



PROTEIN RESEARCH FOUNDATION



2017-2018

RESEARCH REPORT



**PROTEIN RESEARCH FOUNDATION**

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## Vision

The PRF strives to make a significant contribution to the promotion of local production of protein on a sustainable basis, in order to satisfy the growing demand for protein for animal production purposes as well as the optimal utilisation thereof, which will lead to an increase in the standard of living of all people in the Republic of South Africa.

## Mission

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

The PRF subscribes to.....

- A balanced, objective approach, which is sensitive to the developmental needs of the RSA.
- A critical awareness of the latest developments regarding protein supply and utilisation.
- The promotion of cost-effective research.
- The dynamic promotion of the implementation of research results.
- The effective sustainable utilisation of natural agricultural resources.
- The reduction of foreign exchange payable for imports and creation of job opportunities by replacing imported protein as far as possible with locally produced protein.



# **PROTEIN RESEARCH FOUNDATION**

## **RESEARCH REPORT 2017-2018**

### **TABLE OF CONTENTS**

|            |                                                                              |           |
|------------|------------------------------------------------------------------------------|-----------|
| <b>1.</b>  | <b>INTRODUCTION.....</b>                                                     | <b>4</b>  |
| <b>2.</b>  | <b>DISCIPLINES REPRESENTED ON THE BOARD .....</b>                            | <b>10</b> |
| <b>3.</b>  | <b>PROJECTS FINANCED 2017-2018 .....</b>                                     | <b>32</b> |
| <b>4.</b>  | <b>STUDY GRANTS AND BURSARIES .....</b>                                      | <b>56</b> |
| <b>5.</b>  | <b>ACHIEVEMENT AWARDS TO PROMOTE THE PRF VISION AND MISSION .....</b>        | <b>58</b> |
| <b>6.</b>  | <b>CONCLUSION .....</b>                                                      | <b>58</b> |
|            | <b>ANNEXURES .....</b>                                                       | <b>59</b> |
| <b>I</b>   | <b>LIST OF APPROVED PROJECTS IN 2017-2018 .....</b>                          | <b>59</b> |
| <b>II</b>  | <b>LIST OF PROJECTS FINALISED DURING 2016/2017 .....</b>                     | <b>61</b> |
| <b>III</b> | <b>SHORT- AND MEDIUM-TERM DEMAND AND USAGE OF FISHMEAL AND OILCAKE .....</b> | <b>62</b> |
| <b>IV</b>  | <b>PRF STRUCTURES .....</b>                                                  | <b>64</b> |
| <b>V</b>   | <b>LIST OF BURSARY APPLICATIONS: 1995 - 2017 .....</b>                       | <b>65</b> |
| <b>VI</b>  | <b>LIST OF RESEARCH PROJECTS: 1976 - 2017 (SEPARATE ADDENDUM).....</b>       | <b>78</b> |



## 1. INTRODUCTION

During the 2017-2018 financial year the Board of Trustees once again succeeded in their efforts to achieve the Trust's objectives as set out in the Trust Deed.

- Objectives of the Trust

The founding objectives and requirements of the Trust are to place the reserve funds earmarked for the financing of protein research as provided for in Section 20(5) of the Agricultural Research Act of 1990, as well as all future donations provided for in Section 20(5)(c) of the Agricultural Research Act of 1990, in trust for research purposes to be allocated in the Republic of South Africa, as the Trustees may determine from time to time, for the purposes of research in one or another, or all of the following fields:

### (a) Protein Research

Research to the benefit of protein sources earmarked for animal feed and that relates to protein of animal origin, as well as protein obtained from oilseeds and other protein rich plants.

### (b) Oilcake Research

Research related specifically to the oilseed protein value chain.

### 1.1 Board of Trustees

The Trust is administered and managed by a Board of Trustees convened from various disciplines. Currently the Board is composed of the following Trustees:



|                      |                                                                                                |
|----------------------|------------------------------------------------------------------------------------------------|
| Mr GJH Scholtemeijer | - Expert according to the discretion of the Board (Chairman)                                   |
| Mr AP Theron         | - Expert : Representative - Organised Agriculture - Producer of Protein Crops (Vice-chairman)  |
| Dr E Briedenhann     | - Expert : Representative - Oilseeds Processors and Representative - Animal Feed Manufacturers |
| Dr J de Kock         | - Expert : Discipline - Plant Production                                                       |
| Prof RM Gous         | - Expert : Discipline - Protein Consumers                                                      |
| Mr GT du T Keun      | - Expert according to the discretion of the Board                                              |
| Prof FH Meyer        | - Expert : Discipline - Agricultural Economics                                                 |

#### **(i) General Overview**

During the reporting period 1 March 2017 to 28 February 2018, the Trust met seven (7) times. Two (2) of the meetings were combined meetings with the Technology Committee and one (1) Special Board Meeting was held to discuss and decide about matters that will benefit the industry and ensure the realisation of the objectives of the trust.

