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The National Agricultural Marketing Council (NAMC) is pleased to add its voice to *Oilseeds Focus*, the mouthpiece of the oil and protein seeds industry.

Our role as the NAMC is skewed towards promoting market access. Even our tagline bears testament to this. We play the part of ensuring that there is efficiency in the market, enhancing the viability of the sector and optimising export earnings. These objectives work interchangeably. In all this, we aim to work in the interests of the sector and that of national government.

An unorthodox approach
Often, our determination to promote market access is construed as unorthodox by some in the industry. However, if government and the sector hold different positions of interest, the people who ultimately suffer are our important stakeholders – the farmers. As such, it is important to remember that engagements and disagreements are common hallmarks of healthy discourse when pitching the sector at a winner’s podium.

Take for example the South African Corporate Training Association (SACTA), which applied for a breeding and technology levy two years ago. The NAMC painstakingly worked with all affected parties to scrutinise the application until it accommodated the various stakeholders. Such is our character – we seek a win-win solution, not acrimony.

Collaboration is welcomed
As the NAMC we are pleased with the funding the Oil and Protein Seeds Development Trust (OPDT) commits to research. Tangible research is produced and is aimed at developing the sector. I read about the potential of using extrusion to add value to agricultural raw materials in a previous edition of *Oilseeds Focus*. Such untapped opportunity shows that the industry is serious about its own future.

Again, there are unlimited areas of collaboration between the NAMC and OPDT outside the parameters of trusts and statutory measures. One is the growing consumption of soya beans by the livestock feed industry. This is something we are taking seriously as we rationalise feed for one of our programmes, the National Red Meat Development Programme. In this respect, technical research support and training from the oilseeds industry is greatly welcomed.

We are aware of the 2018/19 drought that caused low yields and crop failures in some of our country’s regions. We are also aware of the challenges facing the OPDT and the industry, and we will do our utmost to relay them to the new political leadership. The state of our relations has a healthy bill and we look forward to exploring more opportunities.

For more information, contact the NAMC on 012 341 1115 or send an email to info@namc.co.za.

Preface

By Zama Xalisa, CEO, NAMC
The state of agriculture

Exports of agricultural products have continued to grow. It is, however, unfortunate that imports remain high. While the country’s foot-and-mouth disease status has had a negative effect on meat exports, a 20% sugar tax will worsen the situation for sugar producers, who are already under severe pressure.

Capital to finance emerging farmers remains one of the most significant barriers to making progress in what should, in reality, be a rapidly developing sector. While this has been an issue for a long time, no efforts to date have yielded major breakthroughs in this regard. However, if some of the current financing initiatives gain momentum, they could make a significant contribution to the sector.

Climate change and the accompanying uncharacteristic rainfall patterns experienced across the country, pose a major threat to sustainable production in several regions. This is where drought-tolerant technology, such as that of Verdeca in Argentina, could become even more critical in the future.

Opportunities abound
Agriculture presents an excellent opportunity to grow the economy. This will result not only in much-needed job creation but will also make a major contribution to improving nutrition for all South Africans.

An excellent start to achieving the above is to tackle the land issue by developing unproductive or underutilised land so it can contribute to the output of agriculture, by increasing exports, and by decreasing imports. Progress in this regard will certainly assist in alleviating some uncertainty in the country.

Technology levy
The introduction of a technology levy on soya beans has the aim of improving access to breeding programmes and technology in South Africa by making use of international expertise. We have already seen increased enthusiasm and interest in the South African market by global players, which will make a pronounced difference in increasing productivity.

The percentage of the levy devoted to transformation will also have a positive impact on implementing necessary transformation initiatives in the country.

To date, the system is progressing according to plan and we look forward to the benefits the soya bean industry will reap in the long term.

Dr Erhard Briedenhann
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Oilseeds Focus is a magazine aimed at addressing issues that are relevant to the canola, soya bean, sunflower and groundnut industries. To subscribe, please contact Beauty Mthombeni on +27 64 890 6941 or email beauty@plaasmedia.co.za. Subscriptions are free.

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In a relationship spanning over half a century, Total has developed a deep understanding of the agricultural sector. An understanding that drives us to develop better, more customer-centric solutions as we continue to support our farmers with the innovative products and expert advice they need.
Western Cape dam levels rise
The Western Cape recently reported a significant improvement in dam levels across the province. An above-average winter rainfall season has increased the province’s dam levels from 29% in August 2017 and 52% in August 2018 to the current 64.5% (as reported on 13 August).

The province’s largest dam, the Theewaterskloof Dam, rose from a dangerously low level of 10% in January 2018 to more than 70.3%. The Clanwilliam Dam saw water levels of 97.8%, and the sluices were opened for the first time in some time. The Voëlvlei Dam’s level reached 83.6% compared to last year’s 63%, while the Berg River Dam’s water level rose to 101%, from 88% last year. – www.engineeringnews.co.za

Startup creates lab-grown palm oil
Green startup C16 Biosciences, has developed a lab-grown alternative to palm oil. Palm oil – an industry that is estimated to be worth US$88 billion – is used in everyday products and is associated with deforestation of rainforests to make way for palm tree plantations.

Using synthetic biology, C16 could create a sustainable, environmentally friendly alternative to palm oil using yeast that grows in tap water and feeding it a feedstock or carbon source to multiply. Given the widespread use of palm oil in products, the company is concentrating its efforts on replacing the use of palm oil in a portion of the market, starting with the skincare and cosmetics industries. – VegNews

Brazil’s soya protein level slips
Preliminary data from the Brazilian government shows that the protein level of the country’s soya beans fell for the first time in four harvests in 2018. This change has cost Brazilian exporters some purchases by top Chinese buyers and places them in the position of having to face cancellations or stricter contract terms, including quality guarantees for buyers looking for certain nutrient standards.

Initial reports show that Brazil’s soya bean protein levels fell from 37.14% to 36.83% in January last year. Brazil’s farmers, however, are not overly concerned, as they chase higher volumes rather than higher protein. Protein levels do not factor into the price they receive.

China has become increasingly dependent on Brazilian shipments due to its trade war with the United States (US), and the country currently buys approximately 80% of Brazil’s soya bean crop, which still has a higher protein content than the average of 34.2% that was present in US soya beans in 2018. However, US protein levels have been on the rise, while Brazil’s have been declining. – www.oilseedandgrain.com

New plant-based protein being developed
Royal DSM, a global science-based company active in health, nutrition and sustainable living, and Avril, an international French agro-industrial group, intend to work together to meet the growing consumer demand for plant-based proteins.

The companies will produce a unique protein based on non-genetically modified canola, which has excellent functional properties, high nutritional value and a balanced taste profile, making it ideal for a range of applications, including meat and dairy alternatives, beverages, baked products, bars and ready mixes.

“With 10 billion inhabitants by 2050, experts predict that the global demand for both animal and plant-based protein will grow, with exponential growth in plant-based proteins due to dietary shifts. Through this collaboration, we intend to join forces to meet the growing demand,” says Avril CEO Jean-Philippe Puig.

The partners’ ambition is to develop a state-of-the-art industrial production facility entirely dedicated to canola proteins at Avril’s Saipol facility in Dieppe, France. Commercial availability from first production could be as early as the end of 2021. – Press release

Exciting findings in peanut allergy study
Although there isn’t a cure for food allergies yet, scientists are studying a new treatment that could help reduce the severity of peanut allergies in people whose allergies are life-threatening. Called immunotherapy, the treatment would help build up patients’ tolerance to peanuts gradually, conditioning them to tolerate peanuts over time.

According to an article from Stanford University, 66 different sites participated in the study, which used a peanut-derived immunotherapy drug called AR101. Participants ingested the drug, first in a small dose which was then gradually increased, to help build up immune system tolerance to peanuts.

Dr Sharon Chinthrajah, one of the researchers, explains that the treatment helped patients with a severe allergy to tolerate small amounts of peanuts, lessening their risk of dangerous consequences in the event of accidental ingestion of peanuts or contamination of food by the allergen. – www.nimasensor.com
Avoid Sclerotinia by managing your cultivation practices

By Wessel van Wyk, contractor at the Protein Research Foundation

Aside from drought, Sclerotinia sclerotiorum is currently the leading cause of low yields in certain seasons in large parts of South Africa where soya beans are cultivated. Unfortunately, it is viewed as a ‘good producer disease’ as the soya beans of good producers are usually planted under ideal cultivation practices, which leads to abundant vegetation. These so-called optimal growth conditions are one of the main reasons why Sclerotinia occurs – the microclimate that forms under the dense foliage is ideal for the development of the disease.

In seasons with good rainfall, the disease is especially prevalent in soil where it was previously spotted. It catches producers off guard as it can suddenly reduce yields of 3 tons/ha in February/March on dryland to yields of less than 1,5 tons/ha. Another factor to consider is that during a good season, rain may fall daily. Overcast conditions and lower temperatures are ideal for the development of the disease.

As soon as the symptoms of Sclerotinia are evident in a field, it is too late to do anything about it as the disease will have already spread inside the plants, where fungicides will be unable to reach it. Pro-active measures are essential in an effort to control the disease.

Multiple challenges

Much of the Sclerotinia research has focused on developing fungicides that control the disease, breeding resistant cultivars, and using cultivation aspects such as lower plant populations, wider row widths, later planting dates and less susceptible cultivars.

The problem with all these efforts is that fungicides (however good) cannot be applied where the disease occurs because the dense foliage prevents the fungicides from being applied to the location of contamination, which is usually on the first two nodes from the ground.

Breeding resistant cultivars is also tricky due to the multiple genes involved. Suggested cultivation practices mostly do not contribute to higher yields, which means that yields will be low even in seasons when the disease was not present as a result of less-than-optimal cultivation practices.

Avoid Sclerotinia by managing your cultivation practices
Nowadays, much effort is put into testing existing cultivars for their susceptibility to *Sclerotinia*, but even that is not always useful because this research is done in greenhouses and cannot be compared to conditions in the field. Some of the research shows that certain cultivars are less susceptible than others. Unfortunately, researchers know that specific cultivars that were shown to be either susceptible or less susceptible in the greenhouse do not necessarily behave accordingly in the field. These observations are the result of artificial contamination in greenhouses, which does not consider the cultivar’s behaviour in the field.

**Planting date and maturity**

Avoidance of *Sclerotinia* is based on the growth stage of a particular cultivar when conditions for disease development are optimal. Ascospores need a ‘wound’ on the plant to germinate. Such vulnerable areas are formed when petals dry, pods form or where flowers fall off. Dry petals serve as ‘food’ for the spores to germinate. If there are already pods and no flowers, it is unlikely that the plants will be contaminated.

Managing the planting date and type of maturity group to which the cultivar belongs, is critical in avoiding *Sclerotinia*. Research has shown that where an MG 4 to 4.5 cultivar is planted during 'normal' planting dates (mid-October to the end of November), it is already in the R5 (pod-filling) stage, which means that there are no flowers present. The fact that an MG cultivar blooms early (35 days in temperate to hot regions and 40 to 45 days in colder areas), causes the plant to be relatively smaller. Smaller plants do not close the canopy of leaves completely, which means that conditions are not yet optimal for the sclerotia to germinate and contaminate the plants.

**Trials at Kinross**

Extensive research was done between 2008 and 2013 at Kinross in Mpumalanga, where various chemical and biological agents, planting dates and cultivars were tested against a fast MG 4 cultivar (in this case LS 6162, which would later become LS 6444.) The results were astonishing and farmers who previously experienced problems with *Sclerotinia* planted early cultivars with great success. The problem was and still is that only one cultivar cannot be planted because harvest time must be extended, which is usually not possible with a single cultivar, especially when planting dates are uninterrupted and the soya beans are all harvest-ready at the same time. Another problem is that it is not feasible to use the best cultivar for all areas, as it is not always available in the same quantity for all areas.

**Figure 1:** Percentage *Sclerotinia* contamination and yield of soya bean trials at Kinross in 2008/09.
possible for a soya bean cultivar with such a short growth cycle to compete with the yields of longer growing plants. In years during which *Sclerotinia* was not a problem, long growers delivered larger yields than the short growers.

In 2008/09 three biological agents, namely Eco-77, Eco-T and Sclerostop, and five chemical agents, namely Benlate, Sumislex, Bellis, Abacus and Opera were applied to the long-season cultivar LS 6150 and compared with the short-season LS 6162/LS 6444 (Figure 1). The agents were all applied according to the instructions on the label.

The trial was planted on 19 November 2008 and the faster cultivar started blossoming (R1) on 29 December 2008, 41 days after planting. On 22 January 2009 the LS 6162 was in the R5 stage and the LS 6150 in the R2 stage. *Sclerotinia* contamination started showing even with all the chemical and biological agents applied. The first sprayings of these agents were at the R1 stage on 15 January 2009 and the second spraying was done four weeks later, on 11 February. At this stage, contamination was severe across the board, except on the fast cultivar, where no *Sclerotinia* was noted.

**Avoiding contamination**

Not far from the trial, on a farmer’s field that was also planted under LS 6162 on 10 December 2008, slight contamination was observed because the plants were in the R1 to R2 stages. This slight contamination could be attributed to the fact that the canopy of leaves was not completely closed yet, which means that the microclimate was not too favourable for the development of the disease. In the end, the farmer harvested 2,2 tons/ha here. On the field across from the trial, the farmer planted the same cultivar on 21 December 2008 after harvesting wheat. No *Sclerotinia* was observed and he harvested 2,8 tons/ha on this field. These observations are invaluable because it shows that no cultivar is resistant to *Sclerotinia*, but that it can be avoided by planting a fast cultivar and changing the planting date. The research proved that a fast cultivar and the date on which it is planted plays a significant role in avoiding *Sclerotinia*.

During the season of 2009/10, cultivars that ranged from MG 4 to 7 were planted on 22 October 2009 and compared (Figure 2). All the treatments (except for the MG 4 treatments) were contaminated with *Sclerotinia* – as much as 53% contamination in some instances – and a yield of 1,55 tons/ha was recorded.

