Vol 4 No 2 • June 2018
ISSN 2410-1206

OILSEEDS focus

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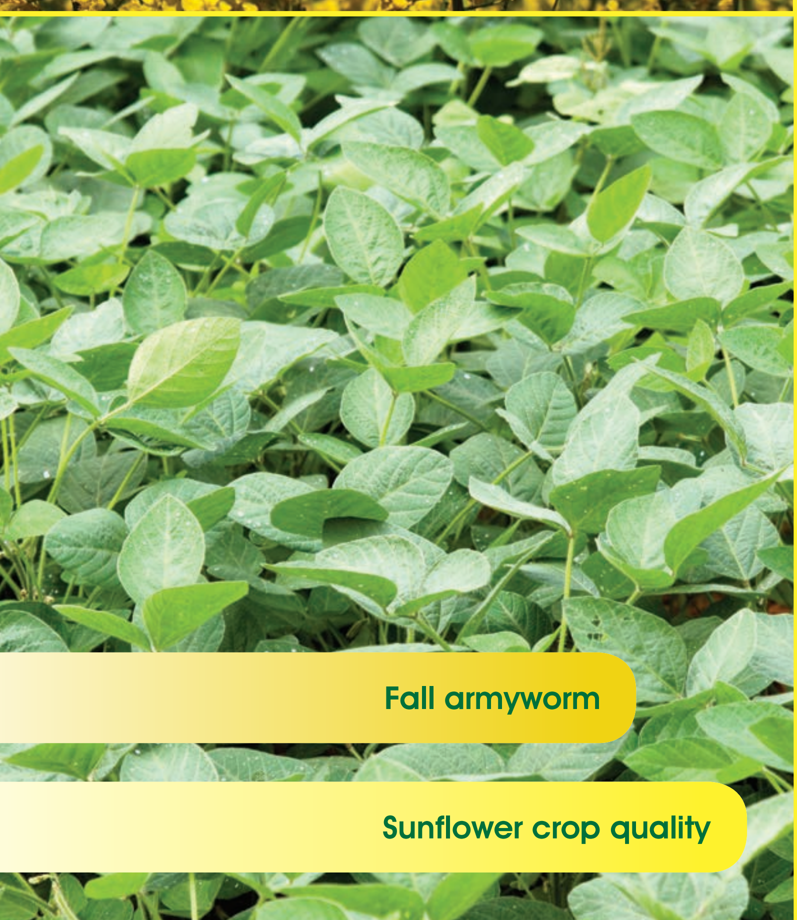

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Transformation through the Grain Farmer Development Association

By Ishmael Tshiame, general manager, GFADA

The Grain Farmer Development Association (GFADA) is an initiative that grew out of the Grain Value Chain Network. It was initially an informal network of grain producers and agribusinesses in the extended value chain, which have met since 2005 to create an opportunity for round table discussions on the agricultural sector in an era of transformation.

During 2015, representatives of the Maize Trust, Sorghum Trust, Winter Cereal Trust, and the Oil and Protein Seeds Development Trust discussed the transformation imperatives and experiences within their respective industries. They resolved to work together to avoid duplication of effort and to work towards the optimisation of the existing resources.

It was recognised that to achieve the organisation's objectives, a more concerted effort was required to address the recruitment of donors and administer the applications and the funding of the various farmer development projects. This approach could ensure that the trusts become important catalysts for transformation in the country.

Strategic intent

Accordingly, as of 2016 the sole owners of GFADA are the Maize Trust, Sorghum Trust, Oil and Protein Seeds Development Trust, and Winter Cereal Trust. These trusts are the voting members of GFADA and are represented on the board of GFADA by two directors and one alternative director from each trust.

GFADA's vision is to establish "successful, competitive, black grain and oilseeds commercial farmers". The mission of GFADA is "to coordinate, facilitate, monitor, evaluate, advise and support the commercialisation of black grain and oilseeds farmers in South Africa".

Farmer support and development

Black smallholder farmers are the core target group for GFADA. The association works with service providers along the grain and oilseeds related value chains that provide implementation capacity, with the objective to seek opportunities that will add value to the growth and development of black farmers.

GFADA uses its experience in the field to engage with government and contribute to the creation of an enabling policy and regulatory framework for the attainment of its vision. While the four trusts provide the base funding for the organisation, GFADA seeks to leverage additional funding support for the transformation projects from government at all levels, as well as the related private sector entities.

As a result, engagement with the Eastern Cape Department of Rural Development and Agrarian Reform led to the association receiving additional funding, amounting to R8 064 million, to support farmers in the Matatiele area for the 2017/18 season.


Ishmael Tshiame.

Support in the 2017/18 season

The Oil and Protein Seeds Development Trust and Oilseeds Advisory Committee approved the total funding amounting to R728 800 and R657 500 for sunflower and soya bean, respectively, for farmers supported through GFADA in respect of the 2017/18 season.

The funding is for crop insurance, soil correction and mentorship. Total area planted by all approved farmers for soya bean and sunflower is 797ha and 1 917ha, respectively. It is worth noting that the membership of the Oil and Protein Seeds Development Trust in GFADA will accelerate the commercialisation of black farmers due to the benefits of crop rotation.

Global trends in the oilseeds environment

Global oilseed production for 2018/19 is projected at 593,7 million tons, of which 354,5 million tons are from soya beans. Argentina's recovery from the drought is expected to increase their production by 17 million tons to 56 million tons. Production of soya beans in Brazil is expected to remain flat at a level of 117 million tons.

According to the World Agricultural Supply and Demand Estimates (WASDE), protein meal consumption is expected to increase by 4% in 2018/19, while China is expected to import a record 103 million tons of soya beans. Global stocks are expected to decline marginally from last year, to 86,7 million tons.

Oilseed production in SADC

We should take note of the increasing oilseed production in the region as well as interest in increasing this production.

SADC countries currently produce an estimated total of 450 000 tons of soya beans, which is increasing each year. The progress that is likely to occur in countries such as Zimbabwe and Angola regarding oilseed production is important to note. The loss of export markets for pulses to India from many SADC countries should also encourage oilseed production.

We remain firmly of the opinion that we can replace imported oilseed meals, which are mainly from Argentina, with South African production. Major investment in the country's crushing capacity, predominantly in soya bean crushing but also sunflower capacity, allows a total estimated crushing capacity of 2,5 million tons, and a demand for 2 million tons of soya meal (including full fat soya) and 870 000 tons of sunflower meal.

Oilseed demand in South Africa

Total soya bean and sunflower seed demand in a self-sufficient scenario is 2,63 million tons. With a combined sunflower and soya bean production of only 2,2 million tons, we have a long way to go to become self-sufficient.

Canola production has kept up well with the growth in demand and is expected to continue to play an important role in the supply of oil and protein in the Western Cape.

The approximately 70 000 tons of soya bean meal imports from Zambia, at below our cost of production, and the slow pace of some feed companies to make the transition from imported to local soya bean meal, have resulted in this self-sufficiency taking longer than anticipated. It has also led to increased frustration for soya bean producers.

With ongoing broiler trials showing that a high percentage of local soya bean meal to produce broiler results are as good as, if not better than, imported soya bean meal, plus significant discounts in price, this transition will logically take place soon.

Dr Erhard Briedenhann

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

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

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NEWS

Brazil to set ninth straight planting record

Brazil's farmers are expected to break the country's soya bean planting record for the ninth year in a row.

Planting for the 2018/19 season is forecast to increase by 2% to 35,8 million hectares, according to the Global Agricultural Information Network (GAIN) report issued in April. From this area, soya bean output is expected to top 115 million tons – the second largest crop for the country on record.

The expansion of plantings is attributed to two drivers: higher demand from China, and higher consumption in Brazil's domestic market. The country's domestic crush is forecast to be 44 million tons for 2018/19; a reflection of Brazil's ongoing economic recovery. Meanwhile, Brazil's soya bean exports are expected to be 67 million tons. – *Oilseed and Grain News*

Ukraine soya bean oil exports reach record high

The Ukraine's soya bean oil exports reached a record high in 2017/18 with 104 200 tons, up 3,3% from the previous year (100 900 tons).

Ukrainian soya bean oil exports totalled 19 600 tons in March 2018. This is as much as in the previous month but down 17,3% from March 2017, when export supplies from the Ukraine hit an all-time high of 23 700 tons.

As before, this season's top importers of Ukrainian soya bean oil include the EU (42% of total exports), China (23%) and India (11%). At the same time, China boosted purchases by almost 83% and thereby outpaced India, which, in turn, reduced its trading activity in the market by 61%.

The diversification of end markets for Ukrainian soya bean oil continues this season. Countries such as Kuwait, the Virgin Islands and Singapore have joined the ranks of importers. In March, Denmark and the Republic of Korea started purchases too. – *UkrAgroConsult*

More US soya beans headed to Argentina

Argentina, the world's third biggest soya producer, booked its largest purchase of US soya beans in 20 years after drought cut its harvest, forcing crushers to turn to imports.

The US Department of Agriculture (USDA) reported that 120 000 tons of US soya beans were sold to Argentina for delivery during the 2018/19 marketing season, which begins on 1 September. This transaction marks US soya beans' largest sale to Argentina since 1997.

"We are seeing a very rapid realignment in soya bean trading," said analyst John Baize, president of John C Baize and Associates.

Baize said Argentina could import 500 000 to 1 million tons of US soya beans this year.

Bulk imports of US soya beans are rare, although Argentina typically brings in some soya beans from neighbouring Paraguay. Argentina will need soya beans by October, a time when crushers in the South American country usually lack sufficient domestic supplies, and crushers want to ensure they have enough after this year's drought.
– *USSOY.ORG*

Stakes keep rising in US-China trade dispute

Trade relations between the US and China remain tense and continue to escalate. Chinese buyers have not agreed to any new purchases of US soya beans. Cargoes of 3 million tons of US soya beans worth $1,3 billion, for which deals have already been set, have not left US ports.

China has also imposed new exorbitant tariffs on US sorghum, leading to multiple ships carrying US shipments en route to China to change course.

Chinese imports of US soya beans for March fell 27% compared to February, as buyers turned to Brazil, Canada and Argentina for supplies. This rising demand for Brazilian beans has led to the widest spread between US and Brazilian soya bean prices in years, with Brazilian beans being quoted at $467 per ton, including cost and freight, compared to $435 per ton for US beans.
– *Oilseed and Grain News*

Drought reducing soya bean output in Uruguay

Due to the recent devastating drought, soya bean production in Uruguay is forecast to drop to 1,7 million tons in 2017/18, according to a Global Agricultural Information Network (GAIN) report from the US Department of Agriculture. This is a drop of 43% compared to the USDA's original estimate of 3 million tons.

"Overall, producers will suffer noteworthy losses due to lower yields," the USDA said. "Land-owning producers may break even or achieve minimal returns without the additional rent expense, but based on information from local contacts, producers on rented areas may lose at least $205 per hectare."

Soya bean crush for 2017/18 is revised down to 60 000 tons – a 20% decline from the previous crop year – due to lower soya bean supplies.

The USDA forecasts a recovery for both soya bean production and crush in 2018/19. It predicts output of 3 million tons and crush at 80 000 tons, which is a return to pre-drought levels. – *World Grain*

Canadian canola trade moves to US exchange

The business of trading and clearing canola futures is poised to leave Winnipeg, Canada, for New York City, United States. Intercontinental Exchange (ICE), the operator of canola exchange ICE Futures Canada, announced it will be transitioning the trading and clearing of canola contracts to New York-based ICE Futures US and ICE Clear US.

ICE expects the shift to take place on 29 July, pending regulatory approvals. It said many aspects of canola trading will remain unchanged, including contract specifications for futures, options and calendar spread options.

ICE has owned the Winnipeg-based, all-electronic canola trading operation, formerly known as the Winnipeg Commodity Exchange, since 2007.

Moving canola to ICE's New York exchange and clearing house is expected to provide "deeper liquidity, reduced administrative costs and a more diversified risk management pool," the company said in a notice to participants.

Canola traders, the company said, will "continue to benefit from ICE's deep commitment to these markets and the same level of hands-on expertise." – *AGCanada.com*

Canada bets big on canola amid China-US spat

As China plans for tariffs against US soya beans, Canada's farmers are gearing up to exploit an opening for demand by doubling down on oilseeds.

Growers will probably swap out lentils, peas and cereal crops in favour of canola amid higher prices and the US-China tensions, said David Reimann, a market analyst at Cargill Ltd. Plantings could reach 9,7 million hectares in 2018, the most ever and up 4,4% from a year earlier, according to Tony Tryhuk, branch manager of RBC Dominion Securities in Winnipeg, Manitoba. The crop can be used as a soya bean substitute in cooking oil and animal feed.

"If anything, the China issue encourages more canola," Reimann said, noting that potential tariffs will probably also boost soya bean acres. "It could certainly up canola demand a little bit." The Asian country's purchases of Canadian oilseed shipments could climb by several hundred thousand tons, he estimates. – *Bloomberg*

Events

July 2018

31 – 3 Aug	7th ExtruAfrica, Potchefstroom, South Africa

August 2018

22 – 23	2018 Agri Limpopo Congress, Weesgerus Resort, Modimolle, South Africa
30 – 31	2nd Agri-Biz Import and Export Conference, Gallagher Estate, Midrand, Gauteng, South Africa

September 2018

12 – 15	Nampo Cape, Mega Park, Bredasdorp, South Africa
18 – 20	ALFA Expo, Afridome, Parys, South Africa
20 – 21	AGRI 5 Commodities Workshop and Expo, East London Showgrounds, East London, South Africa
25 – 27	56th Annual Conference of the Agricultural Economics Association of South Africa (AEASA), Lord Charles Hotel, Somerset West, South Africa

Spotlight on soya bean market

In May, the areas that had harvested soya beans received good yields, which supports the National Crop Estimates Committee's production forecasts of a record 1,4 million tons in the 2017/18 production season.

This optimism in soya bean production is not limited to South Africa. Several countries, such as the US, Brazil, China and Canada are in good shape, with the 2017/18 harvest estimated at 119,5 million, 116 million, 14,3 million and 7,7 million tons, respectively, according to data from the International Grains Council (IGC).

The IGC forecasts a 5% year-on-year uptick in 2018/19 global soya bean production to 355 million tons. This is underscored by prospects of a recovery in production by Argentina, Uruguay and India, which in turn is supported by expectations of favourable weather conditions and an expansion in area plantings. Moreover, Brazil's harvest is set to increase further by 3% from the 2017/18 production season to 119 million tons. – *Wandile Sihlobo, Agbiz*

Soya bean SDS in South Africa

caused by *Fusarium brasiliense* and a novel, undescribed *Fusarium* sp.

By Yared T Tewoldemedhin and Sandra C Lamprecht, ARC – Plant Protection Research Institute; and Martha M Vaughan, Gail Doehring and Kerry O'Donnell

Soya bean sudden death syndrome (SDS) was detected in South Africa for the first time during pathogen surveys conducted in 2013 to 2014. The primary objective of this study was to characterise the 16 slow-growing *Fusarium* strains that were isolated from the roots of symptomatic plants.

Molecular phylogenetic analyses of a portion of translation elongation factor 1-a (TEF1) and the nuclear ribosomal intergenic spacer region (IGS rDNA) indicated that the etiological agents were *Fusarium brasiliense* and a novel, undescribed *Fusarium* sp.

This is the first report of *F. brasiliense* outside of Brazil and Argentina and the novel *Fusarium* sp. causing soya bean SDS. Koch's postulates were completed for both fusaria on seven soya bean cultivars that are commercially available in South Africa.

Results of the pathogenicity experiment revealed that the strains of *F. brasiliense* and *Fusarium* sp. differed in aggressiveness to soya bean, as reflected in differences in foliar symptoms, root rot, and reduction in shoot length.

Cell-free culture filtrates of the two soya bean SDS pathogens from South Africa and two positive control strains of *F. virguliforme* from the United States induced typical SDS symptoms on susceptible soya bean cultivars in a whole-seedling assay, indicating that they contained phytotoxins.

SDS in soya bean. (Photograph: www.mississippi-crops.com)

Occurrence of SDS

Sudden death syndrome (SDS) of soya bean (Glycine max (L.) Merr.) is widespread in North and South America, where it has caused significant losses in yield (Hartman *et al.*, 1995; Rupe and Hartman, 1999). For a period of ten years (1996 to 2005), SDS was listed as one of the most important plant diseases in the United States (Wrather and Koenning, 2006; Wrather *et al.*, 2001).

