that naturally arising mutations would. This could also be why opinions are more polarised when it comes to GMOs than gene editing.

Regulating gene-edited crops

Regulatory developments indicate that some governments are adopting unnecessarily rigid regulations, considering that gene editing techniques are not that different from what occurs naturally through mutagenesis, barring the fact that the former are targeted.

One example of what is emerging as a seemingly rigid regulatory landscape is that of Europe. Recently, the highest court in the European Union ruled that gene-edited crops are GMOs and must comply with the tough regulations applied to plants made with genes from other species.

In South Africa, our law is very similar to European law in many respects. South Africa's regulatory law for GMOs, the *Genetically Modified Organisms Act, 1997 (Act 15 of 1997)*, says that a GMO is an organism of which "the genes or genetic material has been modified in a way that does not occur naturally through mating, natural recombination or both".

This is broad enough to encompass gene editing and to hamper the regulatory approval of plants that have been modified using gene editing techniques.

Intellectual property issues

But what of the IP implications of gene editing? South African patent law, according to Section 25(4) of the *South African Patent Act, 1978 (Act 57 of 1978)*, provides that a patent shall not be granted for any variety of animal or plant or any essentially biological process for the production of animals or plants, not being a micro-biological process or the product of such a process.

Chyreene Truluck.

However, there is no case law in South Africa to interpret the meaning of this section. In Europe, it is possible to obtain patent protection for transgenic plants, plants obtained by mutagenesis (including gene editing) and/or biotechnological methods of producing them, so it is likely that our courts will follow the European approach.

In addition, it is also possible to obtain plant breeders' rights protection, provided that the plant meets the requirements of protection, i.e. that it is new, distinct, uniform and stable.

Democratising gene editing

CRISPR, also called CRISPR/Cas9, stands for Clustered Regularly Interspaced Short Palindromic Repeats/CRISPR associated protein 9, which is the full name for the gene editing technique often applied to selective breeding.

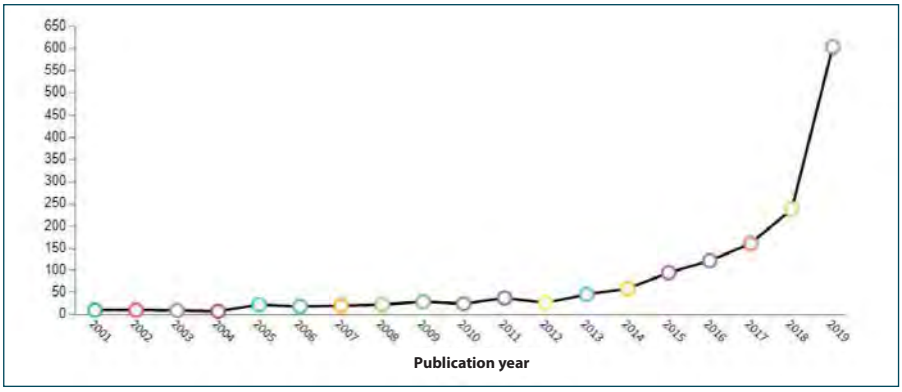
"CRISPR has been democratised," says Rodolphe Barrangou, editor of *The CRISPR Journal* and head of a multi-disciplinary CRISPR lab. "With 100 000

labs and ten people per lab, we now may have over a million geneticists working with this technology."

This bodes well for food security. *Figure 1*, which is based on a patent search formulated to identify patent filings related to gene editing in plants or crops, shows that this appears to be an exponentially and rapidly increasing field, especially over the last decade.

What's more, the fact that the CRISPR/Cas9 system is patented, does not prevent others from obtaining patents for specific embodiments of this technology and, in particular, from using it to produce new, stronger crops.

Figure 1: Gene editing patented inventions for plants or crops by publication year. (Source: Derwent™ World Patents Index)



Considering a patent commons

In other areas, a standard mechanism for creating openness in research and development has involved putting material in the public domain, outside the world of property. So, researchers in the field of gene editing may decide to use IP rights to create a 'food security commons' – much like developers of free and open source software use software copyrights to impose requirements of openness on future programmers; requirements greater than those attaching to a public domain work.

There is nothing that precludes a patent commons for gene editing technologies, and this could be a great way to develop technologies for solving problems linked to food security. For example, a similar COVID-19 commons was recently proposed for sharing solutions to combat the pandemic. Although a patent commons operates much in the same way as open source software or creative commons, the difference is that copyright is automatic, while patents need to be applied for.

My view is that, if we can combine the scientific strides being made with the appropriate IP protection and alignment of the regulations with the actual risks posed, gene editing could very well turn out to be an important technology for future food security.

For more information, email the author at c.truluck@spoor.com or visit *www.spoor.com*.

The role of soya and oilseeds **in the vegan food revolution**

By Claudi Nortjé

Soya-based foods are known for their high protein content and versatility when it comes to adding nutritional value to a meal, which is why vegans across the globe are incorporating more soya into their diets. When compared to other legumes, soya beans differ vastly in macronutrient content – it is higher in unsaturated fat and protein, but contains relatively low levels of carbohydrates.

A British study that included 570 vegetarian and 102 vegan women, found that an average of 11,2g of soya protein were consumed daily. Only 27% of the vegans consumed less than 5,9g/day; the same was true for 86% of the vegetarians in the study. Western vegans usually consume around 10 to 12g/day of soya protein, mimicking the intake of non-vegetarian Japanese and Shanghai Chinese. However, vegetarians consume roughly half this amount.

Soya beans are the only legume containing high amounts of alpha-linolenic acid. Based on human nitrogen balance studies, soya is also the only plant containing high-quality proteins when measured against all plant protein sources fit for human consumption. According to a study by the National Centre for Biotechnology Information of America, the protein content of soya beans normally varies between 36 and 46%, depending on the cultivar.

There are several traditional and modern soya food options that are becoming more popular as veganism increases worldwide. Soya milk, edamame, tofu, soya cheese, miso, soya sauce, tempeh, nattō, sufu, yuba, soya flour, soya protein isolate, and meat analogues (also called textured vegetable protein) are all popular choices for a healthy vegan lifestyle.

Rise of the ingredients market

Seeing as more consumers in developed countries are reducing their animal product intake and supporting more sustainable approaches to food production, vegan food companies have started zoning in on demand.