New research was done in 2018 after producers suffered major damage in the 2017/18 season. In cultivar trials that were planted at various producers, it was only the MG 4 cultivars that delivered high yields.

**Great yield potential is possible**

New MG 4 cultivars are available with unbelievable yield potential if performing successive plantings. However, where there are a few weeks between plantings, one could perhaps get away with planting only this cultivar so that harvest time is not affected. The later plantings will have to be tested to see whether the yield decreases to such an extent that it is not profitable, and to determine whether these cultivars, which will flower in February/March, can still avoid *Sclerotinia*. 

For references or more information, email the author at zenzele@netactive.co.za.
Recovery of soil health crucial for agricultural sustainability

Press release by Agri Technovation

The life of agricultural soil in South Africa is in a state of total imbalance after years of uninformed application of agricultural chemicals combined with practices that are, often unwittingly, detrimental to soil health.

This is according to Johan Habig, senior researcher in microbiology at Microlife Research Centre. “Soil life plays a vital role in soil health due to the wide range of functions fulfilled by various organisms,” he explains. “These functions include the mineralisation and circulation of micro- and macro-elements from the organic material and root exudates, production of plant growth hormones, organic acids and even toxins that could keep disease-causing bacteria, fungi and nematodes away from plant roots.”

Promoting soil health

Habig says the imbalance could be exacerbated by increased application of chemical fertilisation, resulting in soil life that cannot function optimally, which is detrimental to plants and general soil health.

“When we as people ‘rest’, we don’t do it without food and clothing. Similarly, agricultural land merely lying fallow does not promote soil health,” he says. “The most beneficial way to let soil ‘rest’, is to keep a layer of organic material on the surface or to plant a cover crop. This keeps soil life nourished and prepared for the next growing season.”

Soil cover also regulates soil temperature, prevents water loss and reduces erosion.

Chemical dependence

According to Habig there could be various reasons why producers do not apply these practices, including high costs and a lack of correct information.

He warns that the most detrimental biological result of inadequate attention to soil health is that plants and crops become dependent on chemical fertilisation and other chemical agents to survive. “When this happens, increasing quantities of chemical fertilisers are needed to maintain the same yields,” he says.

Secondary functions such as aggregate stability, soil capacity for water penetration and the suppression of soil-borne diseases are compromised by a decline in soil health.

“Soil health deals with the chemical, physical and biological interactive processes and features of soil that are important for sustainable production. Laeveld Agrochem and its partners support the attempts of producers to improve their soil health and we make the technology available to take the necessary measurements of these interactive processes and features. “Our purpose is to assist farmers to ensure sustainable production and, ultimately, to make nutritious food available to consumers,” says Phillip Venter, marketing manager of plant nutrition at Laeveld Agrochem.

A decrease in nutritional value

There is no record of the biological facets of soil health in South Africa, but Willem Eigenhuis, chief agronomist of grain and pecan nuts at Agri Technovation, says international research indicates that the mineral content of the food we eat, particularly fruit and vegetables, has decreased dramatically. “Data from the past 50 years indicates that the mineral content of food such as fruit and vegetables has decreased by between 20 and 50%;” says Eigenhuis.

“This is alarming, because it means we are producing food without the necessary nutritional value, which could also be a reason for the growing incidence of obesity; people taking in large quantities of food depleted of essential minerals and nutritional value.”

Damage to the natural environment

A WWF South Africa report, titled Agri-Food Systems: Facts and Futures, which was released earlier this year, points out that the way in which we put food on our tables could cause more damage to the natural environment than any other human enterprise.

“Existing practices could lead to a loss in biodiversity, deforestation, poorer soil health, desertification, water scarcity and poorer water quality and also contribute to widespread damage to our marine ecosystem,” the report states.

“This unfair and environmentally unfriendly food system means that South Africa will have to produce 50% more by the year 2050 to feed the local population, which is estimated to reach 73 million by that time.”

Eigenhuis points out that the focus should not be exclusively on greater production, but also the cultivation of more nutritious food. “Corrective agricultural processes could help to produce food with improved mineral content on fewer hectares, which is critically important for South Africa as a water scarce country with only 13% arable agricultural land. More nutritious food will hold the additional benefit of consumers having to take in less to obtain the same, or the necessary nutritional value,” he concludes.

For more information, email info@agritechnovation.co.za or visit www.agritechnovation.co.za.
Conservation agriculture is the implementation of a combination of agricultural practices that benefit the soil and its surrounding environment while ensuring sustainable yields. These practices include no-till, minimal soil disturbance, crop rotation and the use of cover crops throughout the year. Other practices include limiting the use of chemical substances and including cattle in the system to utilise cover crops and boost soil improvement. The benefit of this system is that it is more sustainable and resilient to environmental changes.

The first rule of ecology is to limit invasion of and damage to an ecosystem. Conservation agriculture is based on the same principle. Insects and plant pathogens that feed on crops can cause significant yield and economic losses. Consequently, there is conflict between the ‘do no harm’ principle and the success of cash crops. But, to ensure a stable yield, how can conservation agriculture be implemented, and the damage caused by insects and plant diseases limited?

**Basics of conservation agriculture**

The answer to this question lies in the implementation of conservation agriculture. If practices are applied correctly, pest control should not be necessary. Instead of controlling isolated symptoms in the system, it should be viewed holistically, and the entire system should be managed correctly.

There is interaction between the various components of an ecosystem, each contributing to the smooth functioning of the system. Conservation agriculture increases plant diversity in the system by including a variety of cover crops (multi-species) and the rotation of cash crops. This diversity facilitates an increase in the biodiversity of other organisms above and below ground, which leads to an increase in functional diversity. The higher the diversity, the more ecosystem functions are performed. This contributes to the entire system’s functioning. These ecosystem functions include pest control, pollination, decomposition and biocirculation.

**Natural predators**

Biological control is the application of practices that sustain and benefit the reproduction, survival and efficacy of predatory organisms. Natural enemies are important for regulating the population of agricultural insect pests.

The approach to the conservation of these organisms include avoiding practices that will affect them negatively and implementing ones that will benefit them. These organisms need food, water, shelter and protection from harmful circumstances to survive.

The principles on which conservation agriculture is based, create ideal conditions for natural predators by establishing an increase in plant diversity and density. When natural predators are favoured, they are better able to perform ecological functions, meaning more efficient pest control.

Other organisms that benefit from conservation agriculture, such as decomposers, can contribute to the successful circulation of nutrients in the soil. This will contribute to the general growth and health of the crop which, in turn, will be more resistant to insects and pathogens.

**Follow the right principles**

Achieving the goal of conservation agriculture requires knowledge of the biology of the natural organisms that contribute to ecological functions. The right principles can then be followed in creating beneficial habitats for these organisms. It is important to limit external disruptions, such as the use of chemicals, as it will have a negative impact on organisms that perform vital ecological functions. It will weaken the entire system and prevent it from functioning efficiently.

For more information, email the author at jankielsohna@arc.agric.za.
Sclerotinia population dynamics: A force to be reckoned with

By Dr Adré Minnaar-Ontong and Dr Chrisna Steyn, University of the Free State

Crop farmers often suffer enormous yield losses because of Sclerotinia sclerotiorum. Research has been conducted on its population dynamics to give insight into its genetic structure and population distribution across the world. This research may help oilseeds farmers to better understand and manage this formidable foe.

Genetic structure
A population is a group of individuals who share a common gene pool and originate from a limited geographic area. Fungal strains are classified as a set of isolates that cannot be identified as distinct from each other and can be differentiated from other isolates. The gene pool changes as these individuals adapt to their local conditions. The goal of population genetic studies is to describe the changes, determine their causes, and understand their consequences for the individuals, population and community of which they are a part.

The genetic structure reflects the evolutionary history and potential of the population. Multiple environmental changes can affect the genetic structure of fungal populations. These include, but are not limited to, the following factors:
- Host availability.
- Geographic location and climate.
- Timing of agricultural practices such as planting.
- Frequency and concentration of fungicide and fertiliser applications.
- Irrigation.
- Crop rotation and timing of infection.
- Disease initiation.

Consequently, the genetic structure of a population is not always reflected in the geographical distribution of the individuals involved. Understanding the genetic structure of a fungal pathogen’s population assists in the evaluation and improvement of disease management strategies.

A primary use of this tool is in plant breeding and the incorporation or manipulation of host crop genetics to withstand pathogen infection. The ultimate goal is the development of resistant or tolerant pathogen infection to combat disease development and spread while still producing acceptable yields.

Population research
Population studies have been conducted to give insight into the genetic structure of S. sclerotiorum populations across the world. To date, only a preliminary study of 77 S. sclerotiorum isolates has been conducted in South Africa. Extensive research on more than 950 isolates across eight of the nine South African provinces is underway at the University of the Free State’s Department of Plant Science to resolve the genetic structure of this population. Isolates are collected from fields across South Africa and pure cultures are made. From these isolates, DNA is extracted and compared.

The results are analysed with specialised statistical software. S. sclerotiorum is a homothallic fungus, meaning it has male and female reproductive structures on the same thallus and thus a significant amount of self-fertilisation takes place.

The homothallic nature of this pathogen suggests a limited amount of gene flow and therefore low levels of genetic diversity; however, the preliminary study indicated significant levels of genetic diversity. This may be due to environmental pressure on the pathogen forcing change to survive in areas not previously occupied by the pathogen, resulting in a more diverse gene pool.

The population is mostly clonal, which shows that the population has been around for a considerable time (S. sclerotiorum was first identified in South Africa in 1979). Additionally, genetic diversity suggests that variation in pathogen aggressiveness might occur within the population. The results are incorporated into a pre-breeding programme in the greenhouse, where further evaluations are done. Promising lines are planted in the field for evaluation under natural conditions and selection for further studies can then be made.

Resistant genes
In the preliminary study, no association can be found between the pathogen’s aggressiveness and location or host. This indicates that the S. sclerotiorum population in South Africa is uniform and forms part of a worldwide population. This could be an advantage for breeders as sources of resistance are available in other countries; these genes could be incorporated into local cultivars and assist in the development of cultivars that have sustainable resistance across all regions.

Constant monitoring of the genetic structure provides critical information about potential new pathogen genotypes that may evolve and are better adapted to certain areas or are more pathogenic than currently known. Although these techniques are considered costly, monitoring the genetic structure and the application/addition/incorporation of resistant or tolerant genes to our local cultivars, could provide a sustainable management option to an integrated pest control programme.

For more information and references, send an email to Dr Chrisna Steyn at BothaC@ufs.ac.za.
Although irrigation plays a significant role in higher maize yields in South Africa, there are a number of concerns regarding the availability of water for the sustainable cultivation of maize under irrigation.

South Africa is the food basket of sub-Saharan Africa, but rising temperatures, crippling drought, urbanisation (together with greater demand for municipal water) and more substantial mining activities are all factors that contribute to the depletion of groundwater. There simply is not enough rainfall or supplementation from other water catchment areas to adequately fill the aquifer.

Irrigation from the country’s biggest rivers takes place daily and thousands of hectares across South Africa are also irrigated from boreholes. However, water from boreholes for irrigation is coming under increasing pressure due to factors such as industrialisation and higher electricity costs.

Many of the irrigation systems that are currently in use, are older generation centre pivot systems, which are unable to meet the daily evapotranspiration needs of plants. Compared to the irrigation methods of a few years ago, cultivating maize with limited water or supplementary irrigation is currently considered a prerequisite.

It is common knowledge that moisture stress is hybrid specific, but the impact of moisture stress is much more significant during certain stages of plant growth.

Although accelerated vegetative growth occurs from V10, there is evidence that, should moisture stress occur during this time, it will result in a smaller leaf area index. Vegetative growth, such as root and stem growth, will still occur after pollination, given that surplus nutrients are available for absorption.

What is supplementary irrigation?
Supplementary irrigation is the productive management of water throughout the season. During critical growth stages, producers must irrigate in a bid to reduce stress. To do this, producers must understand how and when the maize plant reacts to moisture, how crop rotation should be applied and how certain practices influence the water requirements of plants.

An irrigation management programme must be established to supply water during critical growth stages, such as the tassel formation phase and first reproductive phases. The application of full irrigation is common during the vegetative stages, resulting in there not being enough water available from tassel formation to grain fill. Producers cannot depend on seasonal rainfall; it should instead be viewed as a bonus to supplement root zone moisture.

Evapotranspiration and moisture
Evapotranspiration is the sum of the evaporation of water from the soil surface...
and the transpiration of moisture from plant surfaces. Evapotranspiration is responsible for good maize yields if factors such as soil fertility, diseases, pests and agronomic practices are properly managed.

Soil characteristics such as water retention, infiltration rate and restrictive layers have a major impact during irrigation. Plant characteristics include water use efficiency, drought tolerance and the hybrid’s growth height. Environmental conditions include temperature, rainfall, wind and relative humidity.

These conditions are calculated using long-term measured data, which is used to modulate the plant’s development and determine critical irrigation periods. The total amount of available water for the season is vital.

*Figure 1* illustrates how evaporation from the soil surface contributes approximately 20 to 30% and transpiration from plants approximately 70 to 80% to the total evapotranspiration use in a maize plant’s growing season. The curve remains the same across various hybrids. The primary variables are growth height, time per growth phase and water use efficiency of the specific hybrid.

**Yield and irrigation timing**

The crop’s reaction to moisture stress varies widely during its growth cycle. Flowering, pollination and seed formation stages are the most vulnerable to moisture stress, which means the most substantial negative impact on yield occurs during this time. In cases where water is a limiting factor but the producer has control over when to irrigate, the best strategy is not to apply moisture when the plant is less susceptible to moisture stress, but rather to use stored water during times when moisture stress has the most profound impact on yield.

Stored water offers the greatest yield benefit when it is applied during the reproductive phases. If water is still available during the grain-filling stage (R4 to R5), quality will benefit.

**The effect of moisture stress**

Moisture stress at different stages of development will have varying effects on the phenotypical characteristics of the maize plant. It will influence traits such as plant height, leaf area index, grain yield per hectare, number of ears per plant, grain yield per ear and bushel weight.