The causal organism was initially reported as *Fusarium solani f.* sp. *Glycines*. However, molecular and morphological studies have identified four *Fusarium* spp. that cause soya bean SDS (Aoki *et al.*, 2003, 2005, 2012): *Fusarium virguliforme*, O'Donnell and T Aoki; *F. brasiliense*, T Aoki and O'Donnell; *F. crassistipitatum*, Scandiani, T Aoki and O'Donnell; and *F. tucumaniae*, T Aoki, O'Donnell, Yosh Homma and Lattanzi.

All four species are responsible for outbreaks of soya bean SDS in South America. However, only *F. virguliforme* has been shown to cause SDS in North America (Mbofung *et al.*, 2012; O'Donnell *et al.*, 2010; Wang and Chilvers, 2016).

The causal pathogens have been isolated most frequently from diseased roots and less frequently from lower stems, but never from the leaves (Rupe, 1989). Foliar symptoms, which include interveinal chlorosis and necrosis and, initially, chlorotic spots and leaf curling and wilting without root infection, appear to be caused by fungal toxins that are translocated to the leaves where chloroplasts are targeted (Brar and Bhattacharyya, 2012; Hartman *et al*., 2004; Jin *et al*., 1996; Li *et al*., 1999).

Severity varies among years

Root colonisation and expression of foliar symptoms are affected by environmental (Scherm and Yang, 1996), physical (Scherm *et al*., 1998), chemical (Rupe *et al*., 1993), and biological factors (McLean and Lawrence, 1995; Melgar *et al*., 1994).

Severity of SDS varies among years, which suggests that variation in environmental conditions such as soil moisture and temperature affect disease development (Wrather *et al*., 1995). Reports indicate that high levels of soil moisture and low soil temperatures, especially in early reproductive stages of the soya bean, increase SDS severity (Hirrel, 1987).

Soil compaction that inhibits soil profile drainage and increases duration of soil saturation can also increase SDS due to its relationship with soil moisture (Rupe *et al*., 1993; Scherm *et al*., 1998). In addition, several studies have reported variation in aggressiveness of *F. virguliforme* isolates on soya bean, based on severity of foliar symptoms and root rot (Gray and Achenbach, 1996; Li *et al*., 2009; Rupe *et al*., 2001).

Soya bean is an important oilseed crop in South Africa, where approximately 1 million tons were produced on 687 300ha during the 2014/15 growth season (Dredge, 2015). When soya bean SDS was first discovered in South Africa in 2013, it was reported as *F. virguliforme*, based on BLASTn searches of the National Center for Biotechnology Information's GenBank, using portions of translation elongation factor 1-a gene (TEF1) and the nuclear ribosomal internal transcribed spacer region (ITS rDNA) as the queries (Tewoldemedhin *et al*., 2014).

Outbreaks in South Africa

During the initial outbreak, leaf lesions typical of SDS were first observed in February 2013 on a farm in Lydenburg, Mpumalanga, planted with soya bean (PAN 737) for a second consecutive season. Symptoms developed at the R6 growth stage near physiological maturity of the soya bean plants. Leaves exhibited interveinal chlorotic blotches that became necrotic, while the veins remained green.

These symptoms appeared throughout the plant but were most severe on the top leaves. Vascular tissue in the upper taproot and lower stem turned grey-brown and lateral roots exhibited decay, but the pith remained white.

Additional soya bean SDS isolates were recovered during 2014 field surveys in the Free State and North West (*Table 1*). Given this background, the primary objectives of the present study were to:

- Identify the etiological agents employing molecular phylogenetics.
- Complete Koch's postulates on soya bean cultivars that are commercially available in South Africa.
- Assess whether the SDS isolates differed in aggressiveness to soya bean.
- Determine whether culture filtrates of the isolates could induce typical SDS symptoms on susceptible and moderately resistant cultivars in a feeding assay using intact seedlings (Brar and Bhattacharyya, 2012; Swaminathan *et al*., 2016).

Table 1: Isolates recovered from soya bean roots symptomatic for SDS in three South African provinces.

Isolate	PPRI[a]	KOD[b]	Isolation date	Species[c]	Area, province
S1	PPRI13434	1163	February 2013	*F. brasiliense*	Lydenburg, Mpumalanga
S2	PPRI13435	1164	February 2013	*F. brasiliense*	Lydenburg, Mpumalanga
S3	PPRI13436	1165	February 2013	*F. brasiliense*	Lydenburg, Mpumalanga
S4	PPRI13437	1166	February 2013	*F. brasiliense*	Lydenburg, Mpumalanga
S5	PPRI13438	1167	February 2013	*Fusarium sp.*	Lydenburg, Mpumalanga
S6	PPRI13439	1168	February 2013	*Fusarium sp.*	Lydenburg, Mpumalanga
S7	PPRI13440	1169	February 2013	*F. brasiliense*	Lydenburg, Mpumalanga
S8	PPRI13441	1170	February 2013	*F. brasiliense*	Lydenburg, Mpumalanga
S9	PPRI20927	1171	February 2014	*Fusarium sp.*	Bethlehem, Free State
S10	PPRI20926	1172	February 2014	*Fusarium sp.*	Bethlehem, Free State
S11	PPRI20925	1173	February 2014	*Fusarium sp.*	Bethlehem, Free State
S12	PPRI20924	1174	February 2014	*Fusarium sp.*	Bethlehem, Free State
S13	PPRI20923	1175	February 2014	*Fusarium sp.*	Bethlehem, Free State
S14	PPRI20922	1176	February 2014	*F. brasiliense*	Bethlehem, Free State
S15	PPRI20921	1177	February 2014	*F. brasiliense*	Potchefstroom, North West
S16	PPRI20920	1178	February 2014	*F. brasiliense*	Bethlehem, Free State

[a] *Plant Protection Research Institute (Agricultural Research Council) culture collection number.*

[b] *KOD = accession number in O'Donnell lab, United States Department of Agriculture – Agricultural Research Service, Peoria, IL.*

[c] *F. brasiliense and Fusarium sp. were both strongly supported as genealogically exclusive species-level lineages in the translation elongation factor 1-a + nuclear ribosomal intergenic spacer region phylogeny.*

A molecular phylogenetic analysis indicates that *F. brasiliense* and a novel, undescribed soya bean SDS pathogen, reported here as *Fusarium* sp., were recovered in two and three of the South African provinces surveyed, respectively. Although *F. brasiliense* isolate S15 was the only SDS pathogen recovered in Potchefstroom in North West, *F. brasiliense* (S14 and S16) and *Fusarium* sp. (S9, S10, S11, S12, and S13) were isolated from symptomatic plants collected at Bethlehem in the Free State.

Revealed by genotyping

Multilocus genotyping also revealed that six of the eight isolates previously reported as *F. virguliforme* from the Lydenburg area in Mpumalanga were *F. brasiliense* (PPRI13434, PPRI13435, PPRI13436, PPRI13437, PPRI13440, and PPRI13441) and two were the putatively novel soya bean SDS pathogen *Fusarium* sp. (PPRI13438 and PPRI13439) (Tewoldemedhin *et al*., 2014).

Prior to the present study, *F. brasiliense* was only known from soya bean symptomatic for SDS in Brazil and Argentina (Aoki *et al*., 2005; O'Donnell *et al*., 2010), whereas the *Fusarium* sp. was represented by only a single isolate recovered from *Phaseolus* *vulgaris* in California and deposited in the ARS culture collection as *F. solani* f. sp. *phaseoli* (NRRL 22411 = BBA 64394 = CBS 265.50 = ATCC 38466).

Without the benefit of multiple isolates of *Fusarium* sp., which allowed us to determine that it and *F. phaseoli* are reciprocally monophyletic sisters, NRRL 22411 was erroneously reported as *F. phaseoli* in a single nucleotide polymorphism-based multilocus genotyping assay for SDS-BRR pathogen determination (O'Donnell *et al*., 2010).

Infested soya bean

The present study has extended our knowledge of the host range and geographic distribution of the *Fusarium* sp. represented by NRRL 22411 via the discovery that it causes soya bean SDS in South Africa. It remains to be determined whether this pathogen can cause BRR, as previously thought, given the host from which NRRL 22411 was originally isolated (O'Donnell *et al*., 2010).

However, with the completion of Koch's postulates, it represents the fifth species within the SDS-BRR clade of *Fusarium* that can cause soya bean SDS. Given our working hypothesis that the SDS-BRR fusaria likely evolved in South America (Aoki *et al*., 2003; O'Donnell, 2000), we speculate that *F. brasiliense* and *Fusarium* sp. were introduced into South Africa recently on infested soya bean, presumably from South America.

Currently, it is unknown what New World hosts the soya bean SDS pathogens evolved on. However, it was clearly not soya bean, because this Asian host has only been cultivated in South America for the past century (Simpson and Conner-Ogorzaly, 2001).

Results of the PCR assay for MAT idiomorph show that, in contrast to Brazil, where MAT1-1 and MAT1-2 strains of *F. brasiliense* are present (Hughes *et al*., 2014), only MAT1-1 strains were detected in South Africa. Similarly, only the MAT1-1 idiomorph of *Fusarium* sp. was detected in the eight isolates of this SDS pathogen in South Africa.

The latter finding is noteworthy because the only other strain of this species, NRRL 22411 *Fusarium* sp. from *P. vulgaris* in California, possesses a MAT1-2 idiomorph (Hughes *et al*., 2014). Taken together, these results suggest that both species might possess a heterothallic sexual reproductive mode.

Level of aggressiveness

Additional pathogen surveys are needed to determine whether both idiomorphs of *F. brasiliense* and *Fusarium* sp. are present in South Africa, because pathogens that reproduce sexually are more likely to overcome host resistance than those that only reproduce clonally (Covert *et al*., 2007; McDonald and Linde, 2002).

The South African isolates of *F. brasiliense* and *Fusarium* sp. generally caused high levels of foliar symptoms and root rot, and reduced shoot height. The level of aggressiveness of the two species was generally equal in almost all the cultivars evaluated. However, in a few instances, *Fusarium* sp. was more aggressive than *F. brasiliense* based on the evaluated measurements.

Variability in aggressiveness was observed for isolates from both species. For instance, even though *F. brasiliense* isolate S2 caused root rot on all cultivars, it failed to induce foliar symptoms on the cultivars evaluated, except on PAN1454R, and it was only on this cultivar that it reduced shoot height. In addition, *Fusarium* sp. isolate S5 caused root rot on all cultivars but did not induce foliar symptoms on three cultivars.

Interestingly, this isolate reduced shoot growth without exhibiting any foliar symptoms on LS6161R and DM6.2iRR. Foliar symptoms in SDS were proposed to be caused by radicicol and proteinaceous fungal toxins produced on or in colonised roots and translocated to the leaves (Hartman *et al*., 2004; Jin *et al*., 1996). Li *et al*. (1999) showed that SDS-like foliar symptoms developed when cell-free culture filtrates containing one or more toxins were fed to cut soya bean seedlings.

Foliar symptoms such as these chlorotic spots and leaf curling and wilting appear to be caused by fungal toxins that are translocated to the leaves where chloroplasts are targeted. (Photograph: www.knowmoregrowmore.com)

Poor root colonising

Recently, Pudake *et al*. (2013) and Chang *et al*. (2016) reported that the FvTox1 and FvNIS1 phytotoxins, respectively, are major virulence factors involved in foliar SDS development in soya bean. Consequently, it is possible that certain fungal isolates are effective in colonising the host root but may not be good toxin producers and, conversely, some isolates may be relatively poor root colonisers but may or may not be good toxin producers.

In our study, the poor root colonising isolates generally caused less severe foliar symptoms and did not reduce shoot growth significantly. However, there were a few instances where the poor root colonisers that induced less severe or no foliar symptoms also reduced shoot growth.

This phenomenon was also reported by Li *et al*. (2009). Most of the cultivars evaluated in the present study showed more or less consistent reaction to the isolates. In general, cultivars with high root rot severity also exhibited extensive foliar symptoms and stunted shoot growth.

There were few cases where cultivars reacted differently to a specific isolate or isolates. *F. brasiliense* isolate S14 caused high root rot severity, extensive foliar symptoms, and stunted shoot growth on all cultivars. However, the severity rating for foliar symptoms induced by this isolate on LS6161R was the lowest in comparison with the other cultivars evaluated.

Extensive foliar symptoms

This may be due to the root rot severity on this cultivar that was relatively the lowest and shoot growth the highest compared with other cultivars infested with the same isolate. It is worth mentioning that some of the other *F. brasiliense* isolates

(S3, S4, S7, S8, S15, and S16) caused extensive foliar symptoms on this cultivar.

In addition, *F. brasiliense* isolate S16 induced high root rot severity, stunted shoot growth, and extensive foliar symptoms on four cultivars (LS6161R, LS6444R, PAN1454R, and PAN1664R). However, on NS5909R and DM6.2iRR, it induced little root rot and little to no foliar symptoms and had an insignificant effect on shoot growth.

By way of contrast, even though *F. brasiliense* isolate S16 induced little root rot on NS5009R, it caused significant reduction in shoot growth and incited moderate foliar symptoms. This suggests that the above-mentioned cultivars may have some mechanism to either reduce infection by the specific isolates or interfere in the virulent mechanisms (i.e. toxins) that are responsible for the foliar symptoms.

According to data obtained from the intact seedling assay with cell-free culture filtrates, the *F. brasiliense* and *Fusarium* sp. isolates tested were capable of causing SDS-like foliar symptoms in the absence of root colonisation or rot, which is consistent with the production of fungal toxins.

Additionally, the amount of toxin produced by each isolate likely varies because the foliar symptoms between isolate filtrates varied. As expected, moderately resistant MN1606 displayed the least symptoms. However, the species and isolate that caused the most symptoms and chlorosis was different on susceptible Spencer and Sloan, which is consistent with the variability observed between the seven cultivars in the pathogenicity experiments.

Disease parameters

The persistence of cultivar differences in response to cell-free culture filtrates favours the hypothesis of an alternative mechanism in soya bean for coping with the fungal toxins that are responsible for the foliar SDS symptoms.

In previous research conducted with *F. virguliforme*, soya bean cultivar resistance response has been evaluated primarily based on severity of leaf symptoms (Stephens *et al*., 1993) rather than decreased colonisation of roots by the pathogen. For instance, Gray and Achenbach (1996) reported that SDS-inducing isolates caused crown and root rot of soya bean and differences in foliar symptoms, but there was no difference in root rot severity between the moderately resistant Ripley and the susceptible Spencer.

Similarly, Rupe (1989) and Hartman *et al*. (1997) also showed that there was no difference in root infection between cultivars rated for their susceptibility or resistance based on foliar symptom rating. However, Luckew *et al*. (2013) used four disease parameters (foliar disease incidence, foliar leaf scorch disease severity, area under disease progress curve, and root rot severity) to investigate disease resistance of soya bean lines by evaluating 14 quantitative trait loci (QTL).

Based on their finding that some of the QTL were associated with more than one of the disease parameters, it is theoretically possible that several QTL can be stacked to develop soya bean cultivars with greater resistance to SDS.

Martha M Vaughan, Gail Doehring and Kerry O'Donnell are from the Mycotoxin Prevention and Applied Microbiology Research Unit of the Agricultural Research Service at the United States Department of Agriculture.

This article was originally published in *The American Phytopathological Society*, 2017 and has been shortened for publication in *Oilseeds Focus*. References available in the original article.

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Canola fits into crop rotation systems in northern irrigation areas

By André Agenbag

The Canola Development Plan of 2014 stated that an area of approximately 172 000ha is suitable to produce grain crops in the central and northern irrigation areas of South Africa. If canola is planted once in a period of four years as a winter crop, 43 000ha can be used annually to produce canola in these areas. This could be a huge boost for canola production in South Africa.

During 2016 and 2017, canola trials were planted in the Beestekraal (Brits) and Groblersdal irrigation areas to identify the best adapted cultivars (early or late maturing) and optimal planting dates in these areas. Four canola cultivars, Hyola 50 (medium maturing), 44Y89 (medium-early maturing), Belinda (medium-early maturing), and Diamond (early maturing) were planted.

Timely planting of crops

To fit into existing crop rotation systems with maize planted during the summer season, 15 April, 30 April and 15 May were used as possible planting dates. These dates would make it possible to harvest the canola no later than October to allow the timely planting of summer crops.

In these trials phosphorus and potassium were applied according to soil analyses, aiming at a content level of 34mg P (Bray1) and 80mg K (ammonium acetate) per kilogram of soil. Planting densities were adjusted between 3 and 4kg/ha for different cultivars according to the size of the seed, aiming at plant populations of 50 plants m^2.

From *Table 1* it is clear that planting canola between mid-April and mid-May in the northern irrigation areas of South Africa will ensure that plants will flower from approximately the end of July until the end of August, depending on the maturity group of the cultivar and specific planting date.

Table 1: Canola flowering (FD) and physiological maturity dates (PMD) obtained at two localities under irrigation during 2017.