In 2016, the market for global plant protein ingredients was worth $6,4 million and is expected to grow to $12,7 million by 2027. Global plant protein ingredients are mostly derived from soya beans and wheat, but pea protein also shows some promise. However, for sunflower and rapeseed proteins to be directly utilised for food, certain technical barriers still need to be removed.

According to the global vegan food market industry forecast published on *Research and Markets*, the global vegan food market was valued at $14,2 billion in 2018 and is expected to reach $31,4 billion by 2026, registering a compound annual growth rate of 10,5% from 2019 to 2026.

Global soya bean production

According to the *OECD-FAO Agricultural Outlook 2018 - 2027* for oilseeds and oilseed products, soya bean production is anticipated to increase by 1,5% per annum compared to the 4,8% growth per annum over the last decade. Production of other oilseeds such as sunflower seed, groundnuts, and rapeseed are also expected to increase by 1,6% per annum compared to the 3,1% per annum during the last decade.

The United States (US) and Brazil are expected to see similar growth in soya bean production over the next ten years. It is estimated that both countries will reach 130 million metric tons in 2027, with an annual growth rate of 1,2 and 1,3% for Brazil and the US, respectively. Production estimates for Argentina and Paraguay are set at 66 million metric tons and 12 million metric tons in 2027.

> When compared to other legumes, soya beans differ vastly in macronutrient content – it is higher in unsaturated fat and protein, but contains relatively low levels of carbohydrates.

The reduced policy support for the cultivation of certain cereals in China has hampered soya bean production growth over the past decade. However, as two of the most important oilseed producers in the world, China and the European Union's projected production in 2027 are 32 million metric tons and 30 million metric tons, respectively. Production expansion for both regions will likely be small throughout the next decade.

Soya bean production is set to flourish in some countries in sub-Saharan Africa. Similarly, the Ukraine and Russia will most likely expand their oilseed production by 4,3 and 2,2% per annum, respectively.

This global expansion in oilseed production will allow countries to meet the growing domestic consumption needs for vegetable oil. However, the global trend of gradually increasing oilseed production in the major producing countries and the predicted

decline of the stocks-to-use ratio could result in increased price volatility.

Local soya bean production

South Africa ranks 13th in the world in terms of soya bean production and is the third largest consumer internationally. According to the Department of Agriculture, Forestry and Fisheries, local soya bean consumption is estimated at 32% for oilcake and oil, 60% for animal feed, and only 8% for human consumption.

Over the years, fluctuations in soya bean production volumes have been attributed largely to the variability of areas allocated to soya bean crops and unfavourable weather conditions. Yields in South Africa average 1,7 to two tons per hectare under dryland conditions, with total yields ranging from 100 000 to 800 000 tons per annum.

Local demand for soya beans comes predominantly from the processing industry. Rising income levels and improved crushing capacity of processing facilities are the two largest drivers behind the rising demand for oil and meal.

In terms of human consumption, soya milk is one of the most valuable protein supplements in infant feeding. Mature fermented beans are used to make soya sauce while roasted seeds can be utilised as a coffee substitute. Soya flour is used in bakeries and as an additive or extender in cereal flour and meat products in certain health foods.

The myriad health benefits of soya beans have sparked a rising demand for soya-containing products both locally and abroad. The Bureau for Food and Agricultural Policy (BFAP) estimated that one million hectares of soya beans will be planted per season in the next five to ten years in South Africa.

According to the South African Grain Information Service (Sagis), roughly 29 000 tons of soya beans are processed locally for human consumption on a five-year average. Yet more than half of the soya market for human consumption still relies on imports.

Statutory soya bean levy

With local demand for high-quality, nutritious soya food products growing, emphasis would need to be placed on new soya bean cultivars to satisfy this market. As an increasing number of consumers are demanding environmentally conscious products, South Africa would have to expand its range of non-GMO, high-yielding soya bean cultivars that can match the performance of GMO cultivars. Currently, up to 80% of soya beans planted in South Africa consists of GMO cultivars.

In March 2019, a statutory levy was introduced for soya beans, with producers subsequently having to pay R65/ton sold. Role-players in the oilseed industry, represented by the Sunflower and Soya Bean Forum, urged the ministry of Agriculture, Forestry and Fisheries to put this levy in place.

The South African Cultivar and Technology Agency (SACTA) collects the levy each month and distributes it among various seed companies. This serves as compensation for the companies' investment in the research and development of advanced seed technology. The levy increased to R80/ton sold on 29 February this year.

In the long run, more advanced soya bean cultivars that are resistant to harsh climatic conditions and pests will see a decrease in the amount of soya products imported.

Catering for plant-based diets

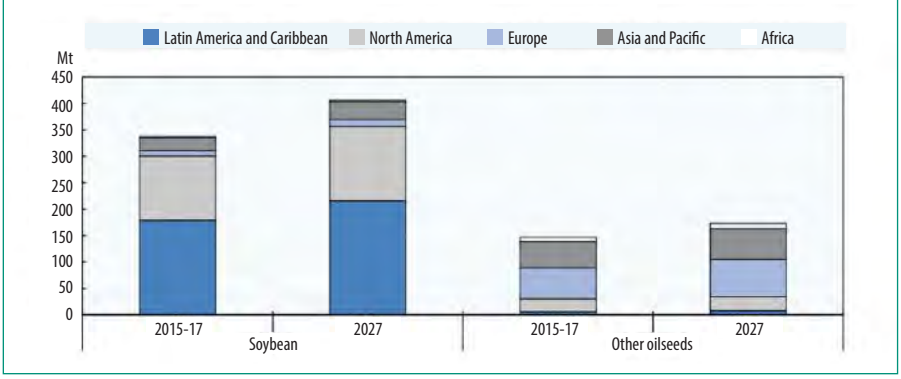
According to Innova Market Insights, approximately 75% of health-conscious South Africans are opting to skip meat during meals at least once a week. More than a quarter of adults in the 25 to 34 age bracket identify as vegan in the US and up to 38% of Americans report that they enjoy meat-free meals once a week; this trend is even more apparent in Germany (69%) and Britain (53%).