In a three-year study, Cakir (2004) found that:

- All yield parameters were negatively influenced when moisture stress commenced during the sensitive tassel (VT) and ear formation stages (R1 to R4).
- Moisture stress during the vegetative and tassel stages was detrimental to plant height and leaf area index.
- Short periods of moisture stress during the accelerated vegetative growth stage (V10) resulted in a 28 to 32% loss in dry matter content.
- The highest yields were obtained under full irrigation and when moisture stress occurred during the vegetative stages.
- A missed irrigation cycle during one of the sensitive stages led to a yield loss of up to 40%. The yield loss was accompanied by extreme drought during one of the three years of the study.
- Yield losses of 60% and more can be expected if moisture stress persists during the tassel and ear formation stages (VT to R5).

**Mulching or crop residues**

Irrigating with limited water is a practice aimed at collecting all available water and storing it in the production system. Crop residues are an effective way in which to increase water storage capacity. It decreases run-off, increases infiltration and decreases evaporation from the soil surface.

Research has shown that crop residues can contribute 62mm of water due to a decrease in evaporation from the soil surface. Most of the saving will be realised before the maize plant reaches full coverage. The residues suppress the formation of a soil crust and increase infiltration. Water drops tend to destroy the soil structure, upon which a crust forms and seals the soil surface, resulting in a decrease of the infiltration rate.

**Plant populations**

Smaller maize stands can be planted when water is limited as it reduces competition for available moisture. This makes sense if rising input costs are also considered. However, to sufficiently meet evapotranspiration needs, stands must hold far less than 45 000 plants per hectare; this, of course, leads to lower yields.

When maize is cultivated under supplementary irrigation, one should select a hybrid with strong multiple ear characteristics. There are only a handful of hybrids in South Africa that have multiple ears at stands of 45 000. Most hybrids lose their multiple ear trait above 40 000.

PIONEER is currently in the process of selecting drought tolerant hybrids that will ensure high yields at larger stands.

---

For more information, contact Philip Fourie on 082 909 3262.
Big stems, bigger roots, biggest leaves.
Bigger yield with Bellis®

Bellis® - The newest addition to the BASF AgCelence® portfolio not only ensures effective disease control for Sunflowers, it also gives additional physiological benefits for the optimum yield. We call it the AgCelence® effect:

• Increased plant growth efficiency with better photosynthesis efficiency, better use of nitrogen and increased bio-mass development
• Increased tolerance to stress in situations such as drought by inhibiting ethylene production

Get the AgCelence® advantage with Bellis®
BASF Clearfield®
Plus Production
(CLП) System

There has historically been limited herbicide solutions available in
sunflowers for weed control after crop emergence and producers
were reliant on the residual action of pre-emergent herbicides
applied during planting. The BASF Clearfield® Plus Production
System benefits farmers by offering a reliable post-emergent
herbicide solution to control weeds that germinate after planting
CLП sunflowers cultivars.

The Clearfield® Plus Production System is the combination of
high-quality, qualified Clearfield® Plus seed enabling the farmer to
apply Euro-Lightning® Plus herbicide over the crop within 32 days
of crop emergence.

Clearfield® Plus qualified seed

BASF partners closely with various seed companies who wish to
develop, produce and sell CLП Sunflower seed. Clearfield® Plus
seed is not genetically modified. The plant’s natural ability to
metabolise the herbicide classifies it as herbicide tolerant.

All seed that is to be marketed as CLП qualified undergoes many
stages of stringent BASF qualification trials and quality control
procedures. Only once these criteria are met can BASF approve
and qualify the seed to be labelled as Clearfield® Plus seed.

Clearfield® Plus cultivar yields

Independently conducted sunflower yield trials have been
conducted and evaluated for several years. These included both
conventional and Clearfield® Plus cultivars. Clearfield® Plus
cultivars have proven to be some of the higher yielding cultivars,
with ongoing investment to further develop, grow and improve
these cultivars.

Clearfield® Plus herbicides

BASF has invested heavily in the newest formulation of the Euro-
Lightning® Plus herbicide to achieve even better results than it’s
predecessor, Euro-Lightning®.

The new and improved herbicide contains a more advanced
formulation which includes highly effective wetter’s, stickers and
adjuvants. Euro-Lightning® Plus delivers improved weed control
compared to its predecessor which is achieved through increased
adherence of the active ingredient to the leaf surface. It additionally
improves the absorption of the active ingredient into the targeted
weed to deliver a higher level of weed control.

The higher level of weed control will result in less weed pressure
on the crop, resulting in the Clearfield® Plus sunflower crop having
less competition and more resources to achieve its optimum yield.

Why invest in the Clearfield® Production System?

2018/19 has not been the easiest of seasons for the South African
farmer, with the level of investment in crop protection always under
question. The question farmers often pose: “Where can I save on
my input costs without sacrificing yield?” Farmers often achieve a
cost saving through buying a lower cost alternative or skipping the
application altogether.

During the 2018/19 sunflower season, BASF conducted various
trials in Clearfield® Plus sunflower. The two focus areas of the trial
were firstly, the benefit of Euro-Lightning® Plus herbicide on weed
control and secondly, the effect of BASF fungicides on final yield.

Yields across Euro-Lightning® Plus treated plots resulted in
harvests of between 2.5 - 2.8 tons/ha. Where no Euro-Lightning®
Plus was applied yields dropped to between 0.8 - 0.9 ton/ha. This
clearly indicates the benefit of applying Euro-Lightning® Plus, a
tried and tested herbicide that controls a broad spectrum of weeds.

The Clearfield® Plus Production System is more than seed
and a herbicide. It is a farm management solution that delivers
peace of mind, sustainability, clean, weed-free fields, resulting in
higher yields.

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**Soya OEMFF**
A foliar feed to enhance the efficiency and production of the crop.

**SoyMagic®**
Planter mixtures with enhanced efficiency to meet the early needs, but also the later nutritional needs, of the soya plant.

**KynoPlus® - NPKS-planter mixtures, such as SoyMagic®**
Planter mixtures with enhanced efficiency to meet the early needs of the soya plant.

**Soya OEMFF®**
A foliar feed applied prior to the flowering stage to enhance the efficiency of the soya plant. It is used for general supplementation and also helps the crop to recover after a period of environmental stress.

Don’t just innovate, #KynoVate.

@KynochFertilizer

www.kynoch.co.za
Drought is a major limitation for crop yields worldwide. Even under moderate drought conditions, crop yields can be reduced significantly. Verdeca’s drought tolerance HB4® technology has the potential to moderate the impact of drought and stabilise crop yields under a broad range of production conditions. Plants respond to water stress by expressing a specific set of genes that allow them to adapt to changing environmental conditions.

Genetic breakthrough
Despite significant progress using transgenic technology, farmers never had a soya bean technology that increased yield under drought conditions.

At the end of the 1990s, a team of Argentine researchers from the National Scientific and Technical Research Council, CONICET, led by Dr Raquel Chan from the National University of the Coast, found a sunflower gene that activated plants’ response to mechanisms of abiotic stress (water and salts). The researchers focused on HaHB4, a sunflower gene encoding a transcription factor that was shown to confer drought tolerance when it was introduced into Arabidopsis thaliana.

After the isolation and characterisation of this gene, Verdeca began collaborating with Dr Chan to develop HB4® technology in plants of agronomic interest.

Promising results
Our results in HaHB4 soya bean support the previously reported phenotypic characteristics observed in Arabidopsis. HB4® soya bean plants showed a higher recovery rate after a period of water deprivation, lower sensitivity to ethylene and delayed senescence (cell deterioration) when compared to the non-transgenic control plants.

In the face of drought, HB4® causes a delay in the cellular deterioration of plants. This allows the crop to keep all its processes running, instead of interrupting them in the face of water restriction. In this way, at the end of the period, HB4® plants show an increase in yield in adverse environmental conditions when compared with unmodified plants.

Based on the results of our field experiments in Argentina and the United States, we conclude that HB4® soya bean is a biotechnological tool that could be incorporated feasibly to manage water stress in a wide range of situations, conferring significant yield increases in low-yielding, rainfed areas with no yield penalties in high-yielding ones.

Reducing the impact of drought
Crops with HB4® technology are better prepared to cope with drought and use available water resources more efficiently. Unlike other drought tolerance strategies, HB4® technology simultaneously controls multiple critical processes of plant metabolism to reduce the impact of drought on crop productivity.

Additionally, the absence of yield penalties under conditions where water resources are adequate is a critical feature of the HB4® trait.

Verdeca’s objective is to submit the dossier for this technology in South Africa and start the regulated field trial requirements before the end of the year.

For more information, contact Martin Mariani Ventura at martin.mariani@verdeca.com.ar.
POWERHOUSE SUNFLOWERS FOR STABLE TOP-END YIELDS

PANNAR’s sunflower hybrids incorporate the best genetic potential and technology on the market – for the past three years PANNAR has delivered five out of the top ten sunflower hybrids in the ARC national trials. The diverse package includes conventional and CLEARFIELD® PLUS hybrids as well as a hybrid high in oleic acid.

VERSATILE SUNFLOWER HYBRIDS

<table>
<thead>
<tr>
<th>Conventional</th>
<th>Clearfield® Plus</th>
<th>High Oleic Acid</th>
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<tr>
<td>PAN 7100</td>
<td>PAN 7102CLP</td>
<td>PAN 7158HO</td>
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<tr>
<td>PAN 7057</td>
<td>PAN 7156CLP</td>
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<tr>
<td>PAN 7080</td>
<td>PAN 7160CLP</td>
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</tbody>
</table>

PAN 7160CLP and PAN 7156CLP are the top performers in the ARC trials.
South African producers can plant Pannar’s sunflower range with peace of mind, knowing that these hybrids possess the best genetic potential and technology on the market.

Pannar’s sunflower hybrid package performs well across all the sunflower production regions of South Africa. Its comprehensive package includes a complete range of conventional and Clearfield® Plus hybrids and delivers excellent, stable performance and outstanding risk management.

**Hybrid performance**

Pannar’s range of high-yielding hybrids maintains an outstanding performance record in the field trials of the Agricultural Research Council (ARC). Proven leaders in stability, these hybrids have delivered five out of the top ten hybrids for three consecutive years.

The conventional and Clearfield® Plus sunflower package is renowned for its performance and stability. Table 1 shows the yield probability as a percentage of the 2017/18 season, while Table 2 shows it as an average of the 2016/17 and 2017/18 seasons. It provides a good indication of the hybrids’ anticipated stability and reliability.

### Table 1: Yield probability as a percentage of yield potential (stability).

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Yield potential (tons/ha) for 2017/18</th>
<th>1</th>
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<td>94</td>
<td>93</td>
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</tbody>
</table>

* Percentages in boldface indicate exceptional stability.

### Table 2: Yield probability as an average of the 2016/17 and 2017/18 seasons.

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Yield potential (tons/ha) for 2016/17 and 2017/18</th>
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<td>86</td>
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</table>

* Percentages in boldface indicate exceptional stability.

### Hybrid recommendations

Choosing a suitable hybrid package is one of the most critical and challenging management decisions farmers make each year. It is important to choose proven performers based on data from multiple years and trials across a large homogeneous area, to rule out variation and improve performance forecasts.

Yield, stability and risk-hedging all play an important role when selecting a hybrid. This is complemented by a hybrid’s agronomic traits and disease risk profile. Select a hybrid package with a variety of growth classes to diversify risk, and phase in new hybrids gradually. Requirements for hybrids differ from region to region.

- **Northwestern Free State (topsoil <10% clay):** High-potential hybrids PAN 7080 and PAN 7160CLP serve as core plantings in the light sandy soil of the northwestern Free State and North West. These are complemented by PAN7100 or PAN 7102CLP.

- **North West and Limpopo (topsoil >10% clay):** In the western and Limpopo production regions, the conventional hybrid PAN 7100 and the Clearfield® Plus hybrid PAN 7160CLP are recommended as the main plantings. PAN 7080 and PAN 7057 as conventional hybrids and PAN 7156CLP as Clearfield® Plus hybrid, respectively, can be used as a package with each of the main hybrids.

- **Cooler, temperate production regions:** Clearfield® Plus hybrids PAN 7160CLP and PAN 7102CLP are recommended as the core hybrids in the cooler, temperate production region. If a conventional hybrid is planted, PAN 7080 is the best choice, if planted on time.

For more information, contact the author on 082 570 8240.
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• Jaarlikse multimiljoen rand beleggings in navorsing en ontwikkeling
• Meer as 350 geregistreerde produkte, spesifiek ontwikkeld vir plaaslike omstandighede
• Vir twee dekades u bondgenoot in suksesvolle gewasproduksie
• Bykans 900 navorsings- en ontwikkelingsproewe
• ISO akkreditasie


Yielding a better tomorrow.
In her controversial book, *Silent Spring*, Rachel Carson questioned human attempts to control the natural world by means of synthetic pesticides. The 1960s saw the advent of the so-called green revolution, which was characterised by the doubling of yields of major grain crops, thanks mainly to frenzied development of improved and novel technologies that spawned more efficient cultivars, fertilisers and pesticides. The concomitant improvement in food security, farmer profits and livelihoods, as well as the upliftment of rural communities that those technological advancements brought, represented to Carson “a smooth superhighway on which we progress with great speed, but at its end lies disaster”.

**Plant toxins**

Even though insecticides, fungicides and bactericides bore the brunt of Carson’s eloquent and generally well-motivated treatise, ‘plant toxins’ (herbicides) did not escape attention and she described them as containing some very dangerous chemicals. She also mentioned that careless use in the belief they are ‘safe’ can have disastrous results.

Her words proved to be prophetic because, over time, ‘dangerous’ herbicides have been identified, systematically deregistered and even banned. Such processes are ongoing as evidenced by the progressive withdrawal of paraquat, which for many decades was a stalwart herbicide for diverse applications in crop production, forestry and vegetation control in non-crop settings the world over.

According to the British Crop Protection Council’s publication *The Pesticide Manual: A World Compendium*, the herbicidal properties of paraquat dichloride were discovered in 1955 and the herbicide was first marketed in 1962 (the year in which Carson’s book was published).