Groblersdal	2017					
	Date of planting					
Cultivar	18 April		2 May		17 May	
	FD	PMD	FD	PMD	FD	PMD
Diamond	26 July	15 Sept	28 July	15 Sept	15 Aug	28 Sept
44Y89	28 July	17 Sept	30 July	17 Sept	19 Aug	30 Sept
Belinda	5 Aug	22 Sept	7 Aug	22 Sept	22 Aug	8 Oct
Hyola 50	5 Aug	24 Sept	7 Aug	24 Sept	26 Aug	10 Oct

Beestekraal	2017					
	Date of planting					
Cultivar	20 April		4 May		19 May	
	FD	PMD	FD	PMD	FD	PMD
Diamond	18 July	6 Sept	4 Aug	20 Sept	18 Aug	28 Sept
44Y89	23 July	10 Sept	8 Aug	22 Sept	20 Aug	30 Sept
Belinda	25 July	16 Sept	14 Aug	29 Sept	24 Aug	8 Oct
Hyola 50	1 Aug	20 Sept	14 Aug	29 Sept	26 Aug	10 Oct

FD = 50% flowering date; PMD = physiological maturity date

Canola under irrigation in the Groblersdal irrigation area.

Diamond, a high yielding canola cultivar, during the pod filling stage.

Physiological maturity, which gives an indication of the date when plants start to ripen and become ready for swathing, will be reached between mid-September and approximately 10 October, depending on cultivar and planting date. Cultivar selection and planting date will therefore enable producers to fit the canola crop into their existing production systems and avoid frosty periods.

Grain yields

Despite problems with diseases (*Sclerotinia*) at the Beestekraal locality during 2016 and early lodging due to excessive vegetative growth at the Groblersdal locality during 2017, grain yields of more than 4,5t/ha were still achieved during these problem years (*Table 2*).

During 2016 at Groblersdal and 2017 at Beestekraal, when diseases were successfully controlled and no lodging occurred, yields of more than 5,5t/ha were achieved. Such yields will ensure that canola, at present prices, will show higher profit margins than wheat. In areas where *Fusarium* diseases hampered the production of maize and wheat, the inclusion of canola may also result in higher yields with maize and wheat, because canola will act as a break crop to reduce the incidence of this disease.

From this table it is clear that although all cultivars tested performed well, the highest yields were recorded with the early maturing cultivar Diamond, while the later maturing cultivar Hyola 50 showed lower yields, especially at later planting dates.

With regard to planting dates, a general trend showing a decline in yields with later planting dates were observed. Although optimal planting dates, as shown in *Table 2*, may differ between years, it is recommended that canola should not be planted later than the first week in May in the northern irrigation areas.

It is, however, important to note that canola is frost sensitive (temperatures lower than -3˚C) during flowering stage (*Table 1*), and later maturing cultivars or later planting dates should be used in frosty areas.

Optimise canola yields

Key factors that will optimise canola grain yields:

- **Establishment:** Canola seed is much smaller than that of maize and wheat and should be planted at an even depth of 1-2cm in a firm seedbed to ensure good seed to soil contact. For this reason, planting in seedbeds with a lot of residue from the previous crop may create uneven germination and establishment. A plant population of 40-50 plants per m^2 are required for optimum yields and higher plant populations may result in plants having thin stems, which make them prone to lodging at pod filling stages.
- ***Sclerotinia* stem rot disease:** Canola, like soya beans, is very susceptible to *Sclerotinia* and spraying with a registered fungicide at 20-30% flowering is recommended. If soya beans form part of the crop rotation system, a second spraying three weeks later may be necessary.
- **Harvesting of canola:** Canola pods are prone to shattering during ripening and canola seed is very small. For these reasons, harvesting losses and losses during the transport of canola after harvesting may have a negative impact on yields. It is recommended that canola in irrigation areas be swathed before harvesting. If suitable swathers are not available, chemical ripening should be used before the canola is harvested.

Table 2: Canola-grain yield (kilogram per hectare) obtained at two localities under irrigation during 2016 and 2017.

Groblersdal	2016			2017		
Cultivar	Date of planting			Date of planting		
	21 April	9 May	24 May	18 April	2 May	17 May
Diamond	5,842	4,186	3,812	4,408	4,166	4,733
44Y89	4,029	3,029	3,117	3,033	3,483	2,541
Belinda	4,863	3,549	2,721	4,021	3,854	2,966
Hyola 50	4,724	3,334	3,058	3,524	3,708	3,349
Mean	4,865	3,525	3,177	3,747	3,803	3,397

Beestekraal	2016			2017		
Cultivar	Date of planting			Date of planting		
	25 April	11 May	17 May	20 April	5 May	19 May
Diamond	4,427	4,977	3,507	5,412	5,557	5,562
44Y89	3,988	4,235	3,191	5,391	5,253	5,532
Belinda	4,419	3,871	3,650	5,236	5,512	5,537
Hyola 50	4,113	3,801	2,819	5,303	5,486	4,578
Mean	4,237	4,221	3,291	5,336	5,452	5,302

Canola cultivar trials planted 20 April (left), 4 May (centre) and 19 May (right) at the end of June 2017 at Beestekraal, Brits.

Although there is no doubt that canola can add great value as a break crop to cropping systems in the northern irrigation areas of South Africa, producers are advised to start off with no more than 30-50 hectares of canola, as this will give them the opportunity to master the techniques for canola production before large areas are planted.

For more information, contact André Agenbag of the Protein Research Foundation on 082 221 5944.

Novel and updated findings regarding nematode soya bean research in South Africa

By Dr Akhona Mbatyoti, Agricultural Research Council – Tropical and Subtropical Crops

Controversy exists regarding the effect of continued application of glyphosate on nematodes (both plant-parasitic and non-parasitic) and other organisms (e.g. microbes) that occur in agricultural soils. Although knowledge exists relating to the abundance and diversity of plant-parasitic nematodes in South African conventional soya bean production areas, efforts to characterise nematode communities (both plant-parasitic and beneficial) in glyphosate tolerant soya bean cropping systems were only made recently.

My PhD study, under the supervision of Prof Driekie Fourie (North-West University, Potchefstroom), Dr Mieke Daneel (Agricultural Research Council – Tropical and Subtropical Crops) and Dr Antoinette Swart (Agricultural Research Council – Plant Health and Protection), and during which field, glasshouse and microplot studies were conducted, addressed this topic.

Dr Mariette Marais of the Agricultural Research Council – Plant Health and Protection also formed part of this study since she did the identification of plant-parasitic nematodes to species level.

Plant-parasitic nematodes

The study confirmed that root-knot (*Meloidogyne* spp.), followed by lesion nematodes (*Pratylenchus* spp.) are the main nematode pests of local soya bean crops (both in conventional and glyphosate-tolerant fields) that adversely affect yield (*Figure 1a and b*). The two predominant root-knot nematode species present were *Meloidogyne incognita* and *Meloidogyne javanica*, while an unidentified root-knot nematode species was also found.

Important to note is that the identified root-knot nematode species can interact with soil-borne fungal pathogens, abundant in local soils, which can result in a highly damaging disease complex causing even higher soya bean yield losses.

Interactions between these pathogens and root-knot nematodes have, however, not yet been studied and should be made a priority to be addressed in future research in collaboration with plant pathologists.

Interestingly, high *Meloidogyne* population densities were also observed in the roots and rhizosphere soil of natural vegetation adjacent to soya bean fields, which suggested that such sites can act as a primary source of inoculum of these nematode pests. Planting soya bean or other annual crops on a cleared natural field may thus have an adverse impact on crop production.

Concern to local producers

The lesion nematode species P*ratylenchus zeae* and *Pratylenchus brachyurus* followed root-knot nematodes in terms of abundance, but had the highest diversity since nine species were identified. Three of these species (*Pratylenchus flakkensis, Pratylenchus*

Figure 1a: Soya bean root systems with galls due to root-knot nematode infection.
(Photograph by Driekie Fourie)

Figure 1b: Soya bean roots with black lesions due to infection by *Pratylenchus* spp.
(Photograph by Suria Bekker)

scribneri and *Pratylenchus vulnus*) have, however, been listed for the first time in association with local soya bean crops.

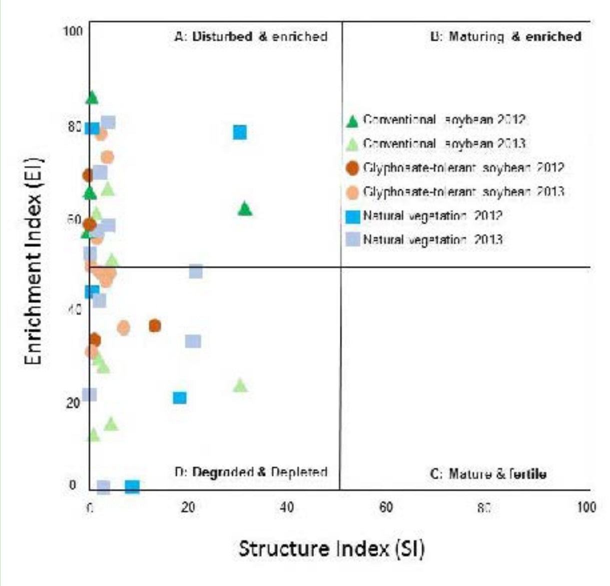
> **Although plant-parasitic nematodes occur in low population densities, it cannot be excluded that their combined damage to plant roots may result in poor crop growth and yield loss.**

The occurrence of lesion nematode species should be of great concern to South African soya bean producers since soya bean is increasingly cultivated in rotation with maize crops, which are also good hosts to lesion nematodes, especially *P. zeae*. *Pratylenchus brachyurus*, on the other hand, is considered the economically most important lesion nematode species in relation to global soya bean production, with major losses reported in especially Brazil (30 to 80% reductions).

The third predominant nematode pest genus identified was spiral nematodes (*Helicotylenchus*), of which four species (*Helicotylenchus dihystera*, *Helicotylenchus martini*, *Helicotylenchus paraplatyurus* and *Helicotylenchus pseudorobustus*) were recorded. Although several *Helicotylenchus* spp. have been found in association with soya bean globally, no yield loss caused by them has been reported to date.

In Brazil, *Helicotylenchus dihystera* and another spiral nematode species, *Scutellonema brachyurus* (also present in local grain production areas), are considered potential pests of soya bean due to the increase in their abundance and spread in the soya bean production areas.

Figure 2: Characterisation of soils, sampled from conventional and glyphosate-tolerant soya bean fields as well as adjacent natural vegetation during two growth seasons, using beneficial nematodes.



The presence of other nematode genera of supposedly unknown importance were also identified as a result of this study and included *Criconema, Criconemoides, Hemicycliophora, Nanidorus, Quinisulcius, Rotylenchus, Rotylenchulus, Scutellonema, Telotylenchus* and *Tylenchorhynchus* spp. Important to note is that although these plant-parasitic nematodes occur in low population densities, it cannot be excluded that their combined damage to plant roots may result in poor crop growth and yield loss.

Beneficial nematodes

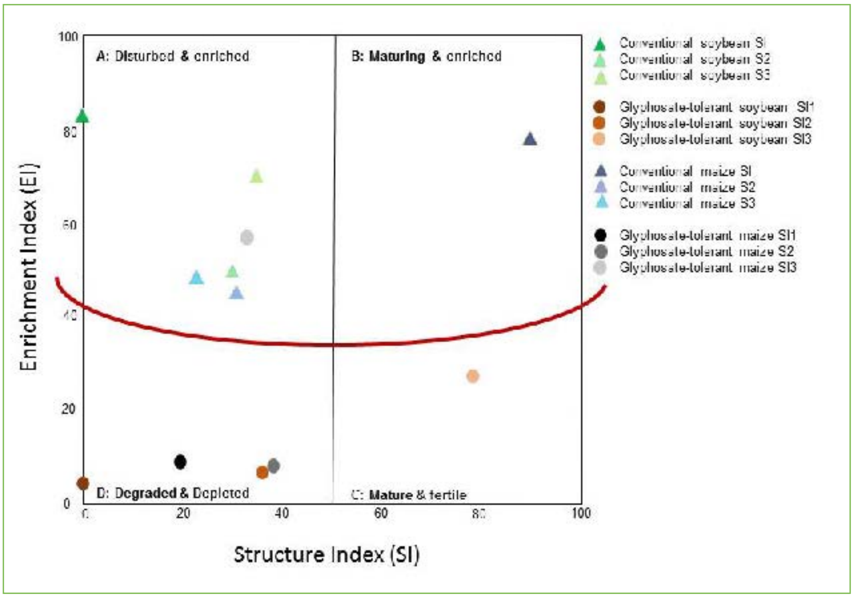
Beneficial nematodes, of which 32 genera were listed for conventional and glyphosate-tolerant soya bean fields and natural vegetation sites during this study, have never been used as bio-indicators of soil quality in South African soya bean fields. The genera identified represented bacterial-, fungal- and omnivore-feeding as well as predatory nematodes, with bacterial-feeding nematodes dominating.

Since soil quality can be monitored by determining the abundance and diversity of beneficial nematodes, a tailor-made tool known as the Faunal Analysis, developed by Prof Howard Ferris (University of California, US) and Prof Tom Bongers (Wageningen University, Netherlands), was used and allowed local nematologists to group soils from the sites sampled into one of four quadrants (*Figure 2*).

Soils from the majority of the sites (54%) were disturbed and/or degraded in terms of the abundance and diversity of beneficial nematodes, plotting in Quadrant D (disturbed and enriched); 46% of the sites plotted in Quadrant A and none in the maturing (Quadrant B) and matured (Quadrant C) quadrants. Not unexpected, the natural vegetation sites had the highest diversity of beneficial nematode

genera (28), followed by conventional (23) and glyphosate-tolerant (21) fields.

Figure 3: Characterisation of soils, sampled from glyphosate-treated and non-treated plots where maize and soya beans were grown during two consecutive growth seasons, using beneficial nematodes.



Distinct variations

Interestingly, distinct variations occurred among the nematode communities recorded for the three sites, with nematode communities in the glyphosate-tolerant soya bean fields differing in the majority of the sites from those in the conventional soya bean fields and natural vegetation sites.

Results from a small field trial, during which 14 non-parasitic nematode genera were identified, showed the abundance of fungivorous nematodes, particularly *Aphelenchoides* and *Aphelenchus*, in glyphosate-treated plots compared to those in non-treated plots. Faunal analyses showed that soils from glyphosate-treated plots were degraded, less enriched and fungal-mediated (*Figure 3*). Conversely, soils from non-treated plots were disturbed, enriched and bacterial-mediated.

> **Soya bean genotypes must be evaluated not only for their yield potential, but also for their susceptibility and sensitivity to diseases and pests, including nematodes.**

Host status assessments of 36 local, commercially available soya bean cultivars were determined for *M. incognita* in glasshouse experiments under two temperature regimes. The host response of the cultivars varied from resistant to highly susceptible, with cultivar DM 6.2i RR being identified as the poorest host.

Of specific importance is that this cultivar retained its poor host status at the higher temperature regime, of which the mean temperature was 2,5˚C higher than that of the other experiment. This is an important observation, especially with climate change being experienced, and this cultivar should be the first choice of producers who experience problems with this root-knot nematode species in their fields.

Minimising the damage

The importance of determining the host response of soya bean genotypes to root-knot nematodes, particularly the predominant species *M. incognita*, in South Africa cannot be overstated. Soya bean genotypes must be evaluated not only for their yield potential, but also for their susceptibility and sensitivity to diseases and pests, including nematodes.

Such knowledge can be used by local producers to minimise the damage of *M. incognita* to their soya bean crops. It is also accentuated that host response of local cultivars to *M. incognita*, *M. javanica* and other *Meloidogyne* spp. prevalent in the local soya bean-based production areas in South Africa should be done on a regular basis to provide producers with the most up-to-date information.

This study re-emphasised the challenges posed by plant-parasitic nematodes, in particular *Meloidogyne* and *Pratylenchus*, to local conventional and genetically-modified soya bean crops. Implementation of various management strategies (not discussed in this article) to combat such nematode pests should be exploited and evaluated to assist producers to produce soya bean.

This study also gave insight regarding the importance of non-parasitic nematodes as bio-indicators of soil quality in soya bean cropping agro-ecosystems. Ultimately, it showed that nematode assemblages generally did not differ among glyphosate-treated and non-treated plots.

For more information, contact Dr Mbatyoti on 013 753 7000 or email MbatyotiO@arc.agric.za, or Prof Driekie Fourie on 018 293 3683 or email Driekie.Fourie@nwu.ac.za.