The global fast-food market was valued at approximately $617,6 billion in 2019, with a compound annual growth rate of 5,5% predicted from 2019 to 2025. Globally, McDonald's is still in the lead with a brand value worth $130,4 billion. Starbucks and KFC are second and third, with a value of $45,9 billion and $17,2 billion, respectively. Veganism has hopped on board the fast-food train with top brands now offering meat-free options on their menus. McDonald's already have meat-free options available while Burger King and KFC are planning to trial vegan versions of crowd favourites.

The Beyond Meat burger, made from ingredients such as pea protein and beetroot, is now available in South Africa, while food retailers such as Checkers and Woolworths are widening the range of vegan products on offer to accommodate the shift in customers' habits towards a plant-based diet.

Fast-food outlets and food retailers that are expanding their vegan product range may be ahead of the curve when it comes to evolving consumer preferences. According to a report by global management consulting firm Kearney, an estimated 35% of all meat will be cultured in 2040 with 25% being replaced with vegan alternatives.

Figure 1: Oilseed production by region in million metric tons (Mt). (Source: OECD-FAO, 2018)



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The how and why of proficiency testing schemes

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

Disputes and product rejections in the grain and oilseed value chains, can be prevented through improved benchmarking and alignment of testing facilities. Successful participation in proficiency schemes can assist value chains to function more efficiently. It is against this background that the Oilseeds Advisory Committee (OAC) requested the Southern African Grain Laboratory NPC (SAGL) to co-ordinate a proficiency testing scheme for soya beans and soya bean meal on their behalf.

A questionnaire was developed to ascertain the number of participants as well as the specific parameters to be included in the proficiency scheme. This questionnaire was distributed to members of the Animal Feed Manufacturers' Association (AFMA) and the South African Oil Processors' Association (SAOPA) in a bid to reach the maximum number of testing facilities in the soya bean industry. Accredited testing laboratories involved in the testing of soya beans and soya bean meal, were also included in the distribution list.

Measuring individual performance

Proficiency testing aims to provide an independent assessment of the competence of participating testing facilities and, together with the use of properly validated methods and well-trained analysts, is an essential element of quality assurance. Successful participation in proficiency schemes forms part of complying with the accreditation requirements under the international standard for testing laboratories (ISO/IEC 17025).

Regular participation in proficiency testing (also called interlaboratory comparisons or ring tests) provides information that can be used to evaluate and carefully monitor individual performance using pre-established criteria. Benefits include equipment verification, method optimisation, benchmarking against other laboratories/analysts, and information on the comparability of test or measurement methods.

It is also a method validation tool, assists with the training of laboratory staff, allows the laboratory to identify analytical drifts and equipment dysfunctions that can be corrected, improves measurement uncertainties, and ultimately provides a means of confirming the accuracy of results.

Proficiency samples are prepared, tested and its homogeneity confirmed before it is distributed to participants. The results submitted by the participants are statistically analysed in order to provide an assigned value for each analyte; the assigned value is derived from the consensus of the results submitted by participants. The assigned values are then used in combination with the standard deviation for proficiency to calculate a z-value for each result.

Identifying outliers in data sets

Outliers in a set of data will influence the average and standard deviation of that data set and thus also the z-value. All outliers are identified and omitted for further statistical analysis. A significance level of 5%, or a confidence level of 95%, is used when determining outliers; the significance level is a specified small probability considered to be the risk of erroneously rejecting a good observation.

Different statistical tests are used to determine outliers, the most commonly used being the Grubbs test, Dixon's Q test, and the David, Hartley and Pearson test.

Significance of z-values

Z-values are used internationally as an indication of a laboratory's proficiency. A z-value is calculated for each reported value. Each individual z-value represents the decimal number of standard deviations by which an analytical result differs from the 'true value', as represented by the average/consensus/assigned value.

A 'perfect' z-value is 0,00. Z-values of less than 1,00 represent outstanding accuracy and precision; z-values of less than 2,00 are considered to represent satisfactory accuracy and precision; z-values between 2,00 and 3,00 are considered to be questionable and it is suggested that some attention to equipment and procedures may be required; and z-values greater than 3,00 are considered to be unsatisfactory and require examination of the equipment and procedures used.

Evaluating overall performance

To grade proficiency schemes on grading parameters, individual samples are prepared per participant. Grain and oilseed samples are cleaned of all defects. Known quantities of defects and foreign matter are then added to each cleaned sample. Prior to the samples being sent to participants, each sample is graded to ensure that the composition of all the samples are similar and to enable comparison of the participants' results.

Results are presented in table and graph format and each participating laboratory can use their own uniquely coded results to evaluate their performance. Information on the specific methods used by the participants are also included in the report. This information provides participants with additional information on the different methods that are used by other testing facilities.

It remains the responsibility of each participant to investigate the reason and to take action if an out-of-spec result is reported. These investigative steps include making sure that the correct results were reported, the correct method was used, the equipment calibration and verification is up to date, and the staff conducting the testing is properly trained.

For more information, phone The Southern African Grain Laboratory NPC on 012 807 4019 or visit *www.sagl.co.za*.

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Chemical composition, protein quality and nutritive value of **commercial soya bean meals produced from beans from different countries**

By MA Ibáñez, C de Blas, L Cámara and GG Mateos

Soya bean meal is the most important source of protein and indispensable amino acids in non-ruminant diets worldwide. The chemical composition, protein quality and nutritive value of commercial soya bean meal depend on numerous factors, including seed variety, environmental conditions during growing, harvesting and storage of the beans, and the procedure used for oil extraction.

A meta-analytical approach was taken to quantify the relationship between the country of origin of the beans (Argentina, Brazil, the United States [US] and India) and the chemical composition, protein quality, and nutritive value of soya bean meal. The data set used was obtained from 18 published papers from 2002 to 2018, which included a total of 1 944 soya bean meal samples. The data was analysed using a mixed model with country of origin of the beans as a fixed effect and the study as a random effect.

The origin of the beans had consistent and significant effects on most of the chemical variables of the corresponding soya bean meal. The Brazilian soya bean meal had more crude protein (CP), neutral detergent fibre (NDF), raffinose and iron but less sucrose, stachyose and K contents than the US or Argentinian soya bean meals (P<0,05). Per unit of protein, lysine, methionine, threonine and cysteine concentrations were greater for the US and Argentinian meals than for the Brazilian and Indian meals (P<0,05).