**Resistance and species shifts**

In modern agriculture one of the most vexing and economically harmful natural factors facing crop production, is weed resistance to herbicides. Herbicide resistance in weeds is linked to the biology and genetics of plants, but the human factor coupled with the injudicious use of herbicides is generally accepted to be the main driver for evolvement of herbicide resistance.

In 1962 Carson dealt mainly with insecticide resistance, such as resistance to DDT. She only briefly touched on the phenomenon of species shifts that occur in weed communities in response to herbicides with selective action, such as the use of 2,4-D. These caused a long-term ‘shift’ in the weed community, from initial domination by broadleaf weeds, to eventual domination by grass weeds.

Species shifts in weed communities is not the same as herbicide resistance. The former should, however, be regarded as a red flag in terms of resistance potential because both phenomena feed on overuse of a single herbicide mode of action for several years. Insecticide resistance was already well established in the 1950s, but herbicide resistance was only recognised as an equally serious problem in the 1990s.

Today, 501 cases of confirmed herbicide resistance have been recorded; 257 weed species and 167 herbicides are involved across 93 crops in 70 countries, including South Africa.

**Balanced weed control**

By the 1960s the herbicide industry was industrious in response to the species shift phenomenon. When early herbicide specialists for broadleaf weed control, for example 2,4-D (in small grains and...
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maize) and atrazine (in maize) caused shifts from broadleaf weed to grass and nutseed weed dominance, the acetalonilide group (e.g. alachlor, acetochlor, metolachlor) as specialist grass and nutseed herbicides came to the fore.

In maize, for example, herbicide combinations that included a triazine such as atrazine, and an acetalonilide such as metolachlor, became popular and was effective in dealing with the species shift problem. In small grains, from the 1970s onwards, the sulfonylurea (e.g. chlorsulfuron, triasulfuron) and aryloxyphenoxy propionic acid (e.g. diclofop, clodinafop) groups of herbicides became dominant in that market by providing balanced weed control.

Unfortunately, the small grains market was eventually hit hardest by the evolvement of resistance in many important weed species to herbicides belonging to both the sulfonylurea and aryloxyphenoxy propionic acid groups.

In soya beans, one sulfonylurea herbicide, chlorimuron-ethyl, is registered. Worldwide there are 59 cases of weed resistance linked to this herbicide, and several of the weed species involved occur in South Africa, no case has yet been recorded in the country.

The herbicide imazethapyr, which is also registered for use in soya beans, has the same site of action as sulfonylureas, namely the acetolactase synthase (ALS) enzyme. Worldwide there are 132 cases of resistance recorded for imazethapyr, but none yet in South Africa.

### Dosages and efficacy

One great success of the agrochemical industry in the last six decades has been the vast reduction in the amounts of chemicals applied for weed control, from kilograms to grams of active ingredients per hectare. For some of the ALS inhibitor herbicides, the registered dosage rates are less than 50g a.i. ha⁻¹ and in some cases even below 10g a.i. ha⁻¹. Such developments bode well for the future because it provides environmental benefits of lower doses without weed control efficacy being compromised.

Cobb and Reade (2010) present an intriguing calculation in support of their postulation that at least another order of magnitude may be achieved in reducing herbicide dosage to less than 1g/ha in future. They concede that their calculation or model is based on some major assumptions and extrapolations that may not be scientifically sound in all respects.

The model postulates that for a weed infestation level of 1 million plants per hectare (100 plants per 1m²), the amount of herbicide required could be as low as 1 x 10⁻⁶ g (one-millionth of a gram) per hectare. Is it farfetched to expect that herbicide field rates measured in milligrams per hectare could be feasible in future? If imagination and innovation can take humankind progressively deeper into space, why would there not be like-minded people in the agrochemical industry who are working on unimaginable breakthroughs in herbicide technology at this very moment?

### Banking on innovation

For the past three to four decades the herbicide industry has been severely challenged by constraints in product innovation, including lag in the discovery of novel sites of herbicide activity (current list is 19, with an additional 33 demonstrated experimentally);

the time lapsed from discovery to market; global competitiveness; and the impact of new environmental legislation, all of which drive up costs.

The impact of glyphosate-tolerant crops on the global herbicide market included the demise of some companies and the merging of others, which contributed to a dramatic slowdown of herbicide research and development in most multinational companies.

In 2016, Dr Hermann Stübler of Bayer AG powerfully articulated the future prognosis at the 7th International Weed Science Conference in Prague as follows: “For the coming ten to 15 years, we have to manage the portfolio of available functioning herbicides intelligently within the framework of strengthened integrated weed management concepts.” This means farmers must throw every weed control method at their disposal into the fray in a scientifically sound way.

### Looking to the future

In the foreseeable future the surest way in which herbicide efficacy can be improved without increasing herbicide dosage, is the use of adjuvants that increase or promote the herbicide uptake of plants and even subsequent translocation in the plant system. This goes hand in hand with best practices of high precision in the application of products at times when environmental conditions and the physiological state of target plants are all conducive to optimal herbicide activity. This is easier said than done, but it is a necessity and should be considered as part of precision agriculture.

Meanwhile, the introduction of the next novel herbicide(s) is awaited with great anticipation. The last of this kind, with brand-new site of action, were the 4-hydroxyphenylpyruvate dioxygenase enzyme inhibitors that came onto the market in the mid-1980s.

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Dr Charlie Reinhardt is dean of Villa Academy, extraordinary professor in weed science at Stellenbosch University, and project leader in the SAHRI at the University of Pretoria. For enquiries and references, contact him on 083 442 3427 or dr.charlie.reinhardt@gmail.com.
The word fertiliser has its roots in the Latin word *fertilis*, which means to be fertile, productive and abundant. Fertiliser usage goes back 8 000 years, when farmers used manure to boost crop production and quality.

Among those who contributed to the advancement of fertiliser are Viscount Charles Townshend (1674-1738), Justus von Liebig (1803-1873), Sidney Gilchrist Thomas (1850-1885) and Percy Carlyle Gilchrist (1851-1935).

Prof Robin Barnard, chief technical advisor at the Fertiliser Association of Southern Africa (Fertasa), gives more detail of events in the 19th century and the use of natural versus synthetic fertilisers.

The role of industrialisation

Before the industrial revolution and the development of superphosphate manufacturing in the mid-19th century, animal manure and composted plant material were the only fertilisers known to man.

“Taking into consideration the rapidly increasing world population and industrialised chemical manufacturing, including the Haber-Bosch process for producing ammonia, the availability of synthetic fertilisers grew fairly rapidly,” says Prof Barnard. “The use of these inorganic fertilisers soon far exceeded that of organic inputs. This went hand-in-hand with the need to produce more food, especially with the general move to the cities.”

The organic approach

More recently there has been a growing awareness regarding the importance of the organic matter in soil, and its chemical, physical and biological advantages.

Prof Barnard stresses that it has always been important to maintain as much organic matter in the soil as possible. “In hot, dry climates such as is seen in most of South Africa, and considering the practice of ploughing and removing soil cover with plant material, this is easier said than done. Farming practices that reverse this approach, such as reduced, minimum or no-till planting, have become widespread. Where they are understood and correctly implemented, these practices are making important contributions.

There is also a move to promote the production and use of ‘organic’ food, by using only ‘organic’ inputs, says Prof Barnard. Synthetic chemicals such as those found in insecticides, herbicides, pesticides and even fertilisers such as superphosphate, are not permitted if the crop is to be certified organic. Prof Barnard says this rather extreme approach, though justified in some respects, has polarised public opinion.

Regulatory frameworks

In most countries across the world, the manufacturing, quality and use of fertilisers is regulated to a greater or lesser extent, and South Africa is no exception.

According to the *Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act*, 1947 (Act 36 of 1947), all fertiliser products, organic and inorganic, must be registered. In South Africa, this law currently regulates the use of fertilisers.

A draft *Fertiliser Bill* aimed at replacing the above-said law, was open for public comment at the time of writing this article. Prof Barnard summarises the main purpose of the proposed legislation as follows:

- To protect the consumers and users of fertiliser.
- To disseminate an efficient and effective traceability system.
- To ensure compliance with food safety, human and environmental requirements.

Fertiliser groups

In South Africa, fertilisers are grouped into three different categories, depending on their properties and concentrations:

- **Group 1 fertilisers** contain a total amount equal to or greater than 100g/kg of nitrogen (N), phosphorus (P) or potassium (K) or any combination thereof.

A pile of urea ready to be used in fertiliser mixes at Greenlands Fertilizers. Urea is a synthetically manufactured nitrogen fertiliser used extensively for heavy nitrogen feeders such as maize.
• Group 2 fertilisers contain a total amount of less than 100g/kg of N, P or K or any combination thereof, or any other recognised plant nutrient(s) in acceptable amounts as indicated in tables 1 to 9 and 13 to 15 of the fertiliser regulations relating to the Act.
• Group 3 fertilisers are natural or synthetic substances or organisms that improve the growth or yield of plants or the physical, chemical or biological condition of the soil. They do not qualify for registration as Group 1 or 2 products.

Essential plant nutrients
The recognised macro-elements that make up essential plant nutrients are N, P and K, as well as sulphur (S), calcium (Ca) and magnesium (Mg). The elements N, P and K are sometimes referred to as the primary elements, with S, Ca and Mg known as the secondary elements.

Iron, manganese, copper, zinc, molybdenum, boron and chlorine are the recognised micro-elements, while nickel, cobalt, selenium and silica are other elements regarded as advantageous to some crops under certain circumstances.

“It should be noted,” says Prof Barnard, “that in general terms, these plant nutrients are taken up in the same ionic form whether they originate from mineralised organic sources or from synthetic inorganic sources. This could be interpreted as a simplistic statement, and there are many forms of complex molecules providing nutrition to plants.”

Inorganic fertilisers
Inorganic fertilisers as plant nutrient sources include:
• Nitrogen: Ammonia, urea, ammonium nitrate, ammonium sulphate, limestone ammonium nitrate and ammonium sulphate nitrate.
• Phosphorus: ‘Rock’ phosphates (igneous and sedimentary). The latter is sometimes used as is, but is mostly chemically processed. Kalmaphos, silicaphosphine (silphos), phosphoric acid, superphosphates, ammonium phosphate (monoaonmonium phosphate and diammonium phosphate), polyphosphates and nitro phosphates.
• Potassium: Potassium chloride, potassium sulphate and potassium nitrate.
• Mixes containing N, P and K.
• Calcium and magnesium: Agricultural lime supplies these elements, which contain different amounts of Ca and Mg. Lime adjusts the background pH so that it is suitable for plant growth and nutrient availability. Lime fertiliser consists of carbonates, oxides, hydroxides and silicates.
• Sulphur: Gypsum, which contains Ca and sulphate, is also used for improving brackish soils and, in some cases, for subsoil acidity.
• Micro-nutrients: These nutrients are available for application in different forms, including natural and synthetic compounds such as chelates, lignosulphonates and polyflavonoids. Foliar applications are often used, as well as applications mixed with solid fertilisers. To ensure more effective mixing and distribution, various coatings containing the nutrients are sprayed onto the dry base fertiliser.

Organic fertilisers
The following are sources of economically important organic fertilisers:
• Guano.
• Chicken manure.
• Untreated cattle manure.
• Composted cattle manure.
• Peat.
• Dry sewage sludge.

Prof Barnard notes that, depending on availability and envisaged use, the products are often mixed in different ratios. “There are strict conditions imposed on the registration of such materials, especially relating to potentially harmful elements and human pathogens.”

The advantages of using organic fertilisers if the fertiliser is applied in the right amounts include improved aeration, better moisture retention, gas exchange and structure. “Organic fertilisers promote microbial activity by providing an energy source and contributing to plant nutrition through nutrient release.”

As the organic fertiliser nutrients are not always ideally balanced for plant nutrition, it is common practice to enrich organic fertilisers with one or more inorganic products (mostly N).

Group 3 fertilisers
This group of fertilisers are referred to as ‘novel’. These natural or synthetic substances or organisms include seaweed, organic acids, biofertilisers, fertiliser coatings and retardants used as controlled-release products. Nitrogen and urease inhibitors and moisture absorption products are also included.

Prof Barnard concludes, saying that many of these enhance the availability of nutrients and promote a more balanced soil ecosystem, making external inputs less necessary and in some cases superfluous. He believes that this development will gain a much higher profile in the future.
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A unique combination of Organic acids, Amino acids and Enzymes for the promotion of healthy roots and vigorous root growth in plants and seedlings.

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- Manganese (Mn) ... 1 g/kg

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- N. Sulphur (S) ... 5 g/kg

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A unique Ultrafine micronized Mg/Ca source in Carbonate form.

- Average Particle size between 5 - 15 µm (100 x smaller than 80% of agricultural lime).
- Ca 190 g/kg
- Mg 110 g/kg

**B4990 COMPLEX CALSUL**

A unique Ultrafine micronized Ca source in Sulphate form.

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- S 140 g/kg

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- Ca 400 g/kg
- Mg 30 g/kg

Contact us

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

Address: 9 Silver Crescent, Delmas, 2210
An alternative to conventional lime

**Article by World Focus Agri**

Ultrafine lime or gypsum is preferred to conventional lime for its superior handling, ease of application and results. Ultrafine lime also achieves a more even and thorough application. This allows the calcium carbonate, the effective neutralising ingredient in limestone, to come into contact with and neutralise as much hydrogen in the soil as possible. Better coverage means that more hydrogen is neutralised or eliminated, which results in higher potential hydrogen (pH).

**Ultrafine vs conventional lime**

The difference between ultrafine lime and conventional lime is in the particle size. Ultrafine lime is difficult to make because it consists of insoluble limestone particles. Limestone on its own does not suspend very well in water.

Ultrafine lime or gypsum in combination with suspension agents can go into suspension with water. This means that the ultrafine lime or gypsum can be used in sprayers and hydroseeders. It can also be applied through centre pivots, drip and micro-irrigation systems. Limited agitation is necessary due to the suspension.