Quality of the 2016/17 season's sunflower crop

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

The 2016/17 sunflower crop quality survey is the fifth annual survey performed by the Southern African Grain Laboratory (SAGL), with financial assistance from the Oil & Protein Seed Development Trust. The goal of this survey is to compile a detailed database by accumulating quality data, collected over several seasons, on the national commercial sunflower crop.

This essential database can assist the industry with decision-making processes. The data reveals general tendencies and highlights quality differences in commercial sunflower produced in different local production regions.

Quality analyses, which included grading, were performed on 176 composite samples. These composite samples, representing each delivery of sunflower seed at the various silos throughout the sunflower production regions, were taken according to the prescribed grading regulations during the 2017 harvesting season.

Permissible deviations

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, 85% (150) were graded as Grade FH1, with 26 of the samples downgraded to COSF (class other sunflower seed). The percentage of FH1 samples increased compared to the 78% of the previous season and is similar to the 86% of the 2014/15 season.

The majority (17) of the samples 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. Other deviations that resulted in the downgrading of samples were the percentage damaged sunflower seed, the percentage foreign matter, the percentage sclerotia, as well as the presence of an undesired odour in the samples.

Refer to *Figures 1* and *2* for the weighted average percentages of screenings and foreign matter per province over five seasons.

The number of samples received for this survey containing sclerotia from the fungus *Sclerotinia sclerotiorum* increased from 18 (10%) in the previous season to 28 (16%) this season. Of these, 14

Figure 1: Average percentage screenings per province over five seasons.

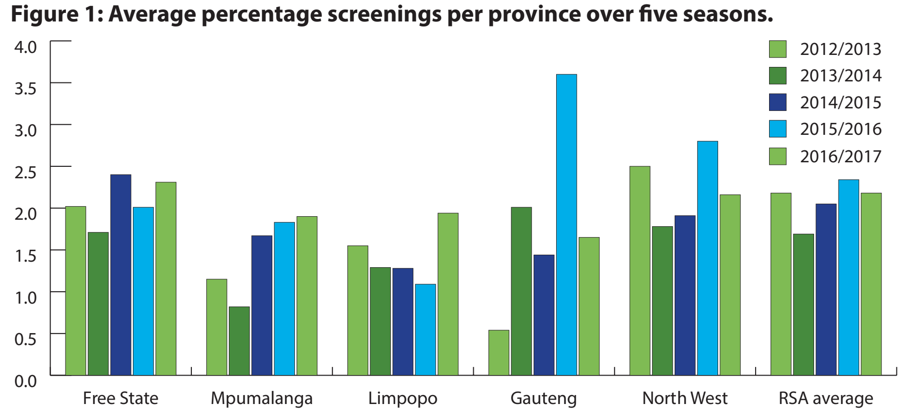
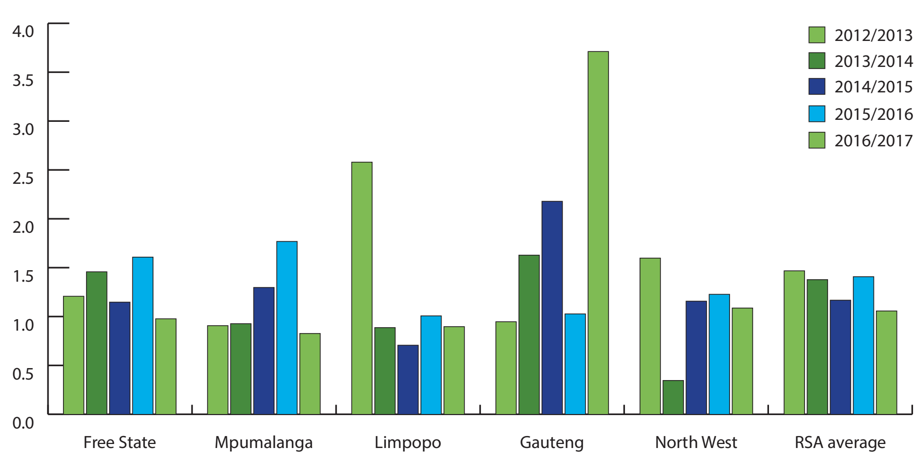


Figure 2: Average percentage foreign matter per province over five seasons.



samples originated in the Free State, 13 in North West and one in Mpumalanga.

Higher national average

The highest percentage (5,52%) was present in a sample from North West; it was the only sample that exceeded the maximum permissible deviation of 4%. Weighted average levels ranged from 0,06% in the Free State to 0,18% in North West. The national average of 0,11% was slightly higher than the 0,04% of the previous two seasons.

Although test weight does not form part of the grading regulations for sunflower seed in South Africa, the g/1ℓ filling weight of each sunflower seed sample was determined by means of the Kern 222 apparatus. The test weight values were then extrapolated by means of formulas obtained from the Canadian Grain Commission's sunflower seed, oil test weight conversion chart. These approximated values provide a measure of the bulk density of South African sunflower seeds.

Over the last three seasons, the national weighted average test weight varied between 42,1kg/hℓ in the season under discussion, 42,5kg/hℓ during the previous season, and 44,2kg/hℓ in the 2014/15 season. Regionally, the weighted average test weights this season ranged from 41,3kg/hℓ in the Free State to 42,7kg/hℓ in the North West province.

The nutritional component analyses, namely crude protein, fat, fibre and ash, are reported as % (g/100g) on an 'as received' or 'as is' basis. See *Table 1* for a summary of the results obtained over five seasons.

Table 1: Weighted average results on an 'as received' or 'as is' basis per season.

Province	Crude protein content, %					Crude fat content, %				
	12/13	13/14	14/15	15/16	16/17	12/13	13/14	14/15	15/16	16/17
Free State	16,22	15,95	16,27	17,77	16,78	39,9	39,7	40,4	38,0	38,5
Mpumalanga	15,24	15,07	16,47	17,14	15,43	40,5	42,4	39,3	38,8	40,2
Limpopo	17,58	16,95	17,44	17,16	17,15	38,2	40,7	38,8	40,0	39,7
Gauteng	16,23	15,44	16,55	17,69	17,37	41,1	42,5	41,4	40,3	38,7
North West	17,21	16,49	17,53	18,24	16,53	38,7	38,8	39,2	38,2	38,4
RSA average	16,77	16,15	16,95	17,93	16,63	39,2	39,6	39,7	38,2	38,6

Province	Crude fibre content, %					Ash content, %				
	12/13	13/14	14/15	15/16	16/17	12/13	13/14	14/15	15/16	16/17
Free State	20,3	20,2	19,9	20,5	20,5	2,58	2,69	2,58	2,64	2,67
Mpumalanga	20,7	18,7	20,7	20,9	21,2	2,43	2,58	2,45	2,49	2,29
Limpopo	19,9	18,6	19,3	20,4	19,7	2,60	2,59	2,56	2,69	2,67
Gauteng	18,9	19,2	19,1	19,2	19,4	2,34	2,53	2,45	2,67	2,37
North West	19,7	20,6	20,1	20,2	21,6	2,51	2,65	2,54	2,55	2,39
RSA average	20,0	20,2	20,0	20,3	21,0	2,54	2,66	2,55	2,59	2,52

Visit *www.sagl.co.za* for detailed results of this as well as previous surveys. The reports are also available for download in PDF format.

With gratitude to the Oil & Protein Seed Development Trust for financial support for these annual surveys, and to the members of Agbiz Grain for providing the crop samples.

Quality of the 2016/17 season's soya bean crop

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

The 2016/17 soya bean crop quality survey is the sixth annual survey performed by the Southern African Grain Laboratory NPC (SAGL). The goal of this survey is to compile a detailed database by accumulating quality data, collected over several seasons, on the national commercial soya bean crop.

> The South African weighted average percentage soiled soya beans of 2,87% is the highest since this survey was started in the 2011/12 season.

This essential data set is a valuable tool, assisting industry with decision-making processes. General trends are revealed and quality differences highlighted in the commercial soya bean produced in different local production regions.

Quality analyses, which included grading, were performed on 150 composite samples. These composite samples, representing each delivery of soya beans at the various silos throughout the soya bean production regions, were taken according to the prescribed grading regulations during the 2017 harvesting season.

The majority of soya beans produced in South Africa are genetically modified (GM), with an estimated 95% of the area planted with soya beans in the country being GM. Worldwide, GM soya beans occupy 80% of the area planted with soya beans.

Grading according to regulations

SAGL screened 15 of the crop samples to test for the presence of CP4 EPSPS (Roundup Ready®). The EnviroLogix QuickComb kit for bulk soya beans was used to quantitatively determine the presence of genetically modified soya beans.

The kit is designed to extract and detect the presence of certain proteins at the levels typically expressed in genetically modified bulk soya beans. Results were scanned and interpreted quantitatively with the EnviroLogix QuickScan system. All the samples tested positive for the presence of CP4 EPSPS.

Grading was done in accordance with the regulations relating to the grading, packing and marking of soya beans intended for sale in the Republic of South Africa (No R 370 of 21 April 2017). Of the 150 samples, 85% (132) were graded as Grade SB1, with 18 (15%) of the samples downgraded to class other soya beans (COSB). During the previous two seasons, 11% (2015/16) and 13% (2014/15) of the samples were downgraded to COSB.

High percentage soiled

The majority of samples (61%) downgraded this season resulted from the percentage soiled soya beans present in the sample, which exceeded the maximum permissible deviation of 10%. More than half of these samples originated from Mpumalanga.

Figure 1: Average percentage soiled soya beans per province over five seasons.

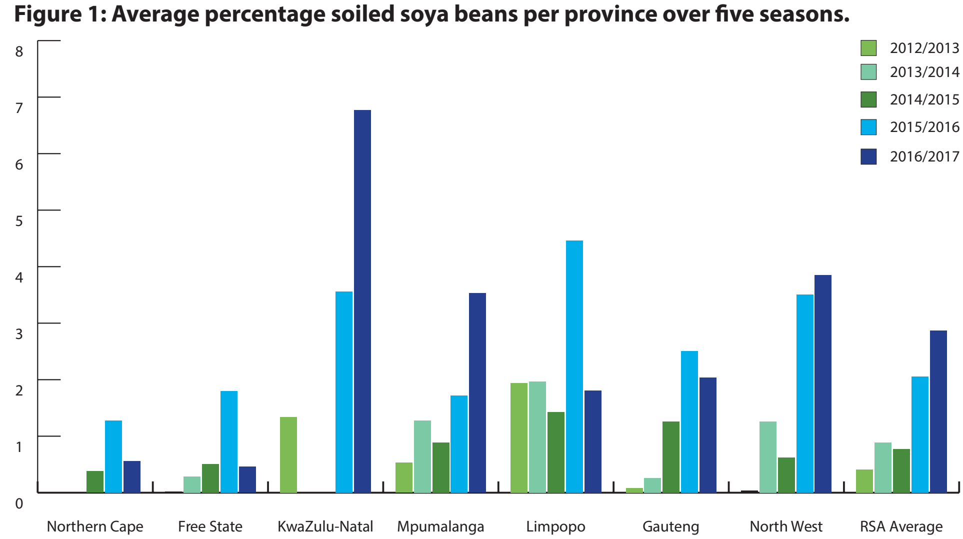
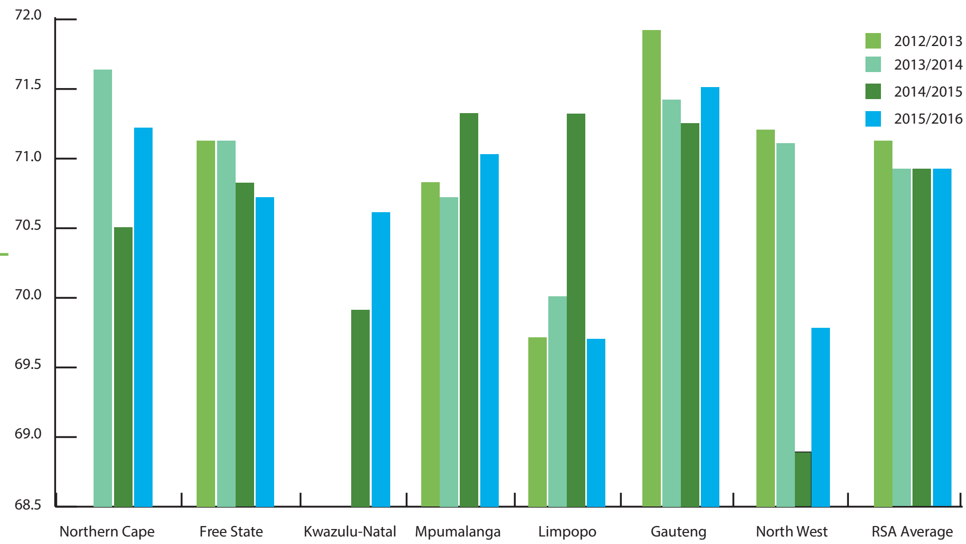


Table 1: Comparison of weighted average nutritional component values on a dry and 'as is' basis over five seasons.

Season	2016/2017		2015/2016		2014/2015		2013/2014		2012/2013	
Moisture, % (17hr, 103°C)	7,4		7,4		7,0		7,1		7,2	
Moisture basis	Dry basis	As is	Dry basis	As is	Dry basis	As is	Dry basis	As is	Dry basis	As is
Crude protein, %	40,15	37,18	40,22	37,24	39,89	37,10	39,84	37,01	40,63	37,70
Crude fat, %	19,8	18,3	19,4	18,0	19,3	17,9	19,7	18,3	18,8	17,4
Crude fibre, %	5,9	5,9	7,3	7,3	6,4	6,4	6,1	6,1	-	-
Ash, %	4,58	4,24	4,61	4,27	4,64	4,32	4,66	4,33	4,65	4,32
No. of samples	150		143		150		150		150	

The South African weighted average percentage soiled soya beans of 2,87% is the highest since this survey was started in the 2011/12 season, when the average was 1,60%. The average last season was 2,06%. See *Figure 1* for the weighted average percentage soiled soya beans per province over five seasons.

Figure 2: Average percentage foreign matter per province over five seasons.



General trends are revealed and quality differences highlighted in the commercial soya bean produced in different local production regions.

Other deviations that resulted in the downgrading of samples were the percentage other grain, the percentage sunflower seed present, the percentage foreign matter, as well as the presence of poisonous seeds. None of the samples graded contained any wet pods.

The national weighted average percentage soya beans and parts of soya beans above the 1,8mm slotted sieve, which pass through the 4,75mm round hole sieve, decreased from 0,92% the previous season to 0,88% this season. This is the lowest percentage of the six seasons for which crop quality data is available. The national weighted average percentage defective soya beans on the 4,75mm sieve increased slightly from 2,02% last season to 2,22% this season. The percentage of samples containing sclerotia from the fungus *Sclerotinia sclerotiorum* almost tripled from the previous season (from 25% to 70%). The three highest percentages of sclerotia observed (0,38%, 0,36% and 0,30%) were on samples from Mpumalanga. These percentages are, however, still well below the maximum permissible level of 4%. The national weighted average percentage this season was 0,07% compared to the 0,04% of the previous season.

Weight conversion chart

Although test weight does not form part of the grading regulations for soya beans in South Africa, the g/1ℓ filling weight of each soya bean sample was determined by means of the Kern 222 apparatus. The test weight values were then extrapolated by means of formulae obtained from the Canadian Grain Commission's test weight conversion chart for soya bean.

See *Figure 2* for a comparison of the test weight per province over the last four seasons. These approximated values provide a measure of the bulk density of South African soya beans.

For a summary of the nutritional content analyses, namely crude protein, crude fat, crude fibre and ash, obtained over a period of five seasons, see *Table 1*. These results are routinely reported on a dry or moisture-free basis (db) for comparison purposes. However, the national 'as is' basis results are provided as well. These 'as is' values were calculated using the weighted national average moisture values.

Visit *www.sagl.co.za* for detailed results of this as well as previous surveys. The reports are also available for download in PDF format.

With gratitude to the Oil & Protein Seed Development Trust for financial support for these annual surveys, and to the members of Agbiz Grain for providing the crop samples.


Van sonlig
TOT KOLLIG
Saam met jou van
DIE WOORD
"GO"
Ons stel ons mededingers in die skadu en jou in die kollig
met ons topgehalte sonneblomsaad.
DUPONT
PIONEER.

Sunflower monoculture's days are numbered

By AJ Steyn, agronomist, Pioneer Hi-Bred SA

Due to the late summer rainfall and the relatively low maize price, sunflower was planted in many fields in the western production areas. This includes fields on which sunflower was cultivated during the previous season.

Producers should inspect their fields during grain filling and ripening to identify possible head diseases. It is important to know which types of head rot occur, as it will impact future management practices.