The protein dispersibility index (PDI), KOH solubility (KOH) and trypsin inhibitor activity (TIA) were lower for the Brazilian and Argentinian meals than for the US and Indian meals (P<0,05). TIA was positively correlated with PDI (r = 0,712; P<0,001) and KOH (r = 0,886; P<0,001). Also, a significant relation was observed between PDI and KOH (r = 0,614; P = 0,001). Urease activity, however, was not correlated with any of the protein quality traits studied. Within the range of CP values (418 to 500g/kg) studied, a decrease in crude fibre increased (P<0,01) the CP content of the soya bean meal.

> When formulating feed, most feed mill managers and nutritionists use a matrix for soya bean meals based on its CP content, which is independent of other characteristics of the beans.

The country of origin of the beans affected the chemical composition and nutritive value of the soya bean meal. Consequently, matrices with different nutrient compositions should be used for soya bean meals of different origins in the formulation of diets for non-ruminant animals.

Importance of geographical region

Soya bean meal is the most common protein source in non-ruminant diets, with the US, Brazil, Argentina and India being the most important exporting countries. When formulating feed, most feed mill managers and nutritionists use a matrix for soya bean meals based on its CP content, which is independent of other characteristics of the beans.

Westgate *et al*. (2000) and Karr-Lilienthal *et al*. (2004), however, reported that factors such as bean genotype, type of soil, environmental conditions during growing, harvesting seasons and storage affect the proximal analyses of soya beans. Moreover, the geographical area of production of the soya beans might affect the protein quality and nutrient content of the corresponding soya bean meal (Grieshop *et al*., 2003; Ravindran *et al*., 2014; García-Rebollar *et al*., 2016; Lagos and Stein, 2017).

The feed compound industry, however, has paid little attention to the influence of the country of origin of the beans on the chemical composition, amino acid profile and protein quality of the soya bean meal (Pfarr *et al*., 2018).

Evaluating the protein fraction

Trypsin inhibitors (TI) are the most important group of antinutritional factors (ANF) present in raw beans. These ANF are inactivated by heat, which allows the use of increased levels of soya bean meal in animal feeding. Excess heat, however, increases the incidence of Maillard reactions, which reduces the digestibility of lysine and other amino acids and the nutritive value of the soya bean meal (Fontaine *et al*., 2007; González-Vega *et al*., 2011).

As the analyses of TI and Maillard reactions are tedious, time consuming and expensive, indirect methods such as urease activity (UA), PDI and protein solubility in KOH are preferred by the industry to indirectly evaluate the quality of the soya bean meal's protein fraction. It is important to note, however, that urea is not an ANF in pigs and poultry; in fact, its

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presence in soya bean meal does not affect animal productivity.

However, urease, an enzyme present in raw beans, is inactivated by heat at a rate that resembles that of TI (Balloun, 1980; Waldroup *et al*., 1985). Consequently, high UA values are indicative of under-processing and an excess of TI remaining in the meal. UA does not have negative values and, consequently, values close to zero might indicate either adequate processing or overcooking of the meal.

Because of its low cost, however, UA is the method preferred by the soya bean crushing industry to evaluate the quality of the soya bean meal's protein fraction. The PDI and KOH methods are used to estimate the solubility of the soya bean meal's protein fraction and, indirectly, its denaturation – high values are indicative of under-processing and low values of over-processing of the meal (Araba and Dale, 1990; Parsons *et al*., 1991; Serrano *et al*., 2013).

Meta-analysis approach

The meta-analysis procedure is used as a statistical tool to compare the chemical composition and nutritive value of any particular ingredient. The technique combines data from independent studies conducted under variable conditions and allows the statistical analysis of published data with greater analytical power (St-Pierre, 2001; Sauvant *et al*., 2008). Consequently, the meta-analysis approach facilitates the transformation of research results into applicable knowledge by taking into account the unavoidable heterogeneity among studies.

The research reported herein studied the influence of the origin of the beans (Argentina, Brazil, the US and India) on the chemical composition, protein quality and nutritive value of commercial soya bean meals collected from 18 independent published papers, using the metanalytical approach.

Conclusions of the study

The country of origin of the beans affects the chemical composition, protein quality and nutritive value of the corresponding meals. On average, Brazilian meals had more CP, NDF and raffinose than the Argentinian and US meals, whereas the Indian meals show the highest ash, raffinose and NDF content. US meals had more sucrose and stachyose but less raffinose and more indispensable amino acids per unit of protein than Brazilian and Indian meals, with Argentinian meal being intermediate. The US soya bean meal had higher TIA, KOH solubility and PDI than the Argentinian and Brazilian soya bean meals.

> Data from the meta-analysis suggests that the chemical composition, protein quality and nutritive value of soya bean meals depend on the country of origin of the bean.

The information provided suggests that the range of PDI, KOH and TIA values recommended by the industry to evaluate the quality of the protein fraction of commercial meals of different origins should be considered very carefully. Despite its lower CP content, the energy content for poultry and swine was similar or even higher in the soya bean meal from the US than the soya bean meal from Brazil, suggesting higher protein digestibility of the US meals.

TIA was positively correlated with PDI and KOH. No correlations were found between UA and any of the other protein quality indicators studied, confirming that UA values are not an accurate prediction of the quality of the protein fraction of soya bean meals currently available in the market.

Data from the meta-analysis suggests that the chemical composition, protein quality and nutritive value of soya bean meals depend on the country of origin of the bean. Consequently, different matrices should be used in feed formulations for commercial soya bean meals obtained from beans of different origins.

This article has been shortened for publication in *Oilseeds Focus*. To read the full article, visit *https://doi.org/10.1016/j.anifeedsci.2020.114531*
or send an email to MA Ibáñez at miguel.ibanez@upm.es or GG Mateos at gonzalo.gmateos@upm.es.