**Advantages of ultrafine lime**

- The increased reactive surface ensures an accelerated reaction time and a higher electrostatic charge for element or energy transfer.
- It initiates an instantaneous change of calcium (Ca): magnesium (Mg) ratio, acid saturation and cation exchange coefficient (KUK).
- The macro-nutrient Ca becomes available due to chemical and biological reduction reactions of Ca/Mg carbonates.
- It includes nitrogen (N) with improved nodulation in legumes and N fixation in free-living bacteria.
- It increases microbial life and activities with faster degradation of organic material and more effective release of nutrient elements, specifically N.
- Soil texture and structure is improved.
- It leads to increased water penetration and moisture retention.

**Comparing types of lime**

Lime that raises soil pH the most, relative to the total cost of liming (lime + freight + spreading), will be the most cost-effective. The dominant cost component of liming is freight, which means a smaller amount of a higher quality product will reduce the overall cost. Quality or the effectiveness of lime per ton, is determined by two factors: neutralising value and particle size.

The neutralising value (NV) of lime represents the purity of the lime, based on a scale of percentage of calcium carbonate (pure lime). Lime with an NV of 90% will be 50% more effective than lime with an NV of 60%, given the same particle size distribution.

**Do the homework**

Before you buy lime, find out exactly what you are buying. Look at the specification sheets for particle size distribution and NVs and do the calculations. If you are looking at a blend, check the proportions of the various ingredients and look at the specification sheets for the different components. This way you can see what you are paying for and determine whether it would be more economical to buy the components separately.

Finer lime neutralises soil more effectively than coarser lime, and the pH rise from finer lime is greater than from coarser lime.

Acid eats away the surface of the lime particle and dissolves lime in soil. When the acid attacks the lime particle’s surface, carbonate, which neutralises the acid, is released. This neutralises the soil next to the lime particle, which is then prevented from dissolving more lime. The lime particle sits in a pocket of neutralised soil and is no longer effective.

Don’t be fooled into comparing lime particles by shaking them in liquid. Coarse lime particles remain in contact with fresh acid and therefore continue to dissolve – this does not happen in the soil. Lime particles smaller than 0.5mm are most effective at raising the soil pH. Choose your lime based on particle size but check the NV of the fine particle fraction to ensure that it is lime, and not clay, you are buying.

_A schematic comparison between fine and coarse lime. Fine lime particles raise soil pH far more effectively than coarse lime particles._

For references or more information, send an email to admin@worldfocusagri.com or visit www.worldfocusagri.com.
At BASF farming runs through our veins and we are passionate about what we do best: farming!

We know the soil and understand the climate ... therefore sustainable farm management solutions are necessary, for South Africans by South Africans.

With the future in mind, it is time for responsible resource management, effective production and a continuous drive towards sustainability.

What are you waiting for? Call your BASF representative today and become part of the solution.

Together we farm better.
Influence of rhizobia per seed on soybean yield

<table>
<thead>
<tr>
<th>Yield (T/ha)</th>
<th>Number of Rhizobia per seed at planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7</td>
<td>1.E +02</td>
</tr>
<tr>
<td>1.8</td>
<td>1.E +03</td>
</tr>
<tr>
<td>1.9</td>
<td>1.E +04</td>
</tr>
<tr>
<td>2.0</td>
<td>1.E +05</td>
</tr>
<tr>
<td>2.1</td>
<td>1.E +06</td>
</tr>
<tr>
<td>2.2</td>
<td>1.E +04</td>
</tr>
<tr>
<td>2.3</td>
<td>1.E +05</td>
</tr>
</tbody>
</table>

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.

**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.

**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.

Always read the label and follow the usage instructions. For enquiries, visit our website for your closest BASF representative.

www.agro.basf.co.za

**Insist on fresh.**

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

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

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

**NOU! GAAN ONS BOER™**

BASF – We create chemistry.
Groundnuts are a high-value crop produced mainly in the northwestern regions of South Africa, particularly the western and northwestern parts of the Free State, North West and Northern Cape. Groundnuts are also produced in Limpopo and Mpumalanga, but to a lesser extent.

**Area planted**

From 2010 to 2019, most of the plantings (40.9%) occurred in the Free State, followed by North West (40.7%), Northern Cape (12.6%) and Limpopo (5.5%). The local groundnut market has been extremely volatile, mainly because of changing weather conditions in the local production regions over the past two or three years.

The estimated area under groundnuts in the 2019 season is 20 050ha, the lowest on record. If one looks at the area under groundnuts historically, an average of 24 000 to 26 000ha of groundnuts were planted in the late 1930s and early 1940s. From 1946, plantings increased rapidly to a record high of 393 000ha in 1970, after which it decreased to the current low level.

The current area planted shows a considerable decrease of 64.4% (36 250ha) when compared to the 56 300ha planted in 2018. It is also 141 771ha below the 50-year (1969 to 2018) average of 161 821ha, 42 248ha below the 20-year (1999 to 2018) average of 62 248ha, and 30 403ha below the ten-year (2009 to 2018) average of 50 453ha.

**Groundnut production**

Figure 3 illustrates groundnut production from 1937 to 2019. In the late 1930s and early 1940s, the average output of groundnuts was between 4 100 and 9 700 tons. During the 1974 season, groundnut production reached 384 000 tons, its highest level ever. Since 1975, however, production started declining to its current level, mainly as a result of a decrease in plantings.
The fifth crop estimate of 2019 projects a crop of 18 880 tons. This is the smallest harvest since 2016, when 17 680 tons were produced. It also represents a decline of 66,9% compared to the 57 000 tons produced in 2018. This year’s harvest is 84,6% lower than the 122 805 tons, 76,9% lower than the 20-year average of 81 905 tons, and 71,5% lower than the 10-year average of 66 247 tons.

**A provincial perspective**

The Free State, North West, Limpopo and Northern Cape produce most of the groundnut crops in South Africa. During the 2018/19 production season, 57,4% of the plantings occurred in the Free State, followed by North West (27,4%), Limpopo (9,2%) and the Northern Cape (6%).

Currently, the expected harvest in the Free State is estimated at 8 625 tons (46%), followed by Limpopo with 3 885 tons (21%), North West with 3 850 tons (20%) and the Northern Cape with 2 520 tons (13%).

**Free State**

The estimated area under groundnuts in the province is 11 500ha, which is 47,7% lower than the 22 000ha that was planted in 2018. It is also 7 100ha less than the average area of 18 600ha for the past five years.

The fifth production estimate for groundnut production in the Free State this season is 8 625 tons. This is the smallest yield since 2016, when only 2 920 tons were produced. It also represents a decline of 59,2% compared to the 21 150-ton harvest in 2018. The 2019 harvest is 58,3% lower than the average yield of 20 694 tons for the past five years.

**North West**

It is estimated that the area under groundnuts in North West this year is 5 500ha, which is 80,4% lower than the 28 000ha that was planted in 2018. It is also 16 960ha below the average of 22 460ha for the past five years.

The fifth production estimate for groundnut production in North West for 2019 is 3 850 tons. This is the smallest yield since 2016, when only 3 320 tons were produced. It also indicates a decline of 82,1% compared to 2018 (21 500 tons). The yield is 82% smaller than the average yield of 21 384 tons for the past five years.

**Limpopo**

The area under groundnuts in Limpopo this year is estimated at 1 850ha, which is 47,1% lower than the 3 500ha that were planted in 2018. It is also 870ha less than the average area of 2 720ha for the past five years.

The current production estimate of groundnuts in Limpopo is 3 885 tons, which is 47,1% lower than in 2018 (7 350 tons). This year’s yield is 7,3% less than the five-year average of 4 190 tons.

**Northern Cape**

It is estimated that the area under groundnuts in the Northern Cape this year will be only 1 200ha. This is the lowest area on record and 57,1% less than the 2 800ha that was planted in 2018. In comparison with the five-year average of 5 180ha, the current plantings show a decrease of 3 980ha. This can be attributed to the expansion of pecan nut and cotton cultivation in the province.

The current production estimate for the province is 2 520 tons, which is 64% lower than the 7 000 tons produced in 2018. The 2019 harvest is also 82,5% less than the average of 14 380 tons for the past five years. As plantings in the Northern Cape occur mainly under irrigation, the decline in production can largely be attributed to the decrease in area planted over time.

For more information, contact Gerhard van der Burgh at gerhard@bfap.co.za.
Trade war and supplies put pressure on oilseeds prices

By Dr Dirk Strydom

Internationally the ongoing trade war between China and the United States (US) is still creating volatility and uncertainty in the oilseeds industry.

Soya beans
The trade war between the US and China has had a significant negative impact on the global trade flow of soya beans in the international context since last year, when initial tariffs were introduced. This caused US soya bean stocks to increase significantly, which put US soya bean prices under pressure. Expectations are that these prices will remain somewhat under pressure for the rest of the season, as large quantities of soya beans are still available in the US.

Although soya bean planting in the US could not occur optimally due to excessive rainfall, improving weather conditions in major soya bean-producing areas is favourable for the season’s production expectations.

In Argentina, soya bean processing for June was approximately 31% more than a year ago, reaching a 23-month high. The greater processing of soya beans in Argentina has sharply increased exports of soya bean meal and oil.

Sunflower seed
The sunflower seed plantings in Russia exceeded expectations this season, with the area planted greater than initially expected. The larger expected production, together with the reasonably large supplies still available, will probably increase the processing of sunflower seeds in Russia. It is expected that 12 million tons of sunflower seed will be processed in Russia during the 2019/20 season. This will be the second consecutive year-on-year increase in Russian sunflower seed processing.

Canola
The Canadian canola market remains under pressure due to production conditions in Canada improving, and processing and distribution occurring at a slow pace. There are currently large quantities of canola available in the country, which keeps prices under pressure.

In Australia, canola production for the season is estimated at 2,4 million tons, which is lower than last season’s production due to lower plantings and drier production conditions.

Groundnuts
The expectation in the international groundnuts market is that the new season’s production will recover slightly from the previous season’s production. The expectation is that the better production expected in China and India for the season. The world groundnut production for the 2019/20 season is estimated at 29,7 million tons, compared to the previous season’s 29,3 million tons.

Global market
In terms of prices in the global market, most of the dollar prices showed a small downward trend year-on-year. However, groundnuts and palm oil increased mainly due to a decrease in supply.
The rand/dollar exchange weakened by 9%, from R13,40 to R14,67.

Local market
In the local market, oilseeds production was less than expected. In the July Crop Estimates Committee report, estimates were 1,17 million tons for soya beans and 655 640 tons for sunflower. This decrease in production figures created a more balanced supply and demand for soya beans. At the beginning of the season it was clear that there would not be enough sunflower seed to meet demand. However, given world vegetable oil prices, it was unclear whether the shortage would be covered by sunflower seed or byproduct imports.

When evaluating the prices of oilseeds in South Africa (Figure 1 and Figure 2), it is clear that prices moved away from an export parity level and closer to a derived price as it became clear that production would be limited and global byproducts grew more affordable due to high supplies.

A decline was also recorded for oilseeds crushing margins. This led to a seven-year high of sunflower oil imports (April to June) and a slowdown in local crushing. Also, the South African Grain Information Service’s (SAGIS) monthly figures indicated that sunflower crushing figures across the production season only recently increased, as the harvest or delivery of the new season’s crop commenced.

Estimates of soya bean supply and demand stock levels are more balanced, given the high opening stock levels at the beginning of the season. However, if one considers sunflower and groundnuts, there is a shortage in the marketing year. A concerning factor is that groundnut seed availability is correlated with supply, which means that the supply of groundnut seeds may be under pressure in the new planting season.

In terms of prices, most of the local commodity prices are close to the derived prices, which means that the market will be more correlated and influenced by the international market. At these levels it is also essential to monitor sunflower oil and soya oilcake prices in the global market. This means the exchange rate and the increased conflict in the China/US trade war must be evaluated in the short term.

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

Figure 2: Parity and derived prices for sunflower. (Source: Grain SA)

Table 2: Supply and demand estimates in tons. (Source: Grain SA)

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Supply</th>
<th>Demand</th>
<th>Surplus/shortage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soya bean</td>
<td>1 655 586</td>
<td>1 597 790</td>
<td>57 796</td>
</tr>
<tr>
<td>Sunflower</td>
<td>782 805</td>
<td>826 140</td>
<td>-43 335</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>44 000</td>
<td>80 640</td>
<td>-36 640</td>
</tr>
</tbody>
</table>

Note: Including normal African exports and a pipeline of 1,5 months.

Figure 3: Soya bean crushing margins. (Source: Grain SA)

Figure 4: Sunflower crushing figures. (Source: SAGIS)
African swine fever (ASF) in China and many other parts of the world, is causing a huge shift in the world’s protein market with consequences for soya bean and chicken production.

“The African swine fever epidemic can become a game changer, changing the position of the entire agricultural sector around the world,” said Alltech’s CEO Mark Lyons at the company’s technical summit in Dublin recently. His sentiment about the market is underlined by a report by Food & Agri Rabobank. It foresees that the loss of animals and thus protein production, mainly concentrated in China, will lead to a shift in worldwide trade patterns of animal protein.

Rabobank saw production losses from ASF eclipsing initial estimates. In 2019, the bank expects Chinese pork production losses of 25 to 35% in response to ASF. Since its discovery in August 2018, ASF has spread to every province in mainland China. With ASF affecting an estimated 150 to 200 million pigs, the expected 30% loss in pork production is nearly 30% larger than annual pork production in the US and equivalent to Europe’s annual pork supply.

On top of this, in some areas of China over 50% of production is affected and the disease has spread to Vietnam, where Rabobank expects production losses to exceed 10%, and Cambodia and could move further into Southeast Asia, with more production losses to follow.

Good cards for poultry

Even if the disease is stopped in its tracks, which is unlikely, it will take at least three to five years for pig production to recover. This is mainly due to the fact that a large part of the breeding stock is affected.

China will try to source pork meat elsewhere, driving up prices, but a shift in animal protein is on the table as well. Rabobank expects available global protein supplies to be redirected to China in an effort to satisfy the growing protein deficit. A secular shift towards lower Chinese pork consumption will support increased demand for poultry, beef, seafood, and alternative proteins that will shape global production trends.