Prof Bradley Flett of the Agricultural Research Council (ARC) Potchefstroom, says a lot of sclerotinia stalk and head rot occurred in the Northern Free State and North West the last season. It was a late season with flowering and grain filling for sunflower in cool, moist conditions. In certain fields, up to 90% sclerotinia head rot occurred.

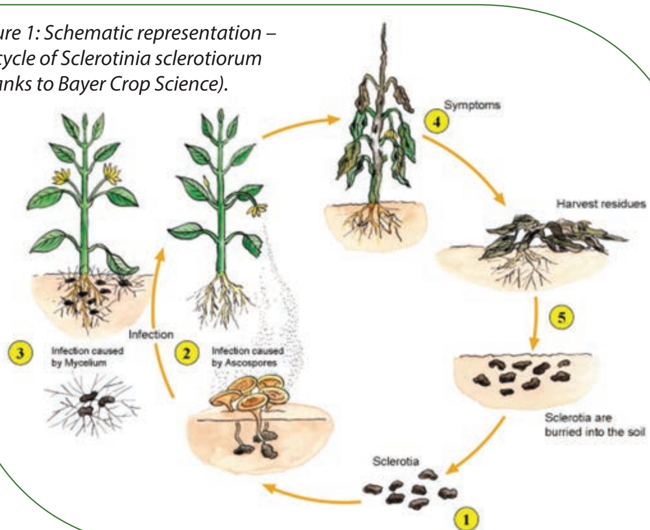
Favourable climatic conditions

After having flowered, sunflower has a relatively long grain filling period and the cool, wet conditions in autumn favours the development of sclerotinia. Should a large-scale outbreak occur, it will pose a real danger to sunflower production in the west. Stalk rot occurring in but a few plants on a field is not a major problem, but sclerotinia head rot can cause more severe damage and more inocula are transferred to the next season.

In wet, saturated topsoil, the sclerotia germinate and form apothecia (fruiting bodies). They produce spores that are spread by the wind. These spores can land on dead flower parts or wounds found, for instance, on the back of flower heads. The germinating spores use the dead organic matter as food source. The fungus develops from these spores and infects the entire head. More sclerotia are formed, thus completing the lifecycle.

Infected fields can be deeply ploughed after harvesting so as to bury the sclerotia as deep as possible. This must be followed by a choice of crop (non-host) and cultivation practices must be adjusted so that the soil is not overturned again.

Figure 1: Schematic representation – lifecycle of Sclerotinia sclerotiorum (thanks to Bayer Crop Science).



Crop rotation

A crop rotation interval of four to six years provides the best control, but does not guarantee zero sclerotinia outbreaks. The suggested norm (for infected fields) is to avoid planting sunflower for five to eight years. A team effort by all producers is needed to ensure that no spores are produced that can be carried to clean fields.

Sclerotinia infection extending into a developing sunflower head. (Photographs by André Nel, ARC-GCI)

Fibrous strands at the upper end of a stalk and head as a result of sclerotinia head rot damage.

The pathogen can survive on a series of broadleaf weeds, vegetables, beans (especially soya beans), canola, lupins and volunteer sunflowers. It is crucial to keep the fields clean from these host plants. Maize is an appropriate rotation crop for the area, but sunflower offers an outstanding rotation crop choice that needs protection against this threat.

No resistance

Prof Flett says certain lines in the US are exhibiting tolerance to the fungus, but sclerotinia resistance does not exist (such as in soya beans). Local cultivars will have to be subjected to tests to determine the tolerance levels.

Seed companies use fungicides on seed to prevent infected seed from infecting clean fields. For peace of mind, buy your sunflower seed from a recognised seed company.

Bayer supplies a biological agent called Contans. It contains spores of the fungus *Coniothyrium minitans* that attack the sclerotia in the soil. This prevents the sclerotia from germinating and developing into apothecia and spores. The earlier it can be sprayed on already infected fields, the more effective it is.

For more information, contact AJ Steyn on 083 627 3788.

Integrated pest management of the fall armyworm

By Ursula Human

Farmer education and community action are critical elements in the strategy to sustainably manage fall armyworm (FAW) populations. This is especially true for smallholder farmers in Africa. The United Nations' Food and Agriculture Organization (FAO) has taken the lead in the provision of education to manage FAW.

The FAO is making use of Farmer Field Schools (FFS) to implement an integrated ecological and sustainable FAW management strategy for smallholders in Africa. FFS is an intensive farmer education approach promoted by the FAO and many organisations worldwide, establishing platforms for farmers to learn, experiment and exchange information.

In this context the FAO recently published an educational guide to provide smallholder farmers in Africa with the necessary information to implement an integrated pest management system, especially for maize production.

South African context

FAW is a polyphagous pest with a preference for grain crops. Although concerns over FAW damage are mostly centred around maize crops, it also affects other important crops. According to the Department of Agriculture, Forestry and Fisheries (DAFF), South African crops also at risk include sunflower and soya, among others.

In March 2017, FAW was reported on soya beans after its appearance on maize in December 2016. DAFF reported minimal damage to soya bean crops. In February 2018, DAFF announced that FAW was detected on young sunflowers in Komatipoort, Mpumalanga. Producers were urged to scout their fields and report any occurrence or suspected

Fall armyworm in a maize whorl. (Photo by FAO)

The larvae are generally characterised by three yellow stripes on the back, followed by a black, then a yellow stripe on the side. (Photo by FAO)

occurrence of the pest to DAFF.

To control and monitor FAW effectively, a steering committee was established that meets once a month. Regulations have also been put in place to limit the spread of the pest. These regulations were published on 26 May 2017 in the *Government Gazette*. National surveillance programme traps have been placed in several provinces.

> Many other maize pests resembling FAW are present in Africa. They are most easily differentiated when one can identify the worms in their various life stages and the type of damage they cause.

According to feedback from the steering committee in February 2018, FAW had been reported in Gauteng (confirmed in Bronkhorstspruit, Cullinan, Vereeniging and Melapong), Mpumalanga (Witbank area and parts of the Nkangala district), Limpopo (Mopani, Vhembe and Waterberg districts), North West (unconfirmed cases around Groot Barn and Koster), KwaZulu-Natal (high infestations in Greytown and other parts), Eastern Cape (confirmed FAW presence), Free State, Northern and Western Cape (no new reports).

High infestation rates

Later in February, DAFF released an update that named Gauteng, Mpumalanga, North West, Free State and Eastern Cape as the provinces least affected. High infestation rates were reported in Limpopo (4 316ha affected in Capricorn, Sekhukhune, Waterberg, Vhembe and Musina District Municipalities) and KwaZulu-Natal (219,1ha affected in Umkhanyakude District Municipality).

This can be compared to only 14ha in the Buffalo City Metro Municipality in the Eastern Cape. It is likely that the areas are less affected due to dry weather, but in other areas the recent La Niña conditions (wet and cool) were more favourable for the pest.

According to DAFF, the overall infestations are less in 2018 compared to 2017, since most farmers are spraying as a preventative measure. There were more chemicals registered during 2017 to control and manage FAW.

In order to successfully control FAW, identification is of the utmost importance. To this end, a protein kit for diagnostic identification has been made available. Pest fact sheets have also been translated into Xitsonga, Sepedi, isiZulu, Siswati, and isiNdebele and distributed by DAFF.

Armyworm identification

The first step in FAW management is the identification of the worm. The pest is new to Africa and farmers need to be able to distinguish it from other pests. It is important to identify it in its various life cycle stages – from egg to larva and pupa to adult.

Half-grown or fully-grown caterpillars are the easiest to identify. The larvae are generally characterised by three yellow stripes on the back, followed by a black, then a yellow stripe on the side. Look out for four dark spots forming a square on the second to last segment. Each spot has a short bristle (hair).

The extensive damage caused by FAW in maize can be seen in this photo. (Photo by FAO)

The head is dark and shows a typical upside-down Y-shaped pale marking on the front.

Many other maize pests resembling FAW are present in Africa. They are most easily differentiated when one can identify the worms in their various life stages and the type of damage they cause. The maize stalk borer closely resembles FAW, for example. The most important stem borer pests on maize are *Busseola fusca, Chilo partellus* and *Sesamia calamistis*.

Scan the QR code for the complete document showing details on life cycles and to see images that can be used to identify FAW and other worms.

FAW in young sunflowers. (Photograph by Grain SA)

The difference in behaviour among stem borers and FAW can help farmers to distinguish between them.

The type of damage inflicted will look different with each type of infestation. The main differences between stem borer and FAW infestations are:

- FAW causes big holes in maize leaves. Generally, the 'big holes' associated with FAW are not present in stem borer attacks (for both young and old larvae).
- Stem borer damage is characterised by a typical dead heart (a deformed, stunted plant), which is easily seen in young maize plants.
- As stem borer larvae mature, they are found less frequently in the whorl (the leaves around the node of a stem), contrary to FAW. They can, however, be found in the maize stem, where they leave holes with visible frass (excrement of insect larvae).

African armyworm vs fall armyworm

Although the appearance of FAW is new in Africa and South Africa, the African Armyworm is well known. It is important to be able to distinguish between the two, and *Table 1* can be used to identify the main differences between the appearance and behaviour of these pests.

Management options

The most promising options available to African smallholders to manage FAW are presented here. These options build on experiences from the Americas and the latest available research in Africa, reflecting integrated pest management (IPM) strategies. There are several management options for FAW that work well in combination.

Crop management: Good crop management techniques can help prevent FAW infestation. Follow the right planting dates and avoid late plantings, i.e. staggered plantings (the planting of fields at different dates in the same area), as this will continue to provide the FAW with food. It is one of the most important recommendations for smallholders.

Good soil health and adequate moisture are critical – they are essential to grow healthy plants, which can better withstand pest infestation and damage. Unbalanced inorganic fertilisation of maize (especially excessive nitrogen use) can increase oviposition by female FAW.

Maize cultivars: Certain maize cultivars are more resistant to FAW, such as Bt maize, which is grown to control the maize stem borer. Bt maize has been genetically engineered by incorporating genes from the bacterium *Bacillus thuringiensis* (Bt) that produce insecticidal

Table 1: Comparison between the fall armyworm (*S. frugiperda*) and African armyworm (*S. exempta*). (Source: DAFF)

Description	Fall Armyworm (*S. frugiperda*)	African Armyworm (*S. exempta*)
Adult larvae colouring	Brown/green with lateral beige stripes.	Velvet black with lateral beige/yellow stripes.
Larval behaviour	Concealed in plants.	Marches through crops.
Eggs	Batches covered in light brown scale-hairs. Laid under leaves.	Batches covered in black scale-hairs. Laid under leaves.
Male moth	Identified per genitalia.	Identified per genitalia.
Host plants	Predominantly maize and sorghum.	Predominantly veld grasses, teff.
Outbreak dynamics	Migration from countries north of South Africa; local breeding and outbreaks have been confirmed during February 2017 in South Africa.	Sporadic local outbreaks, but mostly migration from countries north of South Africa.

FAW app helps smallholder farmers

The Food and Agricultural Organization recently launched the Fall Armyworm Monitoring and Early Warning System (FAMEWS) mobile app, which enables farmers to identify, report and map the spread of the worm.

The app is useful on two fronts: for farmers and agricultural workers in the direct management of their crops to prevent further infestations and to reduce damage; and for all role-players involved in managing fall armyworm in Africa, by providing vital analysis on risks, spread and management.

Scan this QR code to download the app on an Android smartphone (v5 or higher).

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proteins which can kill crop pests. It is important, though, to note that insect populations can adapt to Bt proteins through the evolution of resistance.

Plant diversity: Plant diversity on farms reduces FAW infestation and supports natural enemies of this pest. Although female FAW moths prefer laying their eggs on maize plants, they also lay eggs on other plants, which could help smallholder farmers to divert the pest even if it is present in the area. A farm with monocultures of maize makes it easier for the pest to procreate.

> The Food and Agricultural Organization recently launched the Fall Armyworm Monitoring and Early Warning System (FAMEWS) mobile app that enables farmers to identify, report and map the spread of the worm.

Intercropping maize with plants the FAW dislikes, or planting it nearby, will most likely force moths to move to other areas more conducive to laying eggs. For example, smallholder farmers in Central America have found that planting maize in their traditional *milpa* systems – combining it with beans and squash – lessens pest attacks.

Biological control: FAW has many naturally-occurring enemies that feed on it. These enemies have the potential to substantially reduce FAW populations, but it is a major challenge to create the right conditions to realise the full potential of these beneficial organisms. Broad spectrum pesticides kill many of the beneficial insects.

Biological control agents (BCAs) include predatory insects that eat their prey, parasitoids (insects that are parasitic on other insects) and entomopathogens (microbial pathogens), such as nematodes, fungi, bacteria, viruses and protozoa, all lethal to FAW.

- **Predators** of the FAW kill several individuals either as eggs, larvae, pupae or adults. The following insects predate on FAW in various life stages: earwigs, ladybird beetles, ground beetles, assassin and flower bugs, and predatory wasps. Spiders, birds and bats have also shown to be predators.
- **Parasitoids** are organisms whose adults lay eggs either inside or attached to a single host organism. To enable development, the resultant larvae feed on the tissues of the host until they are fully grown and pupate. Parasitoid larvae always kill their host as the outcome of their development. The majority of parasitoids known to be associated with FAW are wasps, and less frequently flies.
- **Entomopathogens** are pathogens such as fungi, bacteria, viruses and nematodes that affect insects and can control FAW. Viruses such as the nuclear polyhedrosis virus (NPV) and *Spodoptera frugiperda multicapsid nucleopolyhedrovirus* (SfMNPV) are lethal to FAW. So are the fungi *Metarhizium anisopliae, Metarhizium rileyi* and *Beauveria bassiana*. In the case of bacteria, *Bacillus thuringiensis* (Bt), found in Bt maize, also kills the FAW.

Synthetic pesticides: Several synthetic pesticides have been used in response to the invasion of FAW, including methomyl, acephate, cyfluthrin, benfuracarb, methyl parathion, carbaryl, endosulfan, carbosulfan, lindane, chlorpyrifos, cyfluthrin, diazinon, methomyl, and methyl parathion. Farmers must only use approved insecticides and apply the application dosage rates recommended on the product label.

Scan this QR code to download the DAFF document on FAW control.

An important aspect the FAO report fails to mention is that the application must only be made against young instar (phase between two periods of development) larvae less than 10mm long. This is according to a recent report by DAFF on FAW control in South Africa. According to the DAFF report, application against older larvae is not successful since they feed deep inside whorls of plants and are therefore protected from contact with the insecticide.

FAW checklist

The FAO guide for FAW control provides the following checklist of facts that all smallholder farmers should know:

- Farmers need to be able to identify and differentiate FAW (*Spodoptera frugiperda*) from the African armyworm (*Spodoptera exempta*), cotton bollworm (*Helicoverpa armigera*), stem borers and other worms.
- They must recognise the different stages of FAW and understand its life cycle.
- Farmers need to know where to find the FAW in its different life stages on the plant, how the worm feeds on the plant, and what the damage looks like.
- They must know which plants can serve as an alternative host.
- They must also know which plants repel or attract FAW. The same can be true for natural enemies. Plant diversity is important as food sources for natural enemies.
- Farmers need to know which natural enemies of the FAW are present, how they attack the different stages of the worm and how many pests they can eat, parasitise or infect.
- They must understand how plants can compensate for leaf damage in different stages of crop development.

To read the full report on *The Integrated Management of the Fall Armyworm on Maize* visit *www.fao.org*.
For more information or to report a fall armyworm sighting contact Jan Hendrik Venter (DAFF) on 012 319 6384 or janhendrikv@daff.gov.za.

Biofertiliser: The new star of the fertiliser industry

By Ursula Human

The 58th Annual Fertasa Congress and annual general meeting (AGM), where a new board and chairman were selected, were held in April this year. Dr Erik Adriaanse, manager of product and technical development at Sasol Chemicals, was elected as the new chairman of Fertasa.

Adriaan de Lange, managing director of Omnia Fertilizer and outgoing chairman, kicked off the congress with his chairman's report after an opening by the CEO of Fertasa, Dr Pieter Haumann.

According to De Lange, membership and member code of conduct compliance certification show consistent growth. Fertasa will also pay more attention to biofertilisers this year due to its growing influence on the fertiliser industry. De Lange said this could already be seen in the emphasis placed on the biological aspects of plant nutrition, which allows for a more targeted approach to fertiliser.

High intensity horticulture

Dr John Purchase, CEO of Agbiz, gave an overview of the major trends driving the future of agriculture. One of the trends highlighted was the increased demand for horticultural products such as fruit and vegetables, which is fuelled by consumers' increased awareness of a heathy lifestyle.