Key drivers that affect **sunflower seed quality**

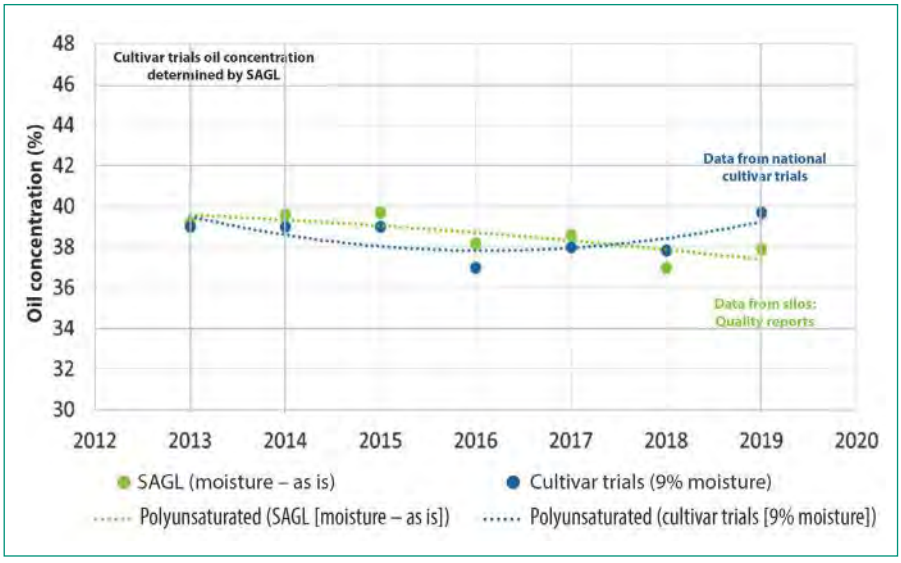
By Marion Delport, manager: data science, Bureau for Food and Agricultural Policy

Over the past seasons the drastic decline in sunflower seed oil content has had a major adverse effect on the industry. Whereas sunflower seed was typically delivered with an oil content of approximately 39% and higher, the oil content has declined significantly. This decline puts crushing margins and the overall competitiveness of the industry under pressure.

In light of this, the Bureau for Food and Agricultural Policy (BFAP) has undertaken a study to provide a deeper understanding of the key drivers that affect sunflower seed quality, the impact of lower oil content on the industry, and potential interventions to upgrade the value chain. The Oilseeds Advisory Committee and Oil and Protein Seeds Development Trust funded the study.

In South Africa, yields and oil yield (tons/ha) have been relatively stagnant over the past decade, managing to increase by an average annual growth rate of only 1% compared to maize yields that have increased by an average annual growth rate of 2,5% over the same period.

Figure 1: Sunflower seed oil concentration based on the cultivar trials (9% moisture level) and Southern African Grain Laboratory (as-is moisture level) results.



Simultaneously, the seed's oil content percentage has decreased by an average annual growth rate of 0,6%. The oil content of sunflower seed produced in South Africa is also significantly lower than that which is produced in Argentina or the Balkan countries.

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

Cultivar	Country	Yield (tons/ha)	Oil content (percentage, moisture – as is)
Cultivar 1 – commercially sold in Argentina and South Africa	Argentina	2,58	52,7%
	South Africa (average 2016 to 2019)	1,77	42,3%
Cultivar 2* in Argentina vs cultivar 3 in South Africa	Argentina	2,51	50,4%
	South Africa (average 2016 to 2019)	1,88	40%

** This cultivar is of South African origin and was moved to Argentina since it could not outperform cultivar 3, the leading Corteva cultivar, in terms of yield in South Africa.*

Cultivars with high oil content

Cultivar trial data from international seed breeders shows that the same high-oil-content cultivar planted in South Africa yields a lower oil content when it is planted under optimal conditions in Argentina (*Table 1*).

This research has clearly illustrated that seed yield and oil content are complex quantitative traits that are not only controlled by many genes, but are also highly influenced by environmental conditions. Both additive and non-additive genetic effects play an important role in the inheritance of seed yield and oil content.

There is some evidence that oil content levels can be increased by introducing more cultivars with high oil content (*Figure 1*). Currently, producers who plant sunflower have a choice of 199 different sunflower seed varieties; some 113 of

these varieties are classified as high-oil hybrids with the potential of achieving an oil content of more than 40%.

The average advertised oil content for South African cultivars is between 38 and 46%. An analysis of advertisements from seed companies supplying the Russian, Ukrainian, Hungarian and Argentinian markets indicated an advertised oil content in the range of 45 to 54%. Thus, the South African sunflower seed market may benefit from new imported cultivars. However, this must be tested first to establish their potential under South African climate and management conditions.

Focusing on oil content

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

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

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

A summary of various international and domestic quality-based pricing models highlighted two options for the sunflower industry:

- Oil-content-based price premium or oil-content-based grading (a common practice in Argentina and Balkan countries' pricing mechanisms).
- Back-payment structure by which the producer gets to share in high-oil-content advantages at crushing level.

A study of incentive systems

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

> Cultivar trial data from international seed breeders shows that the same high-oil-content cultivar planted in South Africa yields a lower oil content when it is planted under optimal conditions in Argentina.

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

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

Of the sunflower seed delivered, the oil content was measured at 46 to 48%. Based on an average sunflower price of R5 887/ton, producers would have received price premiums of between R706 and R883/ton (that is 12 to 15%). On top of the improved price, producers who took part in the pilot study reported average yields of 2 tons/ha. Overall, the 1,5% premium accounts for a yield that is 0,3 tons/ha lower at the average oil content levels recorded in this study.

Oil content testing at silo level would be a key factor in implementing such an oil-content-based price premium, but is currently poorly defined with no standards or thresholds of oil content levels. Not all silo depots have calibrated equipment to measure oil content. The near-infrared reflectance testing methodology would be the analysis of choice at silos and crushing plants due to the speed of the test, the ease of testing and relative accuracy. However, making this technology available at all (or enough) silos would require significant additional investments.

A final thought

It comes down to producers' willingness to adopt new high-oil-content seed and predominant cash crop production practices (e.g. earlier planting dates), as well as the favourable environmental and climate factors mentioned in *Table 2*, to improve their ability to produce seed that exceeds the threshold of 38%, preferably in excess of 41%, oil content. Processors' ability to pay premiums that will sustainably stimulate high levels of high-oil-yielding seed production, while competing with crude oil imports, is also a factor.

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

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

For more information, phone the author on 083 731 9698 or 012 420 5770, or visit *www.bfap.co.za*.