Market access to China can be a hurdle for foreign chicken producers, but with the lack of parent stock in China and the estimated ten million metric tons animal protein supply gap, the Chinese government has to move in an effort to prevent empty supermarket shelves.

More importantly, the first signs of poultry meat moving into China are already there and come from the Chinese ministry of agriculture. It recently reported a 9% increase in poultry consumption in 2019, coupled with a 32% rise in imports, mainly from Brazil.

Cheaper soya for everyone

As a consequence of the diminished pig herd size of the world, the demand for soya beans is dropping. This change in demand is putting the China-US trade tension around soya tariffs on the backburner.

Since 2018 this trade tension has been top of mind, with China avoiding US tariffs by sourcing its soya from Brazil and European traders moving out of Brazil and buying in the US. Price consequences of this merry-go-round were limited, but that was just lucky because of Brazil’s exportable supplies that were more plentiful than anyone had expected.

Today, just as the USDA reports the largest soya stock in the world ever, over 100 million tons and with superb production forecasts in the pipeline, soya is expected to remain cheap. The USDA is forecasting a decline or slower growth in Chinese soya imports for the next couple of years. Chinese soya imports dropped 14% in the first quarter, partly because the trade tension made feed companies switch to alternative proteins.

The forecast for the whole of the 2018/19 season encompasses a decline, for the first time in 15 years, to 88 million tons, which is expected to drop further to 71 million tons in 2019/20 due to the impact of ASF.

In mid-April the International Grains Council noted that the soya bean price was down 21% from one year ago, creating favourable conditions for all disease-free animal protein producers around the world.

This article was originally published on www.poultryworld.net and was shortened for publication here.
The effects of the changing climate, which is, of course, a global challenge, have been felt increasingly in sub-Saharan Africa and parts of Asia in the recent past. This is as a result of erratic rainfall and the more frequent occurrence of droughts and floods. For countries whose economies largely depend on agricultural fortunes, the impact of climate change has mostly been felt in smaller yields, poorer grazing conditions for livestock and ultimately in food price inflation.

However, less of a talking point but equally important is the impact of climate change on value-chain industries such as agricultural input and equipment providers, agricultural financiers and food processing companies, among others.

Agricultural equipment sales
We are witnessing this in South Africa, albeit at a fairly marginal scale thus far. For example, the performance of agricultural equipment has been subdued since the beginning of the year. Several factors gave rise to this trend, the main one being the poor performance of agricultural production due to unfavourable weather conditions.

When the 2018/19 summer grains and oilseeds season commenced in October 2018, only parts of Mpumalanga, KwaZulu-Natal, Gauteng, the Eastern Cape and Limpopo received light showers that enabled plantings. Other provinces, specifically the Free State and North West, only received good rains late in December 2018.

This meant that plantings had to be delayed by about a month, which led to a 4% year-on-year reduction in the area planted to 3.7 million hectares in the 2018/19 summer grains and oilseeds production season. Furthermore, the crop yields in the areas that did plant, also took a knock.

The 2018/19 sunflower seed, soya bean and maize harvests are expected to drop by 29, 21 and 13%, from the previous season, to 611 140 tons, 1.2 million tons, and 10.9 million tons, respectively. All of this is weighing heavily on farmers’ finances, and hence agricultural equipment sales.

Admittedly, the poor performance of agricultural equipment sales cannot be attributed to unfavourable weather conditions only. Last year, sales were relatively robust, which implies that the rate of replacement will likely be down in 2019.

To illustrate this point, South Africa’s overall tractor sales for 2018 amounted to 6 680 units, up by 4% from 2017. In terms of combine harvester sales, 2018 presented a good performance with 200 units sold, which was 2% higher than in 2017.

Policy and investment
Another important aspect that is monitored through the Agbiz/IDC Agribusiness Confidence Index, is the influence of policy discussions on agricultural investment. Sentiment in the sector has generally been subdued since the second quarter of 2018, but the fact that fixed investments in the sector did not decline notably in 2018, was comforting.

However, the subdued confidence levels in the second quarter suggest some urgency in moving the policy levers to ensure that, at least, matters that are within the South African policymakers’ reach, are properly addressed in the interest of sustainable growth of the agricultural and agribusiness sector.

In closing, the climate crisis will continue to be the key driver of performance in the agricultural sector and its interlinked industries in the near term, and for many years to come. Agbiz expects a generally subdued performance in terms of tractor purchases, with a potential turning point around October, when the 2019/20 summer grains and oilseeds production season starts. This, however, is if weather conditions improve.

For more information, email the author at wandile@agbiz.co.za.
Quality of the 2017/18 season’s sunflower crop

By Jolanda Nortjé, laboratory manager, Southern African Grain Laboratory NPC

The sixth annual sunflower crop quality survey performed by the Southern African Grain Laboratory (SAGL) was made possible by the financial support of the Oil & Protein Seed Development Trust and the members of Agbiz Grain, who provided the crop samples.

A total of 176 samples representing the various production regions were submitted by commercial grain silo owners. The samples were received at the SAGL from July to November 2018.

Test weight
The average test weight (a measure of the bulk density) of sunflower seed this season was 40,1 kg/hℓ, with values ranging from 33,2 to 45,9 kg/hℓ. The previous two seasons averaged 42,1 and 42,5 kg/hℓ, respectively, with values varying between 34,2 and 45,5 kg/hℓ, and 35 and 48,1 kg/hℓ. These values were determined by means of the Kern 222 apparatus. The g/1ℓ filling mass of the sunflower seed samples were determined, which was then divided by two. The g/½ℓ filling mass obtained was then used to extrapolate the test weight by means of formulas obtained from the Canadian Grain Commission’s sunflower seed, oil conversion chart.

Permissible deviations
Full grading was done in accordance with the regulations relating to the grading, packing and marking of sunflower seed intended for sale in the Republic of South Africa (No R45 of 22 January 2016). Of the samples, 81% (143) were graded as Grade FH1, with 33 of the samples downgraded to class other sunflower seed (COSF). During the previous two seasons, 15% (2016/17) and 22% (2015/16) of the samples were downgraded to COSF.

The majority of the samples (18) were downgraded as a result of the percentage of either the screenings or the collective deviations, or a combination of both, exceeding the maximum permissible deviations of 4 and 6%, respectively. A further nine samples were downgraded due to the presence of poisonous seeds (either Datura spp., Crotalaria spp. or Xanthium strumarium) exceeding the maximum permissible number.

North West (99 samples) reported the highest weighted average percentage screenings of 2,18%, followed by Limpopo (five samples) and the Free State (64 samples) with 1,84 and 1,56%, respectively. Mpumalanga (eight samples) reported the lowest average percentage screenings at 1,33%.
Table 1: Average crude protein content per province per season.

<table>
<thead>
<tr>
<th>Province</th>
<th>Average Crude Protein Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free State</td>
<td>17.12</td>
</tr>
<tr>
<td>North West</td>
<td>17.12</td>
</tr>
<tr>
<td>Limpopo</td>
<td>15.15</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>15.15</td>
</tr>
</tbody>
</table>

According to an article by researchers of the Department of Plant Sciences: Plant Pathology Division of the University of the Free State, there are currently no commercially available sunflower or soya bean cultivars in the world that are resistant to the fungus (pathogen).

The manner in which sunflower and soya bean cultivars differ in their response to the pathogen under disease-favourable conditions, enables farmers to select cultivars that are more tolerant, which reduces the risk of infection, yield losses and inoculum buildup in the fields.

Nutritional content

The weighted average crude protein content (total nitrogen content x 6.25) was 16.61%, similar to the 16.63% of the previous season. North West had the highest weighted average crude protein content of 17.12% and Mpumalanga the lowest (15.15%).

Mpumalanga has consistently reported the lowest average protein content since commencement of this survey in the 2012/13 season. Limpopo’s crude protein content averaged 16.95% and that of the Free State 15.97%. Figure 1 shows the average crude protein content per province over the last five seasons.

The weighted average crude protein percentage of 37% was the lowest of the past six seasons, and 1.6% lower than the previous season. Mpumalanga had the highest weighted average crude protein content of 40%. Last season, Mpumalanga also reported the highest fat content. The North West recorded the lowest average fat content (36.1%).

The weighted average percentage crude fibre was the highest of the six seasons at 21.9% (21% in 2016/17). Average values varied from 20.2% in Limpopo to 22.2% in Free State. At 2.69% the weighted average ash (mineral matter) content was also the highest over six seasons. The provincial averages ranged from 2.56% in Mpumalanga to 2.74% in Limpopo.

The nutritional component analyses, namely crude protein, fat, fibre and ash, are reported as a % (g/100g) on an ‘as received’ or ‘as is’ basis.

Production overview

World sunflower seed production in the 2017/18 season decreased by 1% year-on-year to 49.6 million tons. The local crop followed the same trend, decreasing by 1.4% (12 000 tons) to 862 000 tons. Globally, the Ukraine and Russia are the main sunflower-producing countries, while in South Africa, the Free State and North West contributed 95% of the total crop.

The area utilised for sunflower production decreased by 5.4% to 601 500ha, compared to the 635 700ha of the previous season. This season’s areas planted are in line with the five-year average of 606 780ha. The national yield average increased by 4.4% to 1.43 t/ha, the highest national average to date. Less than 1.5% of the sunflower seed produced in South Africa this season was planted under irrigation.

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Factors influencing the protein and oil content of soya beans

By Prof Rob Gous

In 2015 Prof Rob Gous from the Protein Research Foundation wrote an article on the factors that influence the protein and oil content of soya beans. Since its publication, no subsequent research has been done on this important subject. As it remains a topical issue, Oilseeds Focus has decided to reprint the original article.

Soya bean, Glycine max (L.) Merr., contains about 200g of oil and 400g protein/kg seed dry matter. It is the major oilseed and protein crop in many regions of the world, providing approximately 60% of the world supply of vegetable protein. For both animal feed and human food utilisation, a high and stable seed protein content is desirable.

In South Africa, the soya bean industry is growing rapidly, with many first-time producers realising the benefits of this crop. However, in order to ensure that the local crop is acceptable to animal feed producers, it is essential that the protein and oil contents of the seeds produced are close to the quantities expected. A number of factors are known to influence the content of protein and oil in soya bean seeds, and these are described below.

The factors can be divided into those associated with the plant, the soil, the climate/environment and with the rhizobia involved in nitrogen fixation.

Plant factors
There are no differences in protein content among seeds within the same pod, but seed protein content has been shown to increase linearly from the lowest to the highest fruiting node of both normal- and high-protein strains of soya bean (Escalante and Wilcox, 1993). The increase is from 344 to 432g/kg for normal and 420 to 509g/kg for high-protein genotypes. This increase in protein content is observed in both determinate and indeterminate varieties. The greatest range in protein within plants has been reported to be from 349 to 510g/kg for indeterminate and from 340 to 487g/kg for determinate plants.

The oil content of soya beans is somewhat different. It also varies with pod position on the plant and on the raceme (flower-bearing branches), but in this case the position of the seed in the pod also causes variation in oil content. Seeds from the lower half of plants are on average 5g/kg higher in oil than those from the upper half; beans near the tip of long, terminal racemes have less oil.
than those further down; and seeds in the tip of the pod have the highest oil content (Collins and Carter, 1956).

If an accurate determination is to be made of the oil and protein content of individual plants, the analysis of seed samples, representative of the entire plant, is essential.

Genetic variation in seed protein content is considerable, thus plant geneticists have the potential to increase protein content by selection. However, there is an inverse relationship between seed yield and seed protein content, especially in indeterminate types. This is true even though the seed protein and oil contents from determinate and indeterminate plant types are similar. Determinate varieties, therefore, appear to have a better potential to combine high seed yield with high seed protein than indeterminate varieties (Wilcox and Guodong, 1997).

Soya beans obtain nitrogen (N) from the soil and from symbiotic fixation, when nodulated with effective strains of rhizobia. These two sources of N may need to be supplemented with fertiliser N for maximum seed yield.

In an analysis of 637 data sets published between 1966 and 2006, Salvagiotti et al. (2008) demonstrated that, on average, 50 to 60% of the soya bean N demand was met by biological N2 fixation. In most instances, the amount of fixed N was not sufficient to replace the N removed from the field in harvested seed. Soya bean yield was more likely to respond to N fertilisation in high-yield (>4,5tons/ha) environments.

A negative exponential relationship was observed between N fertiliser rate and N2 fixation, when N was applied on the surface or incorporated in the topmost soil layers. Deep placement of slow-release fertiliser below the nodulation zone, or late N applications during reproductive stages, may be promising alternatives for achieving a yield response to N fertilisation in high-yielding environments.

Sugimoto et al. (2001) reported a positive correlation between the contents of protein and oil in seeds from nodulated soya bean plants. Seeds from nodulated plants grown on urea-treated soil exhibited higher protein and lower oil contents than those from plants grown on soil treated with coated slow-release N fertiliser (LP-100). The contents of these compounds, in seeds from nodulated plants grown on LP-100 soil, were almost the same as those from non-nodulated plants on the same soil. These observations indicate that N economy in roots during seed maturation affects the contents of storage compounds.

Mineral N absorption

Yield has been shown to be directly related to mineral N absorption in the first stages of the reproductive growth period (R2) and to high N2 fixation rates at stage R6, whereas seed protein content was related to N2 fixation efficiency during the reproductive growth period until late stages (R2 – R6 + 10d). N is therefore utilised independently for yield and for seed protein content (Fabre and Planchon, 2001).

Ham et al. (1975) measured the responses to three readily available fertilisers (ammonium nitrate, urea, and urea plus sulphur) and two slow-release fertilisers (S-coated urea and urea formaldehyde), which were mixed into the top 20cm of soil before planting. One non-nodulating and two nodulating soya bean lines were used. The response to N fertiliser was greater with the non-nodulating line than with the other two lines. Nitrogen fertilisation increased seed yield, weight per seed, seed protein percentage and kilogram of protein per hectare. Plant height and lodging were either increased or unaffected, depending upon locations and/or year. Seed oil percentage decreased following N fertilisation. However, the total oil production usually increased due to larger yields.