Theo Aanhane, business unit manager for horticulture at Eurofins Agro in the Netherlands, discussed the significance of the horticulture industry in high intensity food production systems. Greenhouse systems that operate with hydroponics allow for much higher food production with lower risks from environmental factors. Unlike open field horticulture – influenced by temperature, light, rainfall, wind, soil, insects, bacteria and viruses – greenhouse structures enable climate control.

In addition, it allows for efficient water and nutrient control, more effective pest control, more production in less space, and no specific soils are needed since it is unnecessary to grow produce in such a system. Yield in greenhouses is thus higher. Plant nutrition, however, still plays an important role in high intensity systems, which gives the fertiliser industry new opportunities for expansion.

Nanotechnology and fertilisers

Prof Anne Grobler, director of the DST/NWU Preclinical Drug Development Platform at North West University, discussed the role of nanotechnology and fertilisers. Nanotechnology is not new but can be applied in new ways that could benefit the agricultural industry. It is already used to improve the management of pathogens and to physically track crops and products.

Prof Grobler is involved in the research that utilises the Pheroid® delivery system as a bio-nanotransporter to enhance the absorption of biological molecules in plant production. This technology is already used in pharmaceuticals and has now been adapted for the agricultural industry. It improves nutrient uptake for tank-mixed fertiliser by interacting with plants on a cellular level. It is also financially viable with tremendous gains for farmers.

Speakers at the Fertasa congress. From the left are Dr John Purchase, Dr Hugo Opperman, Adriaan de Lange, Barbara Novak, and Theo Aanhane.

The biofertiliser industry is growing

Biofertilisers were a hot topic at the Fertasa congress, with two speakers focusing on this new star of the fertiliser industry. Barbara Novak, a fertiliser consultant from Italy, gave an overview of how the fertiliser industry in the European Union (EU) is being shaped by strict regulations on traditional fertilisers. Novak said that fertiliser use in the EU is declining – especially the use of nitrogen, which has contaminated surface water.

Alongside regulatory challenges, consumers have shown a preference for food products with fewer inputs. Access to raw materials also has an influence on the industry as the EU relies heavily on phosphate imports. These challenges, though, are driving innovation in the speciality fertiliser industry with new biofertilisers and biostimulants being registered on a regular basis.

Dr Hugo Opperman, head chemist at Microbial Biological Fertiliser International (MBFi), shared a South African perspective. He discussed the most widely used speciality fertilisers in South Africa, such as nutrient speciality fertilisers, biostimulants, and biological fertilisers/stimulants.

According to Dr Opperman, several trials have proved the efficiency of many of these products as well as an increase in yield. He suggested that farmers make use of these products alongside their traditional fertiliser programmes to boost production.

For enquiries, contact Fertasa on 012 349 1450 or visit *www.fertasa.co.za.*

Weeds that can't be killed: Agriculture's great headache

Press release by Syngenta

Herbicide resistance was first reported in the United States in 1957. The weed involved was wild carrot. Today, a mere 60 years later, some 254 species of weeds no longer respond to 163 different herbicides. Resistance to herbicides has been reported on 92 crops in 70 countries. Of great concern is the fact that wheat has the most resistant weed species of all crops, resulting in a clear threat to food production.

According to Francois Viljoen, technical field expert on herbicides at Syngenta, resistance can be defined as the inherited ability of a weed to survive a rate of herbicide that would normally provide effective control. "Inherited means that a few plants in a population have the natural ability to survive a specific type of herbicide and keep on reproducing," he explains.

Resistance develops with the continuous use of the same chemical with the same mode of action. As the resistant plants reproduce, their numbers increase. Once the resistant plants outnumber the susceptible ones, the grower has a resistant population on his/her hands.

How resistance develops, and how fast, depends on factors such as the density of weeds in a field, natural occurrence of resistant plants and how fit they are, how often and at what application rates herbicides with similar modes of action are used, and crop rotations.

The mechanisms of resistance

The two most important mechanisms through which resistance develops are target site resistance and enhanced metabolism.

The target site is that biochemical area in the plant with which the herbicide directly interacts. ALS inhibitors, for example, control grass weeds by disrupting a specific enzyme in the weed. If the shape of this target site changes even slightly, the herbicide can no longer bind to the site of action and is unable to exert its phytotoxic effects.

Figure 1: Number of resistant species for different herbicide sites of action (HRAC codes).

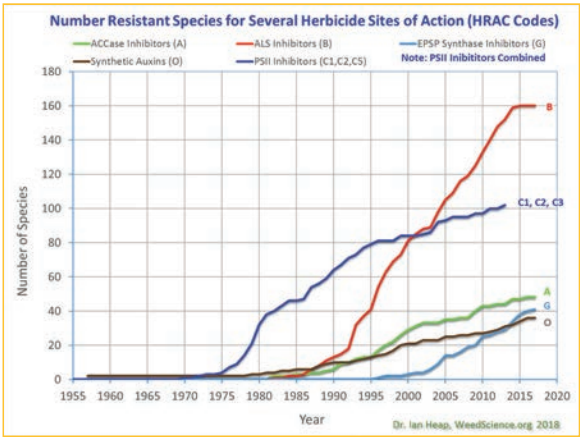
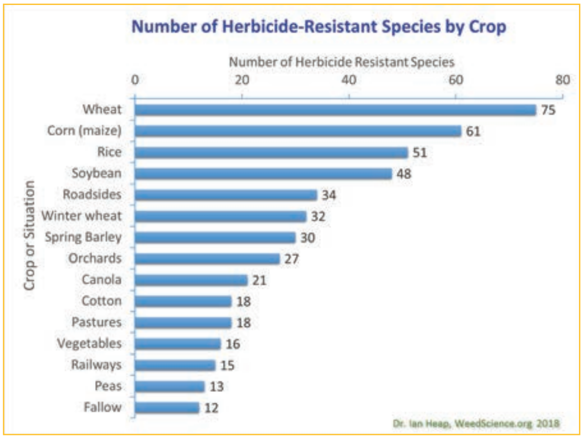


Figure 2: Number of weed species that display herbicide resistance per crop. (Dr Ian Heap, WeedScience.org, 2018)



Enhanced metabolism refers to the increased rate at which the weed breaks down the herbicide into non-toxic products. Metabolic resistance affects most herbicides to some degree; only in severe cases does it result in complete loss of control.

While the first incidence of resistance was reported in 1957, the first serious case only emerged in 1968. By 1989, the resistance to ACCase and ALS inhibitor herbicides led to the establishment of different working groups and finally the formation of the global Herbicide Resistance Action Committee (HRAC). Founded by the agrochemical industry, HRAC helps to protect crop yields and quality worldwide by supporting the fight against herbicide-resistant weeds.

Responsible use

Bleak as the picture may appear, herbicide resistance is not an insurmountable problem. In fact, the fight against it is largely in growers' own hands, says Viljoen.

"The basic principle is that growers must use existing herbicides with care, always keeping resistance in mind. A very small number of new active ingredients are entering the market; we must therefore be extremely responsible with the products we currently have. Syngenta regards the training of growers on resistance prevention practices as one of our most important tasks."

Such practices, according to the HRAC, entails an integrated weed management approach. This includes the use of multiple modes-of-action herbicides with overlapping weed spectrums in rotation, sequences or mixtures. Also, always use the full recommended dosage rate combined with proper application practices and timing. Lastly, growers should scout their fields after a herbicide application and remove all surviving weeds – that could be resistant plants – to prevent them from reproducing.

For more information, contact Syngenta on 011 541 4000 or visit *www.syngenta.co.za.*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High South African stock levels **due to oilcake imports**

By Dr Dirk Strydom, Grain SA

Drastic changes recently took place on the international soya bean market. So far this year, the soya bean exports of the five largest export countries decreased by approximately three million tons, which mainly reflects the decline in Chinese imports.

Processing and pressing of soya beans in the US and Brazil showed a sharp increase between January and April 2018, while there was also a sharp increase in the exports of soya bean oilcake from these countries. Despite the annual increase of soya bean oilcake production and its exports in April, the worldwide oilcake stocks are still under pressure. This is mainly due to the problems with soya bean production in Argentina this year, which is around 18 million tons less than the previous season.

The soya bean harvesting process in Argentina is underway and the reported yields at the writing of this article was approximately 32% lower than the average of the past season. The rest of the production season's expected yields will probably also be lower, with these areas under pressure as a result of the unfavourable weather conditions during the season.

Lower production in Argentina for the season and the weakening of the local currency supported soya bean prices, which increased by 14% from mid-April. The expectations in the market are that Argentine soya bean imports for the season could reach a record of four million tons. It will mainly be imported from Paraguay.

Global production and exports

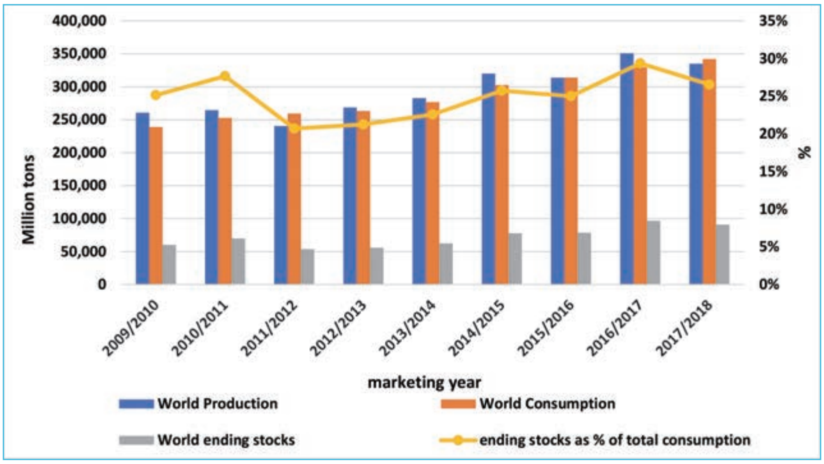
In Brazil, soya bean production for the season is favourable and the expectations are that the country could have another record soya bean crop. US plantings of soya beans are progressing well, and the plantings are well in line with the five-year average rate.

In the Ukraine, sunflower seed plantings are well ahead of last season's rate (for the same period) and expectations should be favourable for the plantings to continue. Plantings in Russia were behind the average rate of last year, but have progressed well despite delays.

Canadian exports of canola oil reached a new monthly high in March, bringing the cumulative canola oil exports from October 2017 to March 2018 to 1,6 million tons. The Canadian canola futures price decreased since the intention to plant report for the season was released, stating that canola plantings may be lower than last year's levels.

Australian canola exports in March were much lower than the year-on-year levels, which will cause large stock levels in Australia that will keep the exportable amount extremely high. According to the latest ASDA production progress report, 9% of the groundnut plantings in the US is completed, which is better than the five-year average of 8% for this time of the season. It is, however, slightly behind last season's 11% measured at the same time of the year.

Figure 1: World soya bean stocks. (Source: USDA)



The local challenge

The challenge this year is targeted at the local market. Locally the stock levels of soya beans are slowly increasing with every season. According to the Crop Estimates Committee's third estimate, the plantings of soya beans are 787 200ha, with an expected crop of 1 430 300 tons.

Regarding the current marketing season, expectations are that there will be carry-over stocks from the previous favourable production season. According to the final Sagis figures for the 2017/18 season, the carry-over in the soya bean market is 332 442 tons. The high carry-over stock situation and possible new closing stock of 571 635 tons have moved the local Safex price of soya beans away from the derived soya bean price.

The initial expectations were that the total production of 1,3 million tons of the previous production year would be processed, but only an estimated 890 000 tons were pressed for soya bean oilcake. It begs the question of why only 890 000 tons of soya beans were processed for soya bean oilcake and additional oilcake imported, while the estimated pressing capacity for soya beans is between 1,8 million and 2,2 million tons.

Figure 2: South African soya bean stocks. (Source: Sagis and CEC)

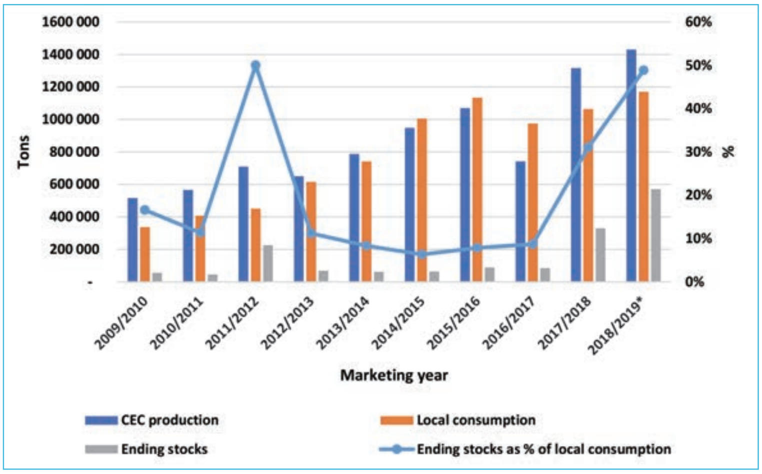


Table 1: Soya bean consumption. (Source: NAMC and own calculations)

Consumer	Current soya bean (tons) consumption potential	Current soya bean consumption (tons)
Press (oil and oilcake)	1 668 000	890 000
Full-fat feed	147 000	147 000
Human consumption	27 000	25 000
Western and Eastern Cape	-420 000	
Domestic potential soya bean	1 422 000	1 062 000

No quality problems

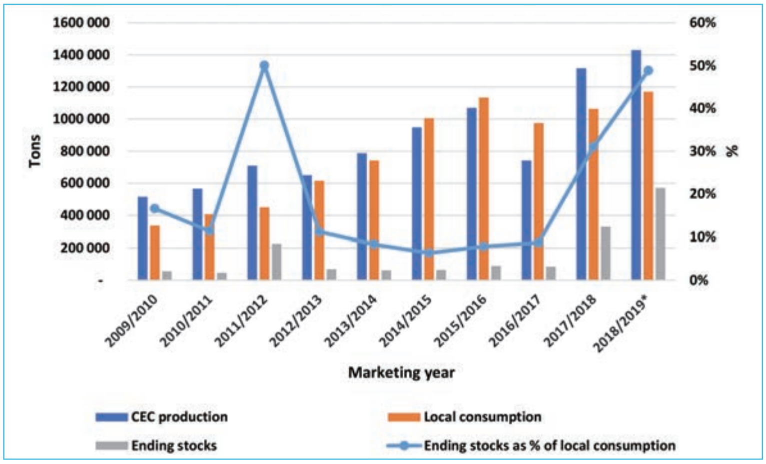
If the quality of local oilcake is taken into account, experts such as Dr Erhard Briedenhann believes that there is no quality problem with local soya beans and oilcake, and that it is better or equal to the quality of Argentine soya beans.

The quality can be divided into two groupings, of which the first is the physical quality of the cake, including parameters such as protein (46% min), fat (2% max), fibre (4% max) and moisture (12%) with the particle size.

The second part is processing quality and includes the Protein Dispersibility Index (PDI), KOH Protein Solubility (KOH PS), Trypsin Inhibitor Activity (TIA-A) and reactive lysine. According to Dr Briedenhann, local oilcake meets the requirements. There is thus no reason why the local cake cannot be used. The main local consumer of oilcake remains the poultry industry.

In the processing market, the dedicated soya bean pressing capacity is 1,46 million tons, of which 890 000 is currently used. The processing capacity of full-fat soya is approximately 160 000 tons, of which 147 000 is currently used. Processing plants that can press both soya beans and sunflower offer an additional possible capacity of 462 000 tons. Currently, there is around 500 000 tons capacity for both sunflower and soya bean processing out of order. The potential processing capacity of soya beans is therefore more than two million tons.

Figure 3: Soya bean production potential with replacement of imports. (Source: Sagis and Grain SA)



Supply and demand

It is important to take the localities of the processing plants and locality of the demand for oilcake into account in the supply and demand of soya bean oilcake. In the Western and Eastern Cape, oilcake consumption is 21 and 8%, respectively, which means that the areas compete well with imported oilcake. The inefficient transport system, however, makes it difficult for domestic oilcake to compete with imported oilcake.

The current local demand for soya beans is reduced even further by one large livestock feed company that still uses imported soya bean oilcake. The total imports of soya bean oilcake the past season was 590 916 tons, which is equal to 777 521 tons of soya beans. Adding to this is the loss of demand for feed due to the amount of chicken imported annually.

If the consumption of the coastal regions is deducted due to the logistical challenges (and assuming that it will still be imported), the current domestic demand remains approximately 1,42 million tons of soya beans, while the current consumption of local soya beans is just more that 1 million tons.

It means that there is still space to produce an additional 360 000 tons of soya beans, even though the coastal areas are served by imports, which will also be enough to increase local production. If the coastal consumption is included, it means the growth potential for soya beans is 777 521 tons.