Cultivating skills for growth

By Laura du Plessis, bursary co-ordinator, L&L Agricultural Services

South Africa is renowned for being a key driver of economic growth and development, and skills development in agriculture should be considered an investment. The social and economic responsibility of the agricultural sector continues to increase, and this situation has compelled the sector to investigate reforms and economic diversification to re-awaken optimism about potential growth prospects.

The population from which agriculture will draw the next generations of employees will be under 30 years old, and South Africa's youth must have the skills needed to build a resilient agricultural sector. Policies aimed at stimulating growth will be successful only if the supply of skills is adequately addressed. It is therefore vital that the youth are given the opportunity to acquire the skills the industry needs to build a global, competitive and resilient agricultural sector.

At present, the grain and oilseeds industry receive a cumulative amount of approximately 200 bursary applications annually. More than half of these applicants are individuals under 30 years of age. There is consequently an urgent need for agriculture to proactively address the skills shortage and help build capacity to serve the aspirations of the sector and the country's economy.

Investing in human capital

Agriculture's strength lies in its human capital. Maize Trust doctoral student, Lucia Zinzi Ndlala, supports the narrative, stating that "the key to success and improving the economy and the livelihoods of our farmers is through empowering and investing in students and their education," making the issue of skilled human capital a valid concern.

L&L Agricultural Services and our clients are committed to skills development and skills upliftment within the grain and oilseeds industry. As part of our contribution to skills development in the sector, we have investigated improved methods for the grain and oilseeds bursary schemes. L&L Agricultural Services has created a new bursary website, with an algorithm that has been structured in such a way as to allow applicants and their supervisors to securely apply/register to the respective bursary schemes.

These bursary schemes invest directly in the education of deserving South African youth and provide students with the opportunity to build a personal and professional relationship with their benefactors. Building relationships is a precondition to student learning. Our clients therefore endeavour to continue interacting with successful applicants throughout the duration of their studies, and to introduce them to potential networking systems and influential role-players within the industry.

A one stop portal

In addition to the funding benefits, bursars can enjoy access to the L&L Agricultural Services website and subsequently any agricultural sector job advertisements. This way, clients are directly supporting the process of attracting talented equity candidates into partner enterprises.

Furthermore, L&L Agricultural Services and our clients have taken the liberty of creating a free entry-level, industry-specific job board on the website *www.agrimanage.co.za*. This platform is intended to create opportunities for qualified agricultural students to gain practical work experience that will complement their studies and/or improve their competence and employability.

Nevertheless, its purpose is also to serve the industry in fulfilling available industry-specific job opportunities by recruiting the best possible job-ready candidates. Although the process is still in its infancy, it is our intention to build a platform that will solidify our position as one of the leading agricultural job boards in South Africa.

L&L Agricultural Services has also added an Alumni tab to the website, where published theses and dissertations of previous bursars are being made available to all industry stakeholders. The website will be further enhanced over time to address the requirements of the sectors concerned.

Pivotal role of bursary schemes

The bursary schemes, aimed at boosting agricultural research and administered by L&L Agricultural Services, are currently benefitting 31 postgraduate students from several South African universities – students from major tertiary institutions in South Africa can apply. These bursaries play a key part in encouraging participation, but when used effectively, can also help to drive attainment and encourage the retention of agricultural students.

These bursary schemes help us in addressing the concerns of some students who feel they may not be able to finance their years of study. There should be no limitation placed on young graduates and their chance to gain valuable skills and experience to drive agriculture forward.

The bane of employment bias

The single biggest change in higher education over the last decade is somewhat related to the reason why students enrol in the first place. Today's students enrol for very practical reasons: to improve employment opportunities, to make more money and to get a good job. While studies continue to show terrific premiums for tertiary-educated employees, the data in question invariably comes from cohorts who have been out of the stream of education for at least ten, and often twenty or thirty, years.

Unprecedented unemployment and underemployment rates for new graduates

have changed student behaviour – likely unalterably due to the affordability crisis. As a result, traditional arguments that 'university prepares you for your fifth job, not your first job' increasingly fall on deaf ears since students know that if they do not get a great first job, they are much less likely to get a great fifth job. This means that universities, colleges and technikons need to do more than just increase career services budgets; they must ensure students are equipped with the technical skills employers require for entry-level positions.

If students are having increasing difficulty 'launching' into the world of employment and self-sufficiency, then employers are as much to blame as any South African tertiary institution. Employers have blithely and blindly driven credential inflation, insisting on master's and doctor's degrees as requirements for professional positions. Employment systems have turned into a 'rigged' game, particularly for new graduates with little to no work experience. And while employers have put up technological walls to employment, they have been content to continue campus-based recruitment at a select number of tertiary institutions because that is the way it has always been done.

In contrast, utilising new methods to identify competencies that are predictive of success, by incorporating these skills into job descriptions and by proactively searching among passive job seekers and current students, will become a competitive advantage for farsighted employers. This will assist in facilitating a shift from degree- and pedigree-based hiring to competency-based hiring, which will go some way to ameliorating a lot of the current issues while also increasing workforce diversity.

Skills development workshops

Most students use online ads when it is finally time to look for their first professional job. They compete with dozens or hundreds of other successful students for every position, while having no industry experience and not much negotiation power. Then there are those students who build relationships in their industry and let industry decision-makers get to know them before they need a job. When one of these managers needs to fill the type of position these students are looking for – or if the manager hears of someone who does – it is quite possible these students will get the job without much, if any, competition.

For this reason, the clients of L&L Agricultural Services, together with representatives from Cereal Science and Technology SA, the Protein Research Foundation and Winter Cereal Trust, host bi-annual soft skills Graduand Career Skills Development Workshops.

These workshops are aimed at providing an opportunity for invited agricultural bursary recipients (including but not limited to the Winter Cereal Trust, Protein Research Foundation, Oil and Protein Seeds Development Trust, Oilseeds Advisory Committee, Maize Trust, Sasol Agriculture Trust, Sorghum Trust and South African Cultivar and Technology Agency) as well as privately funded students and industry representatives to network and discuss career opportunities, options and developments within the agricultural sector in a relaxed environment. These workshops aim to give students an opportunity to build their professional network.