During the period under review, R7 469 712 was approved in respect of research projects, technology transfer and bursaries.

Various issues were discussed, including support of the implementation of a breeding and technology levy for the soybean industry, requirements for the registration of GM canola, expansion of soybean production in the North West Province, the approach to improved average soybean yields, support of the reduction in customs duty rate that applies to canola seeds, saving mechanisms and the composition of the PRF structures, research projects, technology transfer, crop promotion actions, bursaries, achievement awards and the amendment of the PRF Trust Deed.



## **(ii) Financial Overview**

### **(a) Investment and Management of Trust Funds**

Two (2) portfolio managers, Foord and Old Mutual Wealth, manage the PRF trust funds.

The performance of the respective portfolio managers are monitored and reviewed constantly. Except for regular discussions, the Fund Managers are also requested to deliver a presentation to the Board of Trustees at least annually.

### **(b) Audit**

Ashton Chartered Accountants are currently charged with the auditing of the PRF's financial affairs.

As in the past, the auditors issued an unqualified audit report. The report noted the efficient operations and management of the affairs of the PRF by all concerned.

## **1.2 Management Committee**

During the reporting period 1 March 2017 to 28 February 2018, the Management Committee met six (6) times.

The Management Committee may be considered an extension of the Board and provides recommendations relating to policy matters.

The Management Committee consists of the following members:



|                      |   |                                                                                      |
|----------------------|---|--------------------------------------------------------------------------------------|
| Mr GJH Scholtemeijer | - | Chairman, Chairman of the Board and Chairman of the Marketing and Finance committees |
| Mr AP Theron         | - | Vice-chairman of the Board                                                           |
| Dr E Briedenhann     | - | PRF Board member and Chairman of the Technology Committee                            |

### **1.3 Finance Committee**

During the reporting period 1 March 2017 to 28 February 2018, the Finance Committee met six (6) times.

The Finance Committee consists of the following members:

Mr GJH Scholtemeijer - Chairman

Mr AP Theron

The functions of the Finance Committee are as follows:

- The Finance Committee is one of the three Board standing committees and reports directly to the Board.
- The Finance Committee is responsible for managing the PRF finances according to the formulated Board financial policy. Although the Board may delegate some of its responsibilities in terms of financial matters to the Finance Committee, the financial liability for all financial matters and the formulation of the financial policy remains vested in the Board.

### **1.4 Marketing Committee**

During the reporting period 1 March 2017 to 28 February 2018, the Marketing Committee met six (6) times.



The Marketing Committee consists of the following members:

Mr GJH Scholtemeijer - Chairman

Mr AP Theron

The functions of the Marketing Committee are as follows:

- The Marketing Committee is one of the four Board standing committees and reports directly to the Board.
- The Marketing Committee is responsible for the marketing and promotion of the PRF as an organisation, but also for its vision, mission and objectives for all interested parties, as well as creating communication channels and the promotion of communication between the PRF and interested parties, including the preparation of data to provide information and the distribution of such information. It is also responsible for communicating information relating to bursaries and achievement awards.

## **1.5 Technology Committee**

During the reporting period 1 March 2017 to 28 February 2018, the Technology Committee met five (5) times. Two (2) of the meetings were combined meetings with the PRF Board.

The Technology Committee consists of the following members:

- Dr E Briedenhann (Chairman)
- Mr AP Theron
- Mr GJH Scholtemeijer
- Dr J de Kock
- Prof RM Gous
- Prof A Agenbag
- Dr J Dreyer





The functions of the Technology Committee are as follows:

- The Technology Committee is one of four Board standing committees and reports directly to the Board.
- The Technology Committee is responsible for evaluating and selecting all research projects, promoting technology transfer, visiting researchers and research projects, identifying gaps and new topics relating to research projects and the identification of new sources of supply and utilisation of protein for animal feeds.

### **1.6 Soybean Working Group**

During the reporting period 1 March 2017 to 28 February 2018, the Soybean Working Group met three (3) times. Meetings of the Working group were combined with the meetings of the Sunflower, Soybean and Soyfood Forums.

The functions of the Soybean Working Group involve the following:

- \* Discussion of industry matters in the interest of and to the benefit of the soybean industry.
- \* Identification of research projects and technology transfer to the benefit of the soybean industry.

### **1.7 Canola Working Group**

During the reporting period 1 March 2017 to 28 February 2018, the Canola Working Group met three (3) times.

The functions of the Canola Working Group involve the following:

- Discussion of industry matters in the interest and to the benefit of the canola industry.



- Identification of research projects and technology transfer to the benefit of the canola industry.

## **1.8 Canola Planning Committee**

During the reporting period 1 March 2017 to 28 February 2018, the Canola Planning Committee met four (4) times.

The Canola Planning Committee consists of the following members:

- Mr GJH Scholtemeijer (Chairman)
- Mr AP Theron
- Dr E Briedenhann
- Dr J de Kock
- Prof A Agenbag
- Mr C Cumming
- Mr F le Roux

The functions of the Canola Planning Committee involve the following:

- Discussion of industry matters and recommendations to the PRF committees, as these relate to research, technology transfer, liaison and any other action required for the promotion of canola production.

## **2. DISCIPLINES REPRESENTED ON THE BOARD**

### **2.1 Animal Feed and Oilseed Crushing Industry**

World Food Production 2017-2018 increased by 3,6% up to 1,07 billion tons. An average growth of 2,5% has been experienced per annum over the last five years, supported by a healthy growth in the production of meat, milk and eggs. Africa has remained the fastest growing feed region achieving 30% growth for the year (from a low base).

South African feed volumes for 2017-2018 were 11,03 million tons, a decrease of 0,98% from the previous year, while AFMA feed volumes



decreased by 0,7% to 6,43 million tons over the same period. Broiler feed at 29% remains the largest component of animal feed produced in South Africa, followed by beef and sheep at 27%, dairy at 20% and layers at 11%.

Many countries achieved a record soybean crop in 2017-2018, however world soybean output is likely to contract year-on-year to 337 million tons because of a sharp drop in Argentina production due to unfavourable weather. Global soybean consumption is expected to expand, dropping global carryover stocks. If Brazil and Argentina have favourable weather conditions in 2018-2019, global production can rebound. The increase in production is likely to be offset by an expected increase in global consumption to 358 million tons. The greater demand for Brazilian soybeans from China should stimulate production.

Due to a low crush volume of 890 000 tons domestically, a high carry over stock of 330 535 tons resulted at the end of February 2018. The lower than expected crush was due to a lag in some major end users in the soybean market making the change from imported Argentina soybean meal to local production. The uptake of local soybean meal was further influenced by the import of 70 000 tons of soybean meal imports from Zambia.

Soybean production increased further in 2018-2019 to 1,55 million tons. Despite demand for local soybean meal picking up, the labour, technical and mechanical problems at some major soybean crushers temporarily reduced supply of local soybean meal and increasing imports is likely to affect the average crush volumes and result in an estimated carry over stock of 657 235 tons. Predictions are that 760 000 tons local soybean meal will be consumed in 2018-2019 compared to 745 000 tons in 2017-2018. The 2018-2019 soybean consumption is estimated at 1,2 million tons, with 83% allocated for processing to oilcake and oil, this will be 11% higher than volumes processed in the previous season.



Sunflower oilcake exports from the three major producing countries namely Russia, Ukraine and Argentina have dropped nearly 20% year-on-year, mainly due to strong demand from Russia and China.

Locally, low carry over stock of sunflower seed at February 2018 (102 000 tons) has supported sunflower seed prices. There was a strong demand for sunflower oilcake in South Africa, due to the rising prices of soybean meal. Sunflower seed consumption is forecast at 845 000 tons for 2018-2019, down by 5% from the previous year.

## **2.2 Protein consumers**

### **2.2.1 South African Poultry Association (SAPA)**

The poultry industry has seen a recovery in profitability following a number of bad years, due mainly to a reduction in feed prices and an increased demand for poultry meat resulting in part from the demise of many small producers in the country. Bird flu resulted in problems especially for the layer and broiler breeder industries and this has resulted in a change in the housing systems used in these industries. Whereas in the past most layer and broiler breeder houses were open, and hence vulnerable to wild bird visitations, broiler houses are closed in most instances and as a result they avoided being infected by bird flu. Egg producers have taken note and are closing their poultry houses and replacing their four-tier cage systems with six-tier systems, thereby reducing the capital cost of housing by increasing population density whilst simultaneously keeping wild birds out of these buildings. The incidence of future bird flu outbreaks in the egg industry should be curtailed to a large extent by this intervention. Ostriches still remain particularly vulnerable however.



### **2.2.2 South African Pork Producers Association (SAPPA)**

The pig industry was very badly hit by the outbreak of Listeriosis in Gauteng, with the consumption of processed meat falling dramatically as a result. The public are still wary of consuming processed meat products, so the industry is taking a long time to return to normal. Performance of pigs continues to improve, especially as many of the bigger producers have invested in improved housing and equipment, so efficiency of production is better than it has ever been. It is so regrettable that when economic conditions improve for different sectors in agriculture the benefits are short-lived because invariably some disease or other intervention appears and spoils the party.

## **2.3 Plant Production**

### General

This portfolio includes general plant production, but also the following subject areas:

- Agronomy
- Crop physiology/Plant physiology
- Plant growing/Biotechnology
- Soil science/Plant nutrition
- Weed science
- Plant pathology
- Entomology
- Nematology



## Research and Technology Transfer

The PRF promotes research and technology transfer by providing funding for projects at the Departments of Agriculture, Universities and other co-workers.

- Agricultural Research Council (ARC)

ARC-NIPP in Stellenbosch conducts work on soybeans and canola. The work is funded by the PRF. Reports about these projects are submitted annually and appear elsewhere in the Research Report.

- Department of Agriculture

The Department of Agriculture in the Western Cape (DAWC) conducts work on canola and the work is funded by the PRF.

The canola elite trials and canola cultivar evaluation trials are of practical value. Reports relating to these appear elsewhere in the Research Report.

- Universities

The University of Stellenbosch (US) handles canola projects (see reports elsewhere in the Research Report). Funding is provided by the PRF.

In addition, the US also provides an office for Prof André Agenbag. He co-ordinates canola programmes as contractor on behalf of the PRF.

The University of Pretoria (UP) offers land at their Hatfield experimental farm. A contractor (Mr W van Wyk) of the PRF conducts some soybean trials at the farm.



- Co-workers

The PRF is further strengthened by co-operation with local and multidisciplinary companies such as seed companies and institutions like DOW/Du Pont/Pioneer, BAYER/BASF, SYNGENTA and others.

- International Co-operation

Various institutions in South America participate in the soybean elite programme conducted at six localities, representing the most important soybean growing areas in South Africa.

The evaluation sites in the cold areas include Bethlehem, Potchefstroom and Stoffberg. The warm areas are represented by Brits, Pretoria and Pietermaritzburg (Ukulinga).

Forty-five (45) lines and five (5) local standards/controls were planted at the six (6) localities with three (3) replications to evaluate adaptability to local conditions. The maturity groups of the entries varied between MG 4,0 and MG 7,2.

Two of the PRF contractors (Messrs W van Wyk and G De Beer) are responsible for conducting the trials.

DAWC handles canola elite trials and entries were received from various companies, including Agricol, K<sub>2</sub>Agri, Du Pont/Pioneer and Bayer.

#### Congresses / Symposia /Working Groups

PRF representatives attended several of these events. During these, old and new focal points were highlighted:

Conservation farming remains a recurrent focal point and much emphasis is placed on the concept and all its building blocks such as -



- Minimal soil disruption.
- Crop diversity.
- Permanent organic top layers.
- Living roots to stabilise soil.

Rotation farming is one of the mechanisms to promote diverse crops and must be determined for each area. In the maize growing areas, soybeans are a particularly suitable rotation crop and contribute significantly to healthy soil in cases where soil organisms such as *Trichoderma* and *Mycorrhizae* reduce soilborne diseases significantly.

Reduced tilling promotes beneficial predators that increase as organic material accumulates on and in the soil.

Nitrogen fixation with soybeans remains an important aspect. South Africa boasts about 1 500 *Rhizobia* that may be tested. At the moment, WB74 is the most supported race.

Nematodes (eelworms) are a particular problem for soybeans growing in the sandy soils of the Western Free State and the North West Province. In those areas, rotation farming makes a significant contribution. Some cultivars are tolerant and new nematicides are currently being tested.

Cultivar trials in the said areas are being considered urgently to find mechanisms to combat nematodes and obtain information about disease resistance in other areas. *Sclerotinia* is a particularly serious problem in some areas.

Bio-fertilisation, a relatively new aspect, is being addressed by fertilising companies. The term is misleading to a certain extent, because only nitrogen binding organisms produce fertilisation. The others increase fertiliser efficiency by making elements more accessible, or by stimulating plants to promote better growth. It is emphasised strongly that bio-products cannot replace inorganic fertilisers, but that they could contribute to improved





utilisation or improved crop growth and thus increase yield in the process (bio-stimulants).

### Yield Competitions

#### (a) Weigh and Win Competition

The competition for maize and soybean farmers attracted 10% more farmers than last year. The results were very good and may be summarised as follows for soybeans:

| <u>Division</u>            | <u>Producer</u>             | <u>Cultivar</u> | <u>Yield<br/>(tonne/ha)</u> |
|----------------------------|-----------------------------|-----------------|-----------------------------|
| • Irrigation               | Koos Uys<br>Bronkhorstspuit | RA568R          | 6,2510                      |
| • Eastern area             | Michael Allen<br>Middelburg | DM5953R         | 4,8580                      |
| • Western area<br>Dry land | Bernard Rabe<br>Fochville   | DM6.8iR         | 4,4374                      |
| • KwaZulu-Natal            | Cobus Botha<br>Bergville    | P64T39R         | 4,7326                      |

The climate and growing conditions were good, and the producers' practices were excellent.

Although the highest yield of 6,25 tons/ha remains significantly less than the 11,47 tons/ha of the world record holder, Mr Randy Dowdy of Georgia, America, the results are excellent for South Africa.

#### (b) Canola Yield Competition

This competition was repeated for the Southern Cape and Swartland, in spite of less than favourable conditions, due to a particularly dry year in the Western Cape. The two winners showed good yields:

|               |   |               |   |               |
|---------------|---|---------------|---|---------------|
| Swartland     | - | Andries Louw  | = | 2,215 tons/ha |
| Southern Cape | - | Pieter Beukes | = | 3,159 tons/ha |



## General

A large number of articles were published in magazines such as Die Landbouweekblad, Farmers Weekly, SAGrain, Oilseeds Focus, Canola Focus and others, as well as on the PRF website.

Agricultural Sciences: North West University, Potchefstroom Campus:

Two new four-year programmes were developed, focusing specifically on Agronomy, Soil Science and Agricultural Economics.

- (a) BSc (Agric) with Agricultural Economy and Agronomy.
- (b) BSc (Agric) with Soil Science and Agronomy.

Students may register for these new courses from January 2019.

## **2.4 Organised Agriculture**

The 2017/2018 season was turbulent indeed, not only climatically, but also politically. Agriculture experienced a renewed focus from government on the ownership of land and the redistribution of the land in the country. An exercise that impacted very negatively on the sustainability and morale of the whole farming community that was already under serious pressure due to the poor financial position of farmers. A situation that was created after the previous season's record crop that shifted the maize price from import to export parity. We've also seen the inauguration of President Ramaphosa after the resignation of President Zuma. Unfortunately, the confidence in the South African economy was reflected in the downgrading of the S&P grading report. This impacted very badly on the South African economy.

2017 Also celebrated the 20<sup>th</sup> anniversary of the free grain market. We honour those, who played a pivotal role in creating a workable free market system.



Climatically South Africa, especially the Western Cape and Northern Cape, experienced the worst drought in the last 90 years. Challenging times for our wheat and canola producers in these areas. We are thankful for the rest of the country that experienced a normal to an above normal raining season.

2017/2018 Will be remembered as a challenging year in the farming community.

## **2.5 Agricultural Economics**

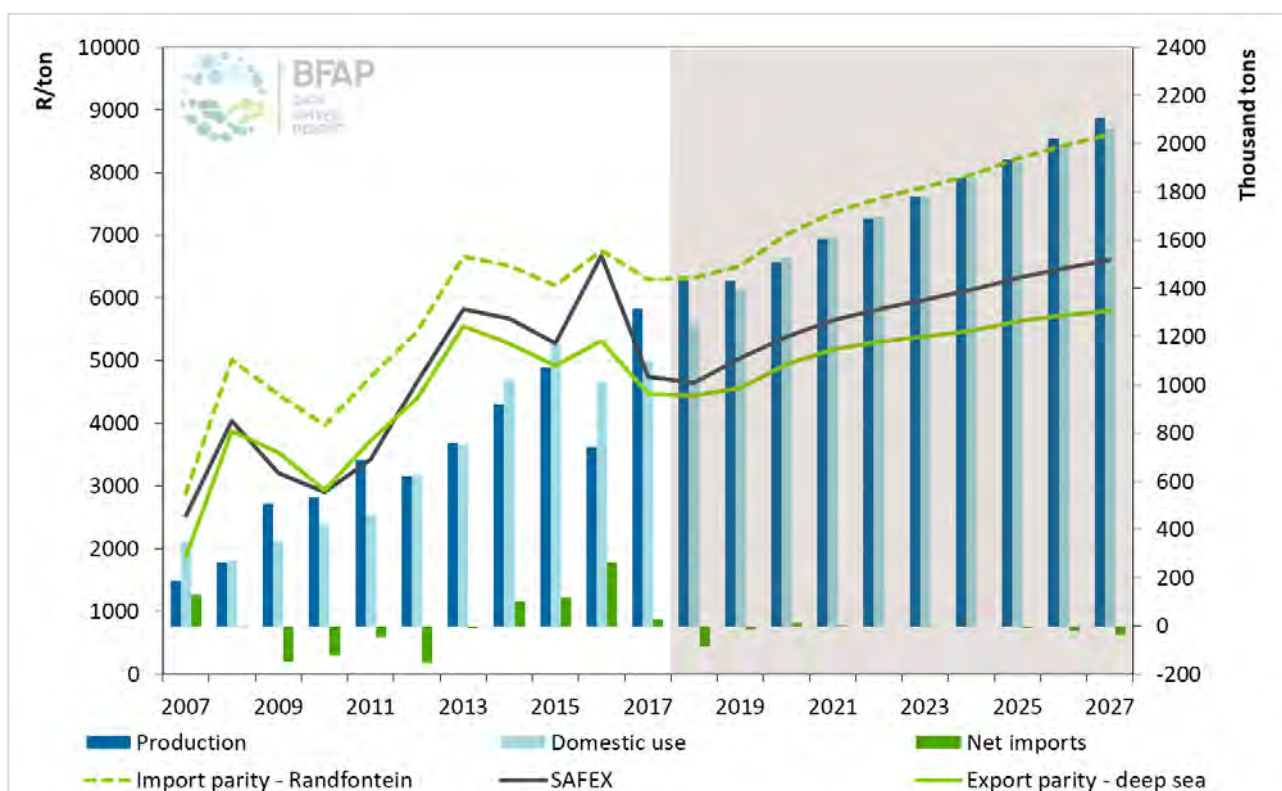
In 2017, South Africa produced 1,3 million tons of soybeans on 574 thousand hectares. The substantial year-on-year increase in yield levels brought the national average to 2,29 tons per hectare; the highest on record. The Crop Estimates Committee reports that in 2018, the area planted to soybeans expanded to an all-time high of 787 thousand hectares, a 37% year-on-year increase. A return to longer term trend yields implies that production is expected at 1,55 million tons. This makes soybeans the fastest growing field crop industry in South Africa over the past decade; area and production respectively increased by an average of 15% and 20% per annum. In the latest outlook produced by the Bureau for Food and Agricultural Policy (BFAP), the area cultivated to soybeans is projected to continue expanding by an annual average of 2,9%, to reach 962 thousand hectares by 2027. In 2017, the average soybean price fluctuated around R4600 per ton, a year-on-year decline of 29% on the back of lower international prices and a strengthening of the Rand over the course of the outlook. The SAFEX price is projected to trade between import and export parity, with the derived price for the cake and the oil determining a relative benchmark for the local price.

In addition to expanding area, projected production growth is underpinned by an average annual yield gain of 2% per annum over the outlook, which is faster than the yield improvements observed over the past decade. There are a number of trends to consider with regard to projecting future soybean yields. Firstly, there is a rapid increase in the number of soybean varieties available for planting. Secondly, the area under soybean production has increased rapidly and the western production regions, which have



traditionally been regarded as marginal areas for soybean production, are gradually coming into production. Thirdly, producers have continued adapting production techniques, resulting in more stable and improved yields.