It is therefore crucial for local livestock feed manufacturers to start buying more local products, and for the transport economy between the inland and coastal areas to be utilised more efficiently. In doing so, the local demand for soya beans will receive a boost.

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Economic impact of the 2017 outbreak of HPAI in South Africa

By Tracy Davids, Marlene Louw, Alfred Smit and Ferdi Meyer, BFAP

The 2017 outbreak of highly pathogenic avian influenza (HPAI) in South Africa had a notable effect on the poultry industry – one of South Africa's largest agricultural subsectors. To facilitate rigorous response strategies, quantification of the disease's impact is critical.

South Africa's strategy, to date, was to contain the disease by culling affected birds. While a possible vaccination strategy is being considered, such a strategy has not been formalised. In the international context, a culling strategy has typically been accompanied by compensation to affected producers, which further highlights the importance of quantifying the economic impact of the disease.

BFAP recently evaluated this impact in terms of a retrospective as well as forward-looking analysis. While key findings are reported in this article, the full report is available from *www.bfap.co.za*.

Larger effect on layer industry

The retrospective analysis considered biological loss, loss of income and direct costs associated with the outbreak. Total cull numbers from the reported AI outbreaks in the broiler and layer industries (up to 8 December 2017) were estimated at around 5,4 million birds.

The effect on the layer industry has been much larger than on the broiler industry, with around 4,7 million birds culled in the layer sector as opposed to around 700 000 birds in the broiler breeder sector. The largest share of layer birds culled was in the Western Cape.

The total biological loss associated with these numbers amounts to just over R317 million. Of this, approximately 75% accrues to the commercial layer industry and its various stages of production. Direct costs associated with the outbreak were around R40,5 million – a conservative estimate given the poor response rate on issues related to direct costs associated with the outbreak.

The total value of lost income as a result of the outbreak is estimated at just over R1,5 billion, which includes income lost from egg sales, pullet sales, day-old chick sales and broiler meat sales. Of this total loss, 85% accrues to the layer industry.

Restocking strategies

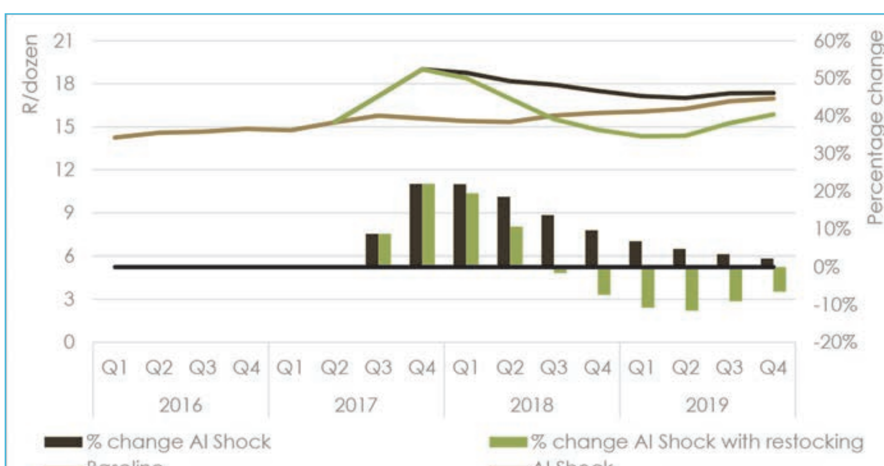
It should be noted that the calculated loss of income is not an instantaneous loss and the impact will be spread over a period of more than two years. It also did not account for company-specific management strategies to mitigate the impact, such as utilisation of excess capacity to reduce the impact on day-old chick volumes in the broiler industry.

The report presents a total loss of around R1,87 billion if biological losses, direct costs and possible loss of income are considered. This represents 18% of the total gross value of egg production in 2016 and 1,6% of the total gross value of animal products in 2016.

The forward-looking analysis was aimed at quantifying the price impact associated with the loss of production, as well as differences in restocking strategies. It focused on the commercial layer industry due to the substantial effect the disease had on this part of the sector. A quarterly partial equilibrium model of the South African layer industry was utilised to evaluate two different scenarios.

The first is a scenario where restocking rates are driven by (current) high priced incentives associated with eggs. In the

Figure 1: Price impact associated with the 2017 HPAI outbreak.



second, a vaccination strategy that allows incremental restocking within the confines of the production cycle is considered. The first scenario resulted in an egg price shock of 22% relative to a baseline simulation, peaking in the first quarter of 2018. The second scenario showed a similar increase of 22% relative to the baseline, but peaking in the fourth quarter of 2017 (*Figure 1*).

Increasing egg prices

Simulation results, however, suggest that a vaccination strategy will support growth in production to mitigate the initial impact with around 12%. Ultimately, this strategy, combined with current price incentives, also supports longer term production growth, with prices reaching an equilibrium below price levels considered as a baseline in the simulation.

From a consumer perspective, the price impact of the outbreaks on egg prices was projected to amount to an increase of around R4 per dozen. This was already evident in the last quarter of 2017 and the first quarter of 2018, with Stats SA reporting an increase of between R3,40 and R4,40 per dozen (depending on packaging sizes) at retail level from September 2017 to March 2018.

Although interviewed respondents explicitly expressed support for a comprehensive vaccination strategy, this course of action has several implications. The first relates to trade; vaccinations will have an impact on possible broiler exports, but the threat of imports from countries where HPAI is already endemic seems small given that the current mix of exported cuts from these countries (specifically China) does not match the current mix of cuts South Africa imports.

The second implication relates to spent hen sales. Under current circumstances, hens are sold to hawkers to be traded in the informal market. Under a comprehensive vaccination strategy, this option is no longer viable, and the hens will need to be slaughtered. The use of a compartmentalised vaccination strategy would mitigate the impact on the live bird market and also protect South Africa from an endemic status.

Broiler, layer shock in 2018

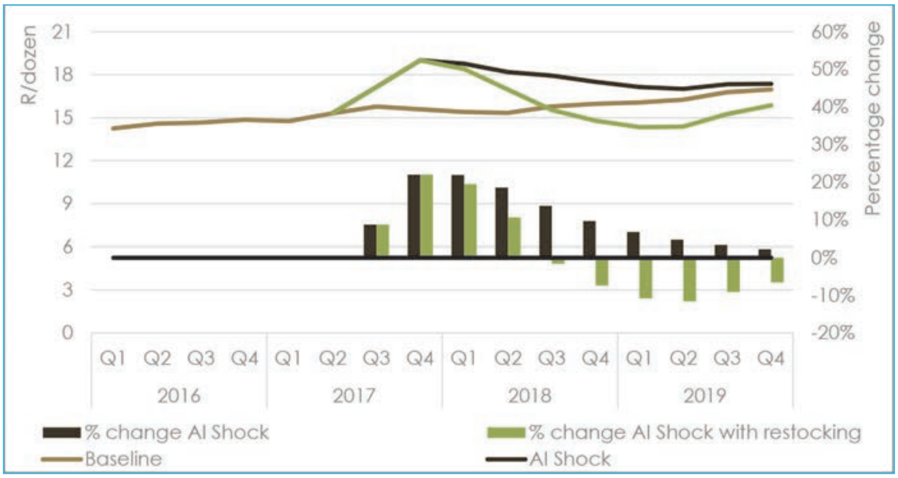
The second step in the forward-looking analysis was the introduction of the shock in the egg and broiler industries into the BFAP sector model (a dynamic, recursive, partial equilibrium model), which links grains to livestock through feed.

By implication, any shock in the livestock sector will influence the demand and hence also prices of feed grains. This is an important attribute considering that the broiler and layer industries account for more than 60% of feed consumption in South Africa.

Within the broiler industry, the impact of the HPAI outbreak in 2017 was significantly less than in the layer industry, and the restocking process is far less constrained than in layers. Given that the outbreaks occurred only in the breeder flock, a once-off shock is introduced into the broiler sector in 2018.

In the layer sector the production shock from the quarterly model relative to the baseline is emulated in the annual model. This combination allows the impact to be simulated across the rest of the agricultural sector.

Figure 2: Feed use impact under both scenarios.



The combined impact of reduced broiler and egg production emanating from the HPAI outbreak results in a reduction of 3,8% in maize used as animal feed in 2018, if restocking is based on economic reasons only. When all affected producers are restocked in scenario two, the reduction in maize used as animal feed is 2,8%.

While these percentages may seem small, the AI shock in scenario one results in a reduction of 200 000 tons of maize used in the animal feed industry in 2018, combined with a further 35 000 ton-reduction in soya bean oilcake consumption relative to the baseline.

Figure 2 presents the maize used as animal feed in South Africa under the baseline, as well as the two different AI-related scenarios on the left axis and the percentage change in each scenario relative to the baseline on the right axis.

The impact of the two different scenarios on agriculture's contribution to GDP is small – with both scenarios inducing a reduction of less than 1% per annum between 2018 and 2020, as the price increase for eggs largely offsets the loss in production volume.

Completely out of production

As with most agricultural sectors, it should be noted that the effect of a disease such as HPAI entailed severe losses in certain areas, while producers not affected in fact benefitted from higher prices. One should therefore not consider the aggregated national impact without noting that affected areas suffered severe losses.

The socio-economic impact of the disease was not included in the study, but it remains a critical consideration. In the Western Cape, a number of farming operations went out of production completely, causing significant losses, both in terms of employment and livelihoods, with no income being generated.

Compensation of such losses is critical when a culling strategy is followed to contain the disease. Despite the decline in production volumes, the nature of the product implies that trade has a very limited role in the domestic market. The disease therefore also results in substantial price increases, which entices some producers to take the risk of expanding production, but also results in much higher cost and reduced consumption levels.

Markets in Malawi and Zambia: **Hindering soya bean growth?**

By Chelsea Markowitz, the South African Institute of International Affairs

In Malawi and Zambia, soya bean production has grown significantly over the past decade, driven primarily by the rising middle-class population in both countries consuming more chicken. Production in Zambia grew from 55 000 tons in 2007 to 350 000 tons in 2017, while production in Malawi grew from 40 000 tons in 2005 to 132 417 tons in 2016/17.

Malawi and Zambia are the only two countries within the Southern African Development Community (SADC) region that consistently produce surpluses of both soya bean and soya cake. This signifies the possibility of greater international and regional trade, particularly given that South Africa faces a production deficit in meeting its domestic demand for soya bean and soya cake.

However, a number of bottlenecks in Malawi and Zambia are preventing greater regional soya bean linkages, including the low production efficiency of smallholder producers, lack of structured markets, logistics constraints and limited access to finance. A key constraint to the soya bean trade is the absence of market information.

The market information landscape

Robust market information is essential for farmers to plan their production for the upcoming season. Smallholders in particular benefit as this lessens opportunities for unfair pricing from traders. Accurate market information assists traders in knowing the quantities available for export and import, and assists policymakers in making appropriate agricultural policy decisions to ensure food security and economic growth.

Structured market systems provide an important investment incentive for processors and input suppliers, and are generally a crucial component in the development of cost-effective value chains.

South Africa boasts a mature market information system, underpinned by the *Marketing of Agricultural Products Act, 1996* (Act 47 of 1996), comprised of a handful of key independent institutions, including the South African Grain Information Service (Sagis), which provides information on production, imports, exports and consumption, the Crop Estimates Committee (CEC), the South African Futures Exchange, and the Bureau for Food and Agricultural Policy (BFAP), all collaborating to provide public market information.

The system is robust enough to detect faulty statistics, given the multiple sources of information. More importantly, the absence of government intervention in the markets ensures the smooth functioning of the system.

In Zambia and Malawi, the landscape is decidedly different, as oilseed value chain players face difficulties in both access to and accuracy of market information. State marketing agencies also have a heavy hand in these industries.

Largely ineffective system

While commercial farmers and large traders and processors in Zambia and Malawi can access the best available market information from private services such as Commodity Insight Africa, smallholders are at a disadvantage because they do not have information to make informed decisions on what to plant and when and where to sell their products.

In a country such as Malawi, where smallholders comprise over 90% of soya bean producers, this renders the market system largely ineffective. In Zambia, the number of smallholders engaged in soya bean production is growing and will soon comprise 50% of total production.

Even for commercial farmers who have better access to information, private services still rely on questionable in-country data collection that often comes from anecdotal/informal accounts, demonstrating the need for more structured data collection. The large number of smallholder producers compound accuracy issues, as smallholders often hold on to stocks that are not recorded and engage in high levels of informal cross-border trade, which is very poorly understood and documented in Malawi and Zambia.

These dynamics are complicated by government involvement in the market through periodic soya bean export restrictions. In addition, price volatility stemming from the purchasing and selling of maize by the government impacts the soya bean price, as well as the productive capacities of many soya bean farmers who rely on maize as a primary source of income.

More accurate market information will ultimately lead to increased predictability and lessen the need for government intervention in the markets for food security purposes, due to greater knowledge of current and predicted stocks. This will improve the ability of government and industry to plan how much soya bean might be needed for domestic processing and enact quotas rather than full export bans, which ultimately collapse smallholder prices.

Improve market information

Zambia and Malawi have made progress in establishing better organised soya bean markets. However, these efforts still face several structural and political challenges. In Zambia, industry and government currently have a 'stocks monitoring committee' for grain and oilseeds, where stakeholders in the value chain report their stocks, which is captured in a report.

Nevertheless, stocks are not checked consistently, and it is generally agreed that there is an approximate 30% margin of error in reported stocks. While general estimates can be somewhat useful for policymakers, industry players such as input suppliers, farmers, traders and processors need accurate information to make informed business decisions. There is a need for a more precise and independent mechanism to curate accurate information, such as the multi-institutional system in South Africa.

Although the development of such systems has been discussed in industry, donor and government circles throughout Southern Africa for years, the Southern Africa Trade and Investment Hub (SATIH), funded by USAID, is now engaged in a potentially promising project.

In Zambia, SATIH is in the process of developing 'ZAGIS', based on the Sagis model in South Africa. SATIH has been meeting with industry stakeholders to support this idea and identify some of the challenges, with the aim of pitching a polished proposal to government. At this stage, a number of potential challenges remain.

Influence of a united industry

At the forefront is the need for a real champion for this initiative, which cannot survive with the primary drive coming from an external funder. While most stakeholders are in favour of ZAGIS in theory, it will require a solidified effort from all industry stakeholders to demonstrate its benefits to government stakeholders. This is complicated by the fact that withholding information can sometimes be beneficial to farmers and companies in the short term, and the lack of trust between the public and private sector.

Also critical to the effective functioning of ZAGIS is the passing of the Marketing Act, which has been sitting in parliament in Zambia for an extended period of time. Without a legal framework mandating and regulating the provision of information, ZAGIS cannot be viable.

Initial interest from government in ZAGIS as well as recent pledges to deregulate the maize markets are perhaps positive signs, but it remains to be seen whether there will be follow-through. Agriculture is very important to the Zambian economy, so a united industry can have a big influence.

> A key constraint to the soya bean trade is the absence of market information.

In Malawi, there is interest in a similar system, though at a less advanced stage. From a technical perspective, the collection of information from farmers will be much more difficult in Malawi given their small size and fragmentation. Farmers' associations such as the National Smallholder Farmers' Association of Malawi (NASFAM) have a critical role in monitoring smallholder crops in order to collect accurate information.

Overcoming capacity constraints

However, they face serious capacity constraints. Securing buy-in for the initiative will be difficult given fewer large industry players (both commercial farmers and multinational processors) with the ability to exercise influence. Nonetheless, there is demonstrated interest among private actors.

Given these circumstances, some of the traders and medium-sized processors in Malawi need to come together to exert pressure on the authorities to generate an appropriate legal framework for the sector. Greater initial donor support will be a necessary reality to get this initiative off the ground given the smaller industry in Malawi.

Both countries have established commodities exchanges that trade soya bean. In Zambia, the Zambia Commodity Exchange (ZAMACE) was established in 2007, but only recently began to gain momentum and buy-in from traders and processors with the implementation of the Agricultural Credits Act.

In Malawi, there are the Auction Holdings Commodities Exchange (AHCX) and the Agricultural Commodity Exchange for Africa (ACE), the latter of which is one of the more effective exchanges in the region in terms of live trades, but still receiving significant volumes from donors.

These exchanges have the potential to greatly improve certainty for market players through the option of futures trades, yet their effectiveness rests squarely on the tackling of the market information challenges mentioned earlier.

Benefit from collaboration

Overall, in both Zambia and Malawi there should be a focus on the improvement of crop estimates where there may be gaps in obtaining information from smallholder farmers. This means that it is important to work closely with institutions that monitor informal trade such as Famine Early Warning Systems Network (Fews Net).