Enhancing important skills

At the workshops we aim to offer the following soft skills:

- Make our students aware of ways in which they can prepare themselves for entering the job market.
- Bring students and potential employers into contact with one another to contribute to the optimal placement of graduate students.
- Keep our career and corporate resources relevant and up to date.
- Advertise job vacancies on the L&L Agrimanage website.
- Equip our students with job-seeking skills.

The workshops are specifically geared towards preparing students for the labour market, which is also our core initiative. This task is carried out by exposing students to workshops and sessions on:

- CV writing.
- Interviewing skills.
- Cover letter compilation.
- Personal branding.
- Presentations and information sessions by agricultural organisations on industry structures and operations.

Skills development in agriculture should be seen as an investment to serve the strategic aspirations of the sector. It is imperative that the industry continues to develop a deliberate strategy to address skills development to not only maximise the value added to the sector, but also to transfer skills to coming generations.

For more information on the Graduand Career Skills Development Workshops or the various bursary schemes, send an email to laura@llagric.co.za or visit *www.agrimanage.co.za*.

Farmer development and transformation in agriculture

By Jane McPherson

As a commercial farmer running an agricultural business, you might say that the only way to survive is expanding the business in order to harness the economies of scale, which include collective bargaining power, advanced mechanisation and access to markets. Your overhead costs, such as labour, interest, mortgage payments on land, insurance, depreciation, and taxes, are high.

When a commercial farmer looks at a developing farmer who only has 20ha to plant to maize, it seems like a futile exercise. What can such a farmer do with the profit generated on 20ha?

Now, let's consider the other extreme (and, of course, all the other situations in between these two extremes). You are a person living on communal land in one of the former homelands. You have access to 15ha of land (if you are in the North West), or perhaps only 1ha if you are in the Eastern Cape or KwaZulu-Natal. What do you do? There is no opportunity for employment, unless you move to the city, where there are other challenges to face. You need to make the most of the land you have available to feed your family – and hopefully generate a surplus that you can sell.

Human needs and satisfiers

Humans have various needs and our happiness depends on satisfying these needs. According to Manfred Max-Neef's Fundamental Human Needs, we all need subsistence, protection, affection, understanding, participation, idleness, creation, identity and freedom. Although we all have the same needs, they are not identical.

In this context, what can be done to assist subsistence farmers to expand their business, or to achieve more through farmer development?

By teaching farmers about good production practices and helping them access the best possible inputs at affordable prices, they will be able to increase their yields.

This will never be seen as commercial agriculture, but in areas that have a high rural population, it is a system that needs to be recognised and supported.

New commercial farmers

In the context of transformation, South Africa has a large contingent of 'missing middle' farmers. These farmers are not subsistence farmers on small pieces of communal land; they are farmers who have access to commercial farms that they are unable to farm optimally due to various reasons. This is the area where real challenges are experienced and where many negative perceptions have developed over the years regarding transformation and black farmers.

Barriers to success

Through the various redistribution programmes of government, such as the Settlement Land Acquisition Grant (SLAG) and Land Redistribution for Agricultural Development (LRAD), the selection of farmers was not necessarily related to their interest or ability to farm the land they were given. Unfortunately, many farms were given to well-connected individuals who had no interest in farming and no intention to make farming their life's work.

Although some of the land made available to black farmers was very good, it is well-known that when the government started buying farms for the purpose of redistribution, it was often land that had limited potential.

The proximity of the land to the townships, or other areas with a high population density, increases the chances of theft. Many black farmers simply cannot plant 'stealable' crops such as maize on their land, because the high incidence of theft will diminish their harvest. They have to look at other crops such as cotton or soya beans. This scenario also applies to livestock.

Limited access to finance

To a large extent, access to production credit is related to the collateral the farmer can offer (a bond on the property, or a notarial bond on the loose assets). Farmers who do not own the land, which is the case for the majority of black farmers, cannot offer a bond to the financier. The earlier land redistribution projects, such as SLAG and LRAD, made the title deeds available to beneficiaries, but most of these projects had limited success.

Many financiers will take a cession on the crop as security for a production loan. However, in the event of a natural disaster, multi-peril insurance is taken out as a back-up plan. In order to obtain this type of cover, the insurance company may require five years' production records. Farmers who have not been able to access production loans in the past will not have such records.

Mechanisation on farms

Mechanisation plays a huge role on larger farms. However, in the case of redistributed farms, the equipment that came with the farm was often in poor condition, and some farms had no equipment at all. For inexperienced farmers, managing the mechanisation aspect of the farm is no easy task, and it can become expensive.

Farmers who could not buy equipment had to make use of contractors, which led to vast exploitation. Some contractors charged exorbitant prices for their services because the market lacked adequate competition to drive prices down. In many cases, black farmers had to pay double the going rate.

The Departments of Rural Development and Agriculture had fleets of equipment in

Support to vulnerable communities

Oilseeds Advisory Committee (OAC)

Oil & Protein Seeds Development Trust (OPDT)

Food parcels sponsored by the Oil and Protein Seeds Development Trust and Oilseeds Advisory Committee.

Two thousand food parcels were distributed to those in need via various networks in Gauteng, Mpumalanga, Western Cape and the Free State.

No one, nowhere should go hungry at any time.

"Food is symbolic of love when words are inadequate."
– Alan D. Wolfelt

Thanks to all non-governmental organisations, churches, departments of agriculture and agricultural businesses for distributing food parcels.

some provinces. However, there were some management issues, including:

- Some farmers who took the equipment to their own farms did not make it available to others.
- No one took responsibility for servicing and maintenance.
- Different drivers did not always treat the equipment with the necessary care and respect.
- In some areas, the equipment was only available from 9:00 to 16:00 on weekdays (even during the planting season).
- Farmers who had to plant at the same time (e.g. after good rains) could not be accommodated at the same time due to limited capacity.

Inputs and infrastructure

The various departments tasked with assisting farmers often bought the inputs themselves. However, this created some challenges: inputs arrived late; seed were often old or not of the desired cultivars; fertilisers were standard products and not necessarily suited to the land or proposed crop; and incorrect chemicals were bought.

In the wetter areas of Mpumalanga, KwaZulu-Natal and the Eastern Cape, the soil is very acidic and large quantities of lime are required to neutralise the acidity. More often than not farmers cannot afford to buy the lime themselves and there seems to be little support for these farmers.