All sources of fertiliser increased N2 fixation, plant nodule weight, nodule number and weight per nodule. Increases in seed yield and/or seed protein percentage, in the nodulating lines, suggest that N fixation failed to supply the amounts of N essential for maximum seed yield and/or protein percentage.

Inoculated seed

In the experiment above, sulphur (S) fertiliser increased seed yield in one case and decreased it in two other cases, depending on location and year. The total S percentage and S-containing amino acids of the seed were not increased with S additions.

In a pot experiment and with seeds inoculated with Bradyrhizobium inoculum before sowing, Morshed et al. (2008) found that N application progressively and significantly increased the yield of soya bean up to the N rate of 26,5kg/ha, where the highest seed yield of 6,85g per plant was obtained. Nutrient uptake and protein content in seeds also increased with increasing levels of N (up to the same rate of 26,5kg N/ha).

A trial conducted in Canada, in which the effects of N fertilisation on yield and protein content were measured, demonstrated that the benefits of N fertilisation depend critically on whether the soya bean seeds have been effectively inoculated prior to planting. The use of an inoculant promoted root nodule formation, enabling the soya bean crop to fix its own N throughout the growing season, leading to high yield and quality at harvest.

However, in non-inoculated treatments it was apparent that 112kg N/ha as fertiliser or manure was insufficient to meet soya bean needs, since crops ripened prematurely and produced lower yield and seed protein. Where seeds were...
inoculated, high soil N may have inhibited nodulation by the root, leaving the crop dependent on soil N supply to meet needs throughout the growing season.

These results suggest that high levels of soil N reduce soya bean yield and quality, and that high soil N from fertilisation tends to cause increased vegetative growth, increased lodging and lower yield and protein content. The effects are likely due to reduced root nodulation, which is required for full season N supply to the crop. This has implications for nutrient management, suggesting that the application of N fertiliser or manure on soya bean land where the seeds have been effectively inoculated is an inefficient use of this fertiliser and may adversely affect the crop.

**Nitrogen fixation**

Nitrogen fixation by soya beans provides N nutrition in a highly sustainable and economically competitive way and, most importantly, increases the seeds’ protein content. N fixation by soya beans may be limited by various environmental conditions. Thus, there exists the need to optimise symbiotic fixation through agronomic and plant-breeding research.

In two experiments conducted in Australia by Pritchard and Cesari (1996), N fertiliser had no significant effect on protein content at one of the sites, indicating that nodules alone were able to maintain both protein content and seed yield, at this site where the previous soya bean crop had been inoculated. At the second site, where soya beans had not been grown previously, mean protein content (39%) under flood irrigation was somewhat lower (41.7%) than at the other site, indicating a possible benefit of higher rhizobia populations in soils with a soya bean history.

Apparently poor nodulation is not uncommon on fields where soya beans have been planted for the first time. Some of the reasons for this include a lack of viable bacteria having been placed on the seed, possibly due to improper storage of the product; the inoculant might not have stuck to the seed or was added unevenly; or there was a problem with plant infection. Excess nitrate, present in the soil at planting time, will also inhibit infection. If there is excess N in the soil, the plant will first use this N before allowing proper nodules to form.

In fields with a history of soya beans, the nodules can form later, but in first-time fields the opportunity may be missed. The roots may have grown past the point where the inoculant was placed, or the bacteria may have died due to dry conditions. This may be the reason why old forage fields sometimes have nodulation failures when first seeded with beans.

**Delayed root infection**

The initial high N level in the field may cause delayed root infection. For fields with a history of soya beans, the bacteria will survive for many years in most soils, once introduced. However, poor nodulation can occur even in an established field if the soil has a low pH or is sandy, if there is excess nitrate in the soil or if it is very dry.

Rhizobial inoculant can only improve yields when the legume crops do not have enough N. Inoculant will not solve additional problems, such as a lack of other soil nutrients (see below). N already present in the soil or left over from earlier fertiliser applications may reduce the N fixation and inoculation benefit. When there are already many rhizobia present in the soil that can stimulate effective N fixation, inoculation may not provide much further benefit.

For proper nodulation to occur, a relatively high number of rhizobia must be present in the soil. Soya bean plants secrete chemical signals (flavonoids) into the soil from the roots. These signals are detected by the bacteria, which in turn send a chemical signal back to the root to then elicit nodulation in the plant.

Factors that influence nodulation, nodular growth and N fixation include excessive or insufficient moisture, soil temperature, soil pH, diseases, organic matter and soil nitrate availability, as well as the rhizobial quality and bacterial strain in the soil. N fixation in soya beans is highly susceptible to soil drying, being more susceptible to water-deficit stress than any other physiological processes in the plant. This may partially explain why soya beans do poorly in dry years, when compared to other crops.

Soya beans generally do not respond to pre-plant N fertilisation, but there are a few exceptions, including poorly drained soils, low organic matter, low residual N, acidic soils and dry conditions.

**Soil trace minerals**

The efficiency of the process of N fixation in soya beans can be limited by micronutrient deficiencies, especially of molybdenum (Mo). Soya beans generally respond positively to fertilisation with Mo in soils of low fertility and in fertile soils, depleted of Mo due to long-term cropping. Seeds enriched with Mo could be a viable alternative to exterior seed treatment, because certain forms of Mo have been shown to be toxic to rhizobium when applied to seed at the time of inoculation.

Severe manganese (Mn) deficiency (less than 15ppm Mn in the leaves) has been shown to increase seed protein percentage and decrease seed oil percentage. Interestingly enough, seed from plants with extremely low leaf Mn levels contains higher percentages of linoleic, palmitic, linolenic and stearic acids, and a lower percentage of oleic acid. The percentages of seed protein, seed oil,
and fatty acids changed markedly at low leaf Mn levels, but remained relatively constant above leaf Mn concentrations of 15 to 20ppm. Amino acid content in seed protein is relatively unaffected by Mn.

**Locality and climate**

Vollmann *et al.* (2000) reports that the protein content of soya beans grown in the northern regions of the world is reduced, owing to climatic conditions such as low temperatures and high volumes of precipitation. In the United States (US), seed protein content in the Western and Eastern Corn Belt has been lower than in southern production regions over a number of seasons.

In South Africa, the soya bean industry is growing rapidly, with many first-time producers realising the benefits of this crop.

Similarly, protein content is reported to be low in the northern locations of Northeast China and in the northern sites of Europe, where large seasonal variations are observed in protein content. Apart from other findings, it was recently discovered that low root-zone temperatures reduce nitrogen fixation, which might explain the low protein content commonly found in northern areas of soya bean cultivation.

In their investigation, seed protein content was the highest for soya bean crops grown under moderately dry conditions and a high temperature during the seed-filling period. In experiments on stress during the seed-filling period, both drought and high-air temperature conditions enhanced the protein content by approximately 30 to 50g/kg, whereas oil content and grain yield were reduced.

At constant water-supply levels, both protein and oil contents were increased at a high temperature and fatty acid composition was most affected by temperature, whereas amino acid composition was stable. In other investigations dealing with water stress and irrigation of early maturing soya beans, the importance of timing the irrigation was emphasised. The protein content was highest with irrigation after the flowering stage, whereas it was lower with continuous water supply. This might be due to higher yield levels or higher oil content at optimum levels of water supply, which would dilute a given amount of protein.

**Environmental conditions**

After observing the variation in seed protein content of early maturing soya beans grown in Central Europe; their conclusion was that environmental conditions, i.e. both seasonal and location effects, can modify seed protein content considerably. Low protein content may be due to insufficient nitrogen fixation in cool seasons or to high levels of precipitation and a low temperature during the seed-filling period.

Karr-Lilienthal *et al.* (2004) obtained soya beans from five leading soya bean-producing countries (Argentina, Brazil, China, India and the US), which had been imported to the US and processed into soya bean meal (SBM) under uniform conditions. Soya beans from China had the highest crude protein content, while soya beans – and the resultant soya bean meal – from Argentina had the lowest.

In Table 1 the chemical composition of the soya bean samples is given (two from India, a low- and a high-protein sample) and then again after processing under standard conditions. It is interesting to note the very low protein content of the Argentinian soya beans (32.6%).

Maestri *et al.* (1999), while working in Argentina, identified a trend towards lower protein content as latitude increased and a negative correlation between latitude and oil content. Also, altitude above mean sea level correlated positively with protein and oil contents and oleic acid percentage, while a negative correlation between altitude and linoleic acid was found.

Fatty acid composition has been shown to be strongly affected by temperature. Linolenic and linoleic acids decreased markedly, whereas oleic acid increased as temperature increased; palmitic and stearic acids, however, remained unchanged (Wolf *et al.*, 1982). Oil content was positively correlated with temperature and protein content increased at the highest temperature.

Piper and Boote (1999) summarised a large data set, in which the temperature effects on protein and oil content of soya beans were measured. Oil content increased along with increasing temperature, with an optimum at 25°C to 28°C above which the oil concentration declined. The protein concentration was either constant or only slightly increased with decreasing mean temperature below 28°C.

**Table 1:** Chemical composition of an individual sample of soya beans from five geographic locations, and of soya bean meals prepared from those produced in different regions but processed under uniform conditions in the United States (from Karr-Lilienthal *et al.*, 2004).

<table>
<thead>
<tr>
<th>Soya bean source</th>
<th>Argentina</th>
<th>Brazil</th>
<th>China</th>
<th>India</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DM (%)</strong></td>
<td>91,0</td>
<td>90,5</td>
<td>90,6</td>
<td>93,2</td>
<td>91,9</td>
</tr>
<tr>
<td><strong>Crude protein</strong></td>
<td>32,6</td>
<td>39,3</td>
<td>44,9</td>
<td>37,5</td>
<td>39,6</td>
</tr>
<tr>
<td><strong>Fat</strong></td>
<td>14,1</td>
<td>13,6</td>
<td>12,9</td>
<td>13,1</td>
<td>12,8</td>
</tr>
</tbody>
</table>

| Soya bean oilcake composition | | | | | |
|-------------------------------|---|---|---|---|
| **Crude protein**             | 47,4 | 57,0 | 58,5 | 54,6 | 57,8 | 53,2 |
| **Fat**                       | 4,4 | 4,4 | 4,6 | 5,6 | 2,9 | 4,1 |

*On a dry-matter basis.*
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At temperatures greater than 28°C, protein concentration increased linearly with temperature. In addition to temperature, shortening day length may enhance the protein concentration by increasing the rate of nitrogen translocation to the seed and seed growth rate.

Water as a contributing factor
Sionit and Kramer (1977) studied the effects of controlled water stress on yield, applied at various stages of development and on two varieties of soya bean. Plants stressed during flower induction and flowering produced fewer flowers, pods and seeds than controls, because of a shortened flowering period and abortion of some flowers.

Stress during early pod formation caused the greatest reduction in the number of pods and seeds at harvest. However, yield – as measured by seed weight – was reduced most by stress during early formation and pod filling. However, water stress did not materially affect the oil or protein content of the seeds at any stage of growth.

Drought stress
Seeds from plants exposed to 35°C during seed fill, contained 4% more protein and 2.6% less oil than those exposed to 29°C, when averaged across drought stress levels. Drought had little effect on the fatty acid composition of the oil, but high ambient temperatures reduced the proportion of the polyunsaturated components.

Genetic variation in seed protein content is considerable, thus plant geneticists have the potential to increase protein content by selection.

A meta-analysis of published data reported by Rotundo and Westgate (2009) showed that water stress reduces the content (mg per seed) of protein, oil and residual seed fractions. Protein accumulation, however, was less affected than oil and residual accumulation, resulting in an increase in final protein concentration (percentage dry weight). Growth at a high temperature also increased protein concentration in a manner similar to that observed with water stress. However, in neither case was the increase in protein concentration due to an increase in protein synthesis.

It is important to note that although the seed protein concentration increased during drought, the actual yield of protein was less. It is of key importance to the industry to maximise the yield of soya bean oil and protein per hectare, not necessarily the percentage of these components in the seed.

Agronomic practices
Delaying the planting date: The protein content of soya bean seeds can be increased by delaying the planting date. Helms et al. (1990) conducted a study to determine if the gross value per hectare was increased sufficiently – due to the increased protein content, resulting from a delay in sowing date – to offset the decreased oil content and seed yield economically. By delaying sowing by five weeks, the seed protein content increased from 34.1 to 34.9%, but the oil content and seed yield decreased from 18.9 to 17.9% and 2.95 to 2.17 tons/ha, respectively. The increased value due to a higher protein content did not compensate economically for the decreased oil content and yield from late sowing.

Plant density: Boroomandan et al. (2009) applied three levels of plant density (15, 30 and 45 plants/m²). Yield increased significantly (with 528 kg/ha) as density increased from 30 to 45 plants/m², but seed protein was unaffected.

Since factors such as longitude, altitude, environmental temperature (heat units) and rainfall play major roles in determining the quality of seeds produced, it is apparent that soya bean producers have only a limited capacity to influence the oil and protein contents of seeds. Nevertheless, seed inoculation prior to planting, the judicious application of N and micro-elements such as Mo and Mg, and the choice of variety and planting time are managed by the farmer. These factors can make a difference and contribute to the quality and yield of soya beans, as indicated above.

More information and references are available from Prof Gous at gous@ukzn.ac.za.
The Fourth Industrial Revolution and agriculture

By Dr WA Lombard, Department of Agricultural Economics, University of the Free State

There is no constant but change, said Heraclitus, a Greek philosopher who lived 2 500 years ago. We could justifiably argue that we live in a world where change is often dramatic, and where it happens at exponential speed. Prof Klaus Schwab, chairman of the World Economic Forum and author of The Fourth Industrial Revolution says the Fourth Industrial Revolution has started, and it will profoundly alter how we live, work and relate to one another.