In terms of improving access to information, the Zambia National Farmers' Union disseminates information to farmers via SMS in Zambia. However, this information does not reach farmers who are not part of the union, and better government dissemination is therefore needed.

In Malawi, the nascent commodities exchange, Agricultural Commodity Exchange for Africa (ACE), provides price information. However, the uptake and effective utilisation of this information in both countries are unclear, and there has not been extensive evaluation of these programmes, which should be prioritised.

Alongside continuous efforts to improve efficiency and yields, it is important that market information initiatives are not neglected and receive unified support from industry, donors and government. South African industry players will benefit from continued collaboration with these efforts, in order to facilitate regional linkages and ultimately help to address under-capacity at their own soya bean processing plants.

For enquiries, contact Chelsea Markowitz on 011 339 2021 or send an email to info@saiia.org.za.

A glimpse into the crystal ball
of grains and oilseeds storage and handling

By Mariana Purnell, general manager: Agbiz Grain

There have been several recent mergers of large global agrochemical and seed companies, whose diversification and highly progressive technological approach bring new, innovative technology to agriculture. To keep up with this, the role of grains and oilseeds handlers/storage facilities will gradually expand.

Temporary storage structures
Unpredictable weather due to climate change could drastically change the intervals of good and bad years. Climate change is leading to a shift in grain and oilseed production. This erratic production and changing demographics will increasingly lead to a need for various temporary grain storage structures that can be deployed when and where required.

Technology
Farm information relating to production will enable the storage facility to optimise planning for storage. Remote sensing technology makes production estimates easier and cheaper. Satellite data makes it possible to identify and classify grain crops, determine growth vigour, monitor plant condition, develop various crops and make yield estimates.

Proactive risk determination
Other earth observation applications make it possible to determine groundwater and classify fields as conventional or conservation agriculture. Technology is available to refine crop insurance by verifying damage and quantifying and comparing it to the scope and size of claims – hence the shift to objective damage estimation. In addition to satellite and index-based insurance, companies can also apply disaster management by identifying problem areas that will have a financial impact on the business, or determine crop prospects that are linked to repayments by individual producers.

> Certain requirements force producers to provide variety names of genetically modified or self-pollinated grain and oilseeds when consignments are delivered.

Crop insurance cover, for its part, can be applied more widely than just for weather, drought, floods, pests and price fluctuations. It is well known that conservation agriculture holds many benefits for production and, if crop insurance is linked to soil quality as well, soil data can be considered when rates are determined and can therefore be used as an incentive. Such monitoring can ensure compliance and reduce risks, while increasing soil health can improve the management of food security, sustainability and climate change.

The integration of data is an aspect that can lead to predictive instruments for pests and diseases. Although chemical control can keep pests and diseases in check, it requires high input


Mariana Purnell

costs, reduces the microbial viability and encourages the development of resistance. Analytical platforms will in future help to predict and identify pests and diseases and determine their extent. Such instruments use sensor-driven field data, aerial photographs, weather and life cycle analyses of diseases and pests to provide an early warning system for diseases and pests in any climate.

Information systems
Certain requirements force producers to provide variety names of genetically modified or self-pollinated grain and oilseeds when consignments are delivered. The intake systems of storage facilities should therefore be adaptable and make provision for changes so that such information can be provided. Technological levies on tons per variety are declared at the first point of trade and will be used to make the newest technology

available locally so that producers can compete in international markets.

Traceability

Origin is becoming increasingly important, and the storage facility's role is vital where an agrochemical passport must accompany a consignment from the farm to the storage facility and then to the processor.

Overseas it is already common practice for every truck to be tested for mycotoxins, pesticides and heavy metals before the consignment is offloaded. Farms are subject to annual independent audits and inspections. Food safety requirements also apply to transporters – whether by road or by rail.

Food security

Mycotoxins have a negative effect on humans and animals. To control the incidence of these fungal by-products, local legislation was amended in 2017. Processors of grain will soon expect storage facilities to provide the assurance that the mycotoxin levels of grain delivered for processing are within permissible levels. As the specialised analysis of mycotoxins is a long, expensive laboratory process, storage facilities will have to rely on cheaper, quicker tests that are reasonably accurate.

Automation

- Electronic samplers, as well as specialised grading apparatus that is based on image analysis and spectroscopy, can quickly, effectively and objectively determine quality on delivery and at the same time point out fungus infections that cannot be detected by the naked eye.
- Protein sorters, for example, can optimally mix wheat at a specific protein level during outloading. The company can benefit financially from maintaining the protein level at a constant 12% (B1) and not needlessly outloading higher proteins.
- Cleaning of silos can be difficult, time-consuming and dangerous. Now there are automatic methods that exclude the human factor. Newly patented technology utilises two large liners that alternately inflate and deflate to remove grain, without the need to enter the bin.

Mobile sensors

Effective, robust and reliable sensors offer a variety of logistical uses. They can be mixed into a grain mass to send signals that warn timeously against undesirable temperature or moisture conditions, as well as fumigants. Signals to prevent grain from spoiling can be sent from inside silos, bunkers, silo bags or shipping containers and warehouses.

For more information, send an email to Mariana Purnell at mariana.purnell@agbizgrain.co.za.

THE SOUTHERN AFRICAN GRAIN LABORATORY NPC

The Southern African Grain Laboratory NPC (SAGL) is an independent non-profit laboratory, established in 1997 by the grain industry to act as a Reference Laboratory for the grain and oilseed industry. The SAGL provides an internationally competitive range of laboratory services for grain, oilseeds and products thereof including food, feed and feedstuffs. These services are driven by the needs of the broader grain industry.

The scope of analysis includes milling, grading, physical, chemical, rheological, baking, mycotoxin as well as macro- and micro nutrient analyses. ISO 17025 accredited test methods are implemented within a comprehensive quality system. Participation in several national and international proficiency schemes demonstrates technical competency, international comparability and traceability to international standards. The stakeholders serviced by the SAGL include grain and oilseed producers, the handling and storage industry, processors including the baking, milling and animal feed producing industries, traders of agricultural commodities, commercial seed breeding companies, agricultural research institutes and since 2016, also companies producing crop protection products.

The SAGL has expanded the scope of analysis by adding a Crop Protection Division to support the broader agricultural community in Southern Africa with accurate and reliable analytical results for registration purposes and after manufacturing quality control analysis of the final product as well as shelf-life extension.

This Division performs 5-batch analysis on technical material as well as the Physical, Chemical and stability testing on formulations as prescribed by the Food and Agricultural Organization of the United Nations(FAO) and the World Health Organization (WHO). This laboratory is equipped to perform most tests required by FAO/WHO according to the latest Collaborative International Pesticides Analytical Council (CIPAC) methods.

As an associate member of CropLife South Africa and through international involvement in the Specification Expert Group (SEG) and the English-Speaking Pesticide Analytical Committee (ESPAC), the SAGL is informed of changes in international requirements as developments take place.

SAGL

Southern African Grain Laboratory

Crop Protection Division

sanas AACC INTERNATIONAL 2012 Corporate Member AFMA Members of Campden BRI CropLife

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So much more than just a bean

By Carmen Muller, Hettie Schönfeldt and Beulah Pretorius, University of Pretoria

Soya was first recorded and described as a sacred grain in the Orient during the Chou Dynasty, between 1134 and 246 BC. Soya crops gained increasing popularity once their fermentation potential was discovered, and in Western civilisation the agricultural potential became prominent.

In 1804, a ship from the Orient to the United States delivered its first batch of soya beans to the Western world. From there, soya spread worldwide and has since been used for both human and animal consumption. Soya bean has often been referred to as the 'miracle crop' due to its high protein content and variety of uses.

Global soya production increased from 27 million tons in 1963 to 218 million tons in 2007 and is projected to rise to 514 million tons in 2050. In South Africa, soya is mostly used as animal feed. In the oilseed industry, however, human consumption is increasing. The production and consumption of soya bean oil for human and animal use is on the rise.

The demand for protein

Soya plays a multifaceted role in the food industry due to its functionality, versatility and nutritional content. Soya is so much more than just a bean and is used in the food industry as lecithin, reconstructed protein, flour and flavourings in baked goods, candies, spreads, coatings and powders, to name a few.

When taking a closer look at ingredient lists of products, it becomes evident that soya can be found in every isle of the supermarket, where it plays various flavour and structural roles as well as contributing to the diet. Apart from being a high protein food alternative, studies are showing that soya can be classified as a low GI food, which can further boost this product's market potential.

The demand for protein as a macronutrient that provides energy and essential amino acids is increasing, along with the growing world population. This should be seen against an environment where people are increasingly enabled financially to purchase and consume a varied diet.

"Global soya production increased from 27 million tons in 1963 to 218 million tons in 2007 and is projected to rise to 514 million tons in 2050.

One of these groups experiencing a rise in expendable income is the South African middle class. This group is also the main consumers of protein extenders and replacers. In addition to a growing need for protein, pressure is placed on the food system to be more environmentally conscious.

Although considered globally as a healthy, sustainable, protein alternative to animal-source foods, soya beans for human consumption have not been mainstreamed in South Africa, which creates an opportunity to grow and develop the sector for farmers and consumers.

Processed for human consumption

Protein plays many functional, structural, metabolic and developmental roles in the human body. Adequate protein intake and the correct ratio of essential amino acids are necessary for overall health. Plant-based foods have been a source of protein for humans for millennia, providing about two-thirds of total protein intake globally.

Although one of the South African Food-Based Dietary Guidelines of the National Department of Health states that adults and children older than ten years should "eat dry beans, peas, lentils and soy regularly", only 4% of total production in 2012 was processed for human consumption.

Even though this contribution is small compared to oilcakes or animal feed, the human consumption of soya beans has increased fivefold since the early 1980s, indicating a potential to grow and establish this commodity as a modern, healthy, culinary item.

Importance of protein quality

The total South African soya bean crop was estimated to be approximately a million tons in the 2016/17 production year, which is only 0,28% of global production. It places the focus on the need to prioritise the consumption of these foods, and more specifically soya.

The World Health Organization (WHO) Technical Report on Protein and Amino Acid Requirements in Human Nutrition (2007) states that the best estimate for a population average requirement is 105mg nitrogen/kg body weight per day, or 0,66g protein/kg body weight per day.

In many developing countries protein intake falls significantly short of these values. Apart from protein quantity, protein quality, including bioavailability and digestibility, is currently being discussed on the global nutrition agenda.

The first International Symposium on Dietary Protein for Human Health, held in Auckland in March 2011, and the follow-up Food and Agriculture Organization of the United Nations (FAO) Expert Consultation on Protein Requirements, both highlighted the importance of assessing the quality of protein from different food sources through the determination of amino acid content.

> Soya plays a multifaceted role in the food industry due to its functionality, versatility and nutritional content.

Throughout the developed world, animal products and cereals are the two most important sources of protein, respectively. In developing countries such as South Africa, this order is reversed similar to low income countries where only 3% of total dietary energy as an indicator of diet composition is derived from meat and offal, 11% from roots and tubers, and 6% from pulses, nuts and oilseeds. The remainder of the dietary energy is mainly obtained from cereal-based staple foods.

As countries are developing, the demand and consumption of protein is continually increasing. Undernutrition, including insufficient consumption of protein, remains a persistent problem in developing communities, and although many diets within these communities are deficient in the quantity of protein compared to recommendations, the quality of the protein is as important.

Table 1: Type and amount of essential amino acids required to form a complete protein.

Essential amino acid	mg/g of protein
Tryptophan	7
Threonine	27
Isoleucine	25
Leucine	55
Lysine	51
Methionine+Cystine	25
Phenylalanine+Tyrosine	47
Valine	32
Histidine	18

Table 2: Protein content of different food groups.

Food group	One serving (g)	Protein amount (g)
Meat	85g beef, lean cooked	28
	85g chicken, cooked	26
	85g anchovy, canned in oil (solids)	25
Legumes	172g (1 cup) cooked soya beans	29
	196g (1 cup) boiled split peas	16
	256g (1 cup) red kidney beans	13
Dairy	245g (1 cup) milk	8
	28g Cheddar cheese	7
	30g low fat cottage cheese	4
Starch and cereals	185g (1 cup) white rice	9
	219g (1 cup) oat bran	7
	25g (1 slice) wholewheat bread	3
Vegetables and fruit	180g (1 cup) spinach	5
	118g (1) banana	1

Mixture of plant proteins

In terms of protein quality for dietary adequacy, most plant proteins are considered to be 'incomplete' in that they are deficient in one or more of the indispensable amino acids. Even though soya contains all the essential amino acids, which are required in order to be classified as a complete protein (*Table 1*), it does not contain these amino acids in the correct ratio, due to the low methionine content of plant products.

Mixtures of different plant protein sources may be complementary, with one source providing the amino acid that is limiting in another source and *vice versa*, thereby making the mixture of plant proteins 'complete' sources of amino acids. Dietary approaches that combine complementary foods, e.g. a cereal and a legume such as maize and soya beans, will meet protein requirements.

Establishing a baseline on the nutritional profile of current cultivars is therefore essential to prioritise the future improvement of the nutritional profile. Translating the knowledge on the nutritional profile of soya beans into such tangible recommendations to meet dietary needs is also needed.

Some amino acids commonly limit the nutritive value of different sources of proteins in the human diet. They are methionine, lysine, tryptophan and threonine. These amino acid concentrations are generally lower in plant-based sources of protein.

Increased opportunities

Even though animal-based foods contain all essential amino acids in the correct proportions, the correct combination of plant-based protein foods could increase the protein quality of the meal (*Table 2*).

The soya bean consists of 40% protein, 20-30% carbohydrates, 18% oil, moisture and ash. Soya can be a protein substitute in the diet, particularly with its ability to be processed to have a meat-like consistency. The high protein content of soya further aids nutrition in a country were protein energy malnutrition is prevalent.

Further research and consumer education on soya may be the key to unlocking more opportunities for the soya bean industry within the South African consumer market.

Failed land reform projects:
Who should foot the bill?

By HJ Moolman

The Restitution of Land Rights Act, 1994 (Act 22 of 1994, i.e. the Restitution Act) is the oldest legislation from a hierarchy of acts aimed at regulating South Africa's land reform process and providing justice to people who were disadvantaged based on race before 1994.

Several other acts were promulgated to ensure the restitution of rights, as well as to ensure more security of tenure and the redistribution of land.

This year marks our 23rd year of democracy, and many South Africans believe that land reform has failed. The government, however, is of the view that more radical steps need to be taken for land reform to succeed, and that the cost of land reform should be transferred to private land owners whose land should be expropriated without compensation.

Basis of compensation

In support of this argument, the main scapegoat for this radical approach is the basis of compensation for existing land owners from whom land was bought to settle claims. The courts consistently maintained the position that the basis of compensation must be a market-related price determined by sworn valuers.

Since 1994, the biggest percentage of the state's annual budget allocated to the purchase of land for land reform and its administration was 2,5%. This indicates a major contrast between the political priority that was placed on land reform, and the extent to which the state was prepared to commit financially to this goal.

The *Restitution Act* produced approximately 75 000 land claims before 31 December 1998, and although the act determines that certain minimum requirements must be met before valid claims can be published in the *Government Gazette*, extremely little and very low-quality work caused thousands of claims without merit to be published.

Increased land value

The publication of these claims and the accompanying encumbrance of land did not only increase the administrative and handling costs of claims, but also undoubtedly increased the value of unencumbered land that was not part of claims.

Apart from other aspects that could in fact have increased land value, the lower offering of unencumbered land and higher demand contributed to higher values, which eventually became the benchmark of the comparable transactions mentioned previously.

The land obtained by the state was transferred to communal property associations in communal possession. As land was transferred with little and in some cases no support after establishment, 90% of these projects failed. Even programmes to recapitalise land and to pair new owners with mentors (existing and retired farmers) to control farms did not yield significant results.

Regarding security of tenure the legislation, to a large extent, constrained illegal and arbitrary evictions.

It is disappointing, however, that millions of rand was spent to finance litigation in court against land owners with valid grounds for legal evictions, instead of using the money to permanently relocate farm dwellers elsewhere with the help of land owners.

On the other hand, this legislation resulted in owners who were no longer prepared to provide accommodation to people working on their farms. The result was that thousands of people took refuge in informal settlements around rural towns.

No quick fix

The redistribution of land and the purchase of land by the state from willing sellers are not without challenges.

The limited ability of the state to carry out and complete these transactions within a reasonable period of time, for instance, has forced many land owners to secure their own survival by withdrawing their land from transactions with the state and finding other buyers.

Irrespective of the manner in which government will tackle land reform in the foreseeable future, the realities of the past cannot be solved merely by new ownership of land. We will have to wait and see whether sound judgement regarding land reform, which will not be to the detriment of food security and the economy, will triumph.

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