In many areas of the country the roads are in such a state that combine harvesters and large grain lorries cannot access fields (particularly in the wetter areas of the Eastern Cape).

Impact of the drought

Some areas of North West and the Free State have experienced severe droughts during the past seven or eight years. Black farmers do not have the reserves required to survive these droughts and they find it difficult to get back on their feet. However, this is not only a problem for black farmers as many commercial farmers have also been unable to survive these droughts.

Developing proper market access

In areas where there has not been much commercial production in the past, the market for grains is not developed and storage facilities are lacking. Although modern storage facilities such as bunkers or silo bags are an option, they are not common in these areas. Increased production will develop the market over time, but immediate problems have been experienced.

Marketing of grains, cereals and oilseeds is complex and to fetch the best price, various marketing tools need to be used. This is particularly difficult for the smaller and less experienced farmers.

Lending a helping hand

Due to black farmers' lack of access to production credit, some companies decided to lend a helping hand. Some did, and continue to do very well, while others have faced difficulties, including:

- Some insisted on a minimum of 200ha of crops per farmer. When that crop failed due to drought and the farmer's inexperience, the project came to a halt and the farmers were left in debt with no hope of repaying the loans.
- They assessed the soil's potential and rainfall and insisted that the farmer seed and fertilise for maximum yield. The competence of the farmer and available equipment were not taken into account. If yields were low, farmers were unable to service the production loan.
- The economists of the banks drew up the business plans and lent the farmers money as they would commercial farmers. When the crop failed to generate the income needed to repay the loan in full, the farmer was left in debt. The bank labelled the farmer a 'high risk' and did not finance the following season's crop. Without being able to plant the next crop, farmers are unable to repay loans.
- Some companies 'took over'. They procured the inputs, engaged contractors, planted, managed and marketed the crop, and gave the farmer the balance left after the season (which was often a negative balance).

To be good at something, you need to put in the hours and gain the experience. Farming is no different. Black farmers needed appropriate guidance, training, skills development and support.

Is real transformation possible?

Yes, it is. Real transformation can be accomplished by making a few necessary changes:

- The efforts of the private sector must be aligned with government programmes. There is plenty of money being spent in the sector by government, but the impact could be much greater if the efforts of all parties involved are combined to help farmers.
- Farmers should be permitted to start smaller enterprises (perhaps not utilising all their land) while they learn so as to minimise the risk of failure.
- The financial support from government needs to be flexible and responsive. Perhaps by distributing money more evenly, the problems of many more farmers can be solved, instead of just the chosen few.
- The combination of a grant component as well as a loan component will be ideal – the grant can then be reduced as the farmer gains experience and builds up some reserves for subsequent seasons.
- Where possible, farmers should have their own equipment (appropriate to the size of the farming enterprise) and not be reliant on outside service providers.
- While the farmer is learning, interest-free or low-interest loans could be advantageous.
- A subsidy on input insurance would assist in creating a safety net for farmers (particularly in light of climate change and the accompanying risks of natural disasters).
- A shared risk model between the input suppliers and the financier could ease the burden and allow for more farmers to participate.
- A database with farmer records should be kept to prevent certain farmers from continuously receiving support and using all the available resources at the expense of other new entrants.
- On-farm support by an experienced person is critical and although this type of support is expensive, it yields great long-term benefits.

For the agricultural industry to succeed in South Africa, we need to develop successful black farmers and improve the production on farms. We need to be honest about our agenda and make sure that we are striving for a united, profitable and sustainable sector.

For more information, send an email to Jane McPherson at jane@alpha8.farm.

Understanding short time **and its implications**

By Adv Christoff Dames

The COVID-19 pandemic has already had severe implications, either directly or indirectly, for many South Africans, as it was responsible for a massive countrywide economic crisis. Since the start of the pandemic, many employers have been concerned about staying operational, especially with regard to loss of income and their obligation to employees.

When employers cannot afford to employ their employees for the ordinary hours of the working week due to slackness of trade, a shortage of raw materials, a general breakdown of the plant or machinery or any other unforeseen emergency, they may implement short time. This, however, is subject to following the correct procedure.

Short time and COVID-19

With regard to the COVID-19 pandemic as an unforeseen emergency, employers can implement short time when the typical volume of work has decreased drastically, but certain duties still need to be performed.

Employees will then work fewer hours and will be compensated accordingly. This arrangement is subject to remuneration for a minimum of four hours worked in terms of Section 9A of the *Basic Conditions of Employment Act, 1997 (Act 75 of 1997)*. When short time is implemented, the available work must be evenly distributed among all employees as far as possible.

The employer's responsibilities

Working hours form part of the employment contract and the employer cannot make any changes unilaterally. In order to implement short time, there must be an agreement in place between the employer and employee in which the employee has given the employer permission to do so. Employers should include a short-time clause in the employment contract to be proactive, as conditions that lead to the implementation of short time are often unforeseen. This can save employers a lot of time and money.

> When short time is implemented, the available work must be evenly distributed among all employees as far as possible.

If there is no prior agreement in place between the employer and employee with regard to short time, the parties must consult about the change in working hours. The consultation process is crucial, and the employer must be sure to consult with all the parties involved. This means that a trade union must be included in the consultation process if it is represented in the workplace.

When the implementation of short time is considered, the following questions must be answered:

- When will short time be implemented?
- How long will short time be implemented for?
- How many employees will be affected/ which divisions will be affected?
- What form of short time will be implemented? For example, will working hours be reduced or will the number of working days per week be reduced?

Employees are entitled to claim benefits from the Unemployment Insurance Fund (UIF) for the shortfall in remuneration compared to what they usually earn. The UIF benefit will be determined on a sliding scale.

Key considerations

One of the advantages of short time is that no dismissals may take place and employees can return to working their usual hours as soon as the employer's circumstances stabilise and the short-time period ends.

Take note that as each workplace differs, the employer's unique circumstances will determine the right solution to be considered. Employers must follow the correct procedure in terms of labour law, as non-compliance poses a serious business risk for employers.

In addition, the Department of Employment and Labour requires employers to keep a detailed logbook of the hours worked by employees. These records can be managed manually or electronically by using a clocking system.

For more information, contact Ansofie van der Walt on 0861 101 828 or send an email to ansofie@lwo.co.za.