The history of industrialisation

Birthed in England during the latter part of the 18th century, the First Industrial Revolution was largely driven by coal-fuelled steam power which made factory production possible, and by a technique of smelting iron ore with coke, which made cheap production of better quality iron and steel possible. England could supply the demand for military hardware, and later, build an extensive rail network. The First Industrial Revolution greatly accelerated urbanisation as people moved to the cities to work, and industry replaced agriculture.

The Second Industrial Revolution, between 1870 and 1914, was a time of rapid industrialisation, improving the technologies of the first using gas, oil and electric power. The motor car, the first aircraft and the telephone were among the new technologies, and economies of scale were seen.

Nuclear energy ushered in the Third Industrial Revolution after World War II. In the 1970s, the introduction of electronics and information technology allowed for automation in production processes, powerful telecommunication systems and computers.

The Fourth Industrial Revolution began with the age of the internet at the start of the new millennium and is based on cyber-physical production systems that integrate computation, networking and physical processes. Digitalisation means that we can manage the physical world from the virtual world. This brings changes to the industrial and agricultural sectors.

Growth and urbanisation

The predictions are that there will be striking changes in world population dynamics. Projected population growth is expected to be concentrated in Africa and South Asia. By mid-century, two thirds of the global population will be urbanised. Already, more people live in cities than in rural areas.

South Asia’s population is predicted to grow until mid-century, while the sub-Saharan population will continue to expand until the end of the century. Predictions show a world population of 11 billion people by 2100 – with nine billion of these people living in Asia and Africa.

More food, more feed, more fuel

To meet the demand for food, the global agriculture sector will have to produce 50% more food, feed and biofuel by 2050 than it did in 2012. According to a United Nations (UN) report, the greatest challenges will be in sub-Saharan Africa and South Asia, where

Figure 1: The first three industrial revolutions were initiated by available energy sources and changes in those sources. The Fourth Industrial Revolution is characterised by digitalisation.
an increase in production of roughly 112% is expected. The rest of the world must increase production by a little more than 34%.

On a positive note, judging by past performance, these demands can be met. Agricultural production more than tripled between 1960 and 2015, with part of this increase ascribed to productivity-enhancing green revolution technologies and expansion in the use of natural resources, such as land and water. In the future, rapid technological development and innovations may offer solutions to agriculture’s requirements.

An astonishing process of industrialisation and globalisation of the food and agriculture market has occurred. Everywhere, except perhaps in the deepest rural areas, there has been an increase in the distance from farm to fork. Food supply chains have lengthened, and there is an increase in the consumption of processed, packaged and prepared food.

However, this expansion in food production and economic growth comes at a high price. Almost half of the earth’s forests have been cut down, groundwater sources have been depleted and global biodiversity has been eroded. And despite the increase in productivity, hunger and malnutrition remain a reality in parts of the world. The current rate of progress will not be enough to eradicate hunger by 2050.

Innovation and trade

Mobile technology plays an important role in keeping farmers informed of the weather, input availability, market prices and connecting them to buyers. Current mobile phone subscribers represent almost 60% of people in low-income countries, and more than 90% of the additional users to be reached by 2020 will live in low- and middle-income countries.

The international trade of agricultural products has accelerated since the start of the new millennium. A reduction in trade occurred during the financial crisis, with slow recovery and slower growth experienced since the crisis.

Despite the relatively fast growth in the trade of agricultural products, most food consumed in countries is locally produced. South Africa, like many other African and South Asian countries, is a net importer of food. Our consumed food imports are in the category of 0 to 20%. Net exporting countries such as Argentina, Australia and the United States export more than 50% of their domestic food supply.

Pests and diseases

Although farmers are conditioned to deal with pests and diseases, food security is newly threatened by an alarming increase in the number of outbreaks of transboundary pests and diseases. On the local front, we had the fall armyworm outbreak of 2016 and the more recent outbreaks of avian influenza (bird flu) and foot-and-mouth disease.

Transboundary animal diseases cause high mortalities and disease rates. This continues to disrupt international and regional livestock markets and trade, posing a constant threat to the livelihoods of livestock farmers worldwide. Poorly regulated animal movement contributes to the spread of animal diseases, such as lumpy skin disease and foot-and-mouth disease.

The international community lacks the capacity and the coordination to prevent, control and eradicate emerging transboundary animal diseases. A UN report states that the successful control of transboundary pests and diseases will reduce yield losses in crops and pastures and improve productivity.

Apart from the food security problem, transboundary diseases have economic, social and environmental impacts. The upsurge in zoonotic diseases, such as avian influenza, could have serious repercussions on human health.

Food losses and waste

On the one side of the value chain, there is an expected increase in future production, while on the other side losses (consumption) should also be reduced. Roughly a third of all food produced is lost or wasted in the food chain between production and consumption. The loss of food is seen as an accidental occurrence due to inadequate technology or a lack of knowledge and skills. Food wastage is characterised by an element of intended or unintended behaviour, such as the removal of food by choice.

Food waste is mostly associated with final consumption, but the deliberate discharge of food can occur in any link in the supply chain. Annually, 1,3 billion tons of edible food originally intended for human consumption, is lost or wasted.

In low-income countries, significant levels of food loss occur upstream during harvest and post-harvest handling due to a lack of investment in production. In sub-Saharan Africa, data shows that a little more than 35% of produced food intended for human consumption is lost or wasted along the supply chain. The biggest losses in these countries occur during harvesting (12,5%) and post-harvest handling (12,7%). In comparison, European countries show greater efficiency in the earlier stages of the value chain with the greatest losses occurring in the final stage (consumption loss of 12,6%).

Reducing food losses may require greater use of energy to preserve food products. How this energy is produced and delivered to the points along the value chain will impact the environment and local economy.

A decrease in food waste requires change in consumer behaviour. Policies need to create conditions that will enable individuals along the food supply chain to achieve socially optimal levels of food loss and wastage.

What agriculture can expect

From an agricultural perspective, we can expect an increase in the use of labour-saving technologies and practices that focus on intensive production systems.

Resource conservation and sustainable farming practices will continue to receive attention. Aquaponics and hydroponic farms may become more popular in South African agriculture and producers will require training and financial assistance to access these intensive farming systems.

The world has become a ‘global village’ with easy access to markets. We may see producers starting to move away from these easy trading practices and isolate their farms so that they are better protected against biosecurity risks in the future. One could also argue for better protection of local producers, such as the poultry and sugar sectors, against world markets. 🌍

For more information, email the author at LombardWA@ufs.ac.za.
To ensure the sustainability and profitability of your business, labour risk needs to be managed proactively.

An employee can refer a dispute to the CCMA on account of dismissal, wages, working conditions, unfair labour practices, workplace changes and discrimination. Most cases referred to the CCMA pertain to unfair dismissal. In general, arbitration awards in favour of the employee due to incorrect procedures followed by the employer.

**Staying out of deep water**

The following top tips can be used proactively to ensure that the consequences of a CCMA case do not mean the end of your business:

- Have clear rules and guidelines in the workplace and ensure that every employee is aware of these rules.
- Employers must have an up-to-date disciplinary code that lists offences, along with the appropriate sanctions to use when rules and procedures are not followed.
- Apply progressive discipline according to the seriousness of the offence and keep a detailed record of the procedure.
- The accused employee was given every chance to prepare for and defend his/her case.
- Aggravating and mitigating circumstances were taken into account.
- The outcome of the dismissal was based on the facts presented during the hearing.
- The sanction was appropriate according to the offence.
- The hearing and outcome were recorded in writing by the chairperson.
- The employee received the outcome in writing.

Labour risk is a serious business risk. To ensure the sustainability and profitability of your business, labour risk must be managed proactively. If the correct procedures are not followed, it can lead to dire consequences with a huge financial impact.

The LWO Employers’ Organisation assists employers to comply with labour law, and to use it to their advantage to protect their business. As a registered employers’ organisation with the Department of Labour, the LWO has the right to represent members at the CCMA. Contact the LWO on 086 110 1828 or ansofielwo.co.za.

Christo Bester is the legal services manager at the LWO Employers Organisation. Christo has a BProc and LLM (Mercantile Law) degree and is an admitted attorney of the High Court. He has extensive experience in various aspects of practising law in the business environment.
As globalisation has greatly widened the lens through which we view human activities, the critical role of agriculture in this larger tableau – and of the farmer in particular – has expanded as well. All of the seemingly intractable global challenges we face – exploding population growth, hunger, poor nutrition, lack of food security and safety, a growing middle class, and changing diets – are falling heavily on the world’s farmers.

By 2050, the earth’s population will reach almost ten billion people and their appetite for quality, nutritious food will grow even quicker. Yet the amount of arable land will decline by almost 10% as the quality of soil degrades and the forces of urbanisation push ever outward. A changing climate adds further stress.

So, it is a good thing they are not alone in facing these challenges. Think of the farmer as the hub of our global food development and supply chain ecosystem and the input suppliers, food companies, regulators, advocates and consumers as the spokes. Every single one of these players has a stake in making sure there’s enough safe food for people around the world and, thus, in increasing both yield and farm sustainability. This makes them natural collaborators with farmers in the effort to address the changes and improvements needed to satisfy the increasing global demand for food.

Sizing up the challenge
The numbers make the enormity of the task at hand all too clear. By 2050, global population will grow by one-third, to almost ten billion; caloric intake will rise even faster because of improved standards of living around the world. The result is that farm output will have to increase by about 70% to satisfy food demand.

Part of the increase in demand will be a direct outcome of increasing urbanisation, which is likely to add around 2.5 billion new city dwellers around the world by 2050. Larger cities mean improvements in commercial infrastructure, which, in turn, generates more jobs, with higher pay. And as incomes rise, people favour more expensive foods – especially meat. Annual per capita meat consumption is projected to reach 45.3kg per person in 2030, up from 36.4kg in 1997 to 1999.

With that, the need for livestock feed will skyrocket, ratcheting up pressure on farm yields since cattle, chicken and pigs typically consume about 70% of the grain grown in the United States (US) and 75% of soya bean crops globally in any given year.

Cause for concern
In many ways, this could not have come at a worse time. Farm yields are growing but not nearly at the pace they need to. Currently, output of four key staples – corn, rice, wheat and soya beans – is increasing at rates of only about 0.9 to 1.6% a year. This translates into overall yield gains for each crop of about 38 to 67% by 2050.

Those of us with a stake in the future of agriculture are well aware that we have reached a crossroads, an inflection point, in our efforts to meet the challenges of feeding an ever-hungrier world. Can we increase agricultural yield and food security while farming sustainably? Can technology help meet the demands of consumers around the world for high-quality, safer food? Can we improve the economic conditions of farmers and farm workers?

Challenges can be overcome
We believe strongly that the answer to all these questions is yes. But addressing and overcoming these challenges will require that everyone with a stake in solving these problems – farmers, agricultural companies, food manufacturers, governments, non-governmental organisations, and everyday people – learn to work together to bring about the progress in farming practices, policies and technologies that the world so desperately needs.

Agriculture is at a crossroads and we hope to contribute to the dialogue about these critical issues. Our goal is to provide an open, informative, balanced view of both the challenges facing the global agricultural industry and the many ways they are being met. Success in feeding the world will require the willing, informed partnership of everyone involved in this mission.

For us, the term ‘crossroads’ is not just about the challenges we face. It is about providing room for the intersection of all the players in the industry of agriculture.
The Department of Trade and Industry (dti), Switzerland through the Swiss State Secretariat for Economic Affairs (SECO), the United Nations Industrial Development Organization (UNIDO), and the South African Essential Oils Producers’ Association (SAEOPA) recently hosted the first South African conference on essential and vegetable oils to facilitate quality exports.

The conference falls within the framework of the UNIDO-SECO Global Quality and Standards Programme country project in South Africa (GQSP-SA), which aims to improve the quality of South African essential and vegetable oil products by addressing quality and standards compliance capacity challenges.

Experts weigh in
The conference theme, ‘Industry milestones, sharing successes and demystifying market requirements’, was deliberated by renowned oil and quality infrastructure experts from South Africa, Australia, Europe and Turkey.

The event brought together more than 150 oil producers from all over South Africa and Southern Africa, and armed them with information pertaining to current burning issues, particularly successful entry into the global marketplace.

Demand for quality on the rise
The demand for both essential oils and vegetable oils is escalating worldwide, which creates an opportunity for South Africa, with its diversity of climate and soil types, to excel and prove itself a worthy contender in exporting both essential and vegetable oils for world consumption.

“The growth in this sector will stimulate increased production of vegetable and essential oils, improved packaging, knowledge of regulatory requirements and internationally recognised testing facilities, understanding of market and export requirements, better pricing and distribution. But in order to compete, this industry must become quality-driven,” says Claudy Steyn, chief director: chemicals, cosmetics, plastics and pharmaceuticals at the dti.

Mobilising the sector’s potential
According to Nonhlanhla Halimana, programme manager at SECO, the conference represented the commitment from the industry and the South African government to join forces to mobilise the potential of the sector.

The event was structured to answer the most daunting questions that small and medium-sized enterprises (SMEs) may have when trying to access markets and provide realistic solutions and success stories.

“We believe in guiding, coaching and mentoring SMEs to embed quality at each stage of the value chain. This is the most practical approach and will allow SMEs considering export to produce quality products, which will build the international image of South African oil products,” says Elsie Meintjies, UNIDO’s chief technical advisor.

A unique opportunity
SAEOPA expressed its gratitude to the GQSP-SA for its support in organising this standard-setting conference and building the association’s capacity to conduct future events for its members and the industry.

“The conference provided a unique opportunity for Southern African oil producers to learn from those who have already succeeded in accessing international markets. It also highlighted the value of quality and the technical infrastructure available in South Africa,” says Karen Swanepoel of SAEOPA.

The public-private dialogue facilitated by the conference will assist in the utilisation of available public services and the development of demand-driven services required by the private sector, ensuring the sustainable and efficient use of the available capacity.

“This will be an important platform in the future to sustainably integrate SMEs into global markets and, moreover, for the achievement of the 2030 Development Agenda,” says Juan Pablo Davila, industrial development officer at UNIDO.

For more information, contact Wim du Toit at secsaeopa@gmail.com.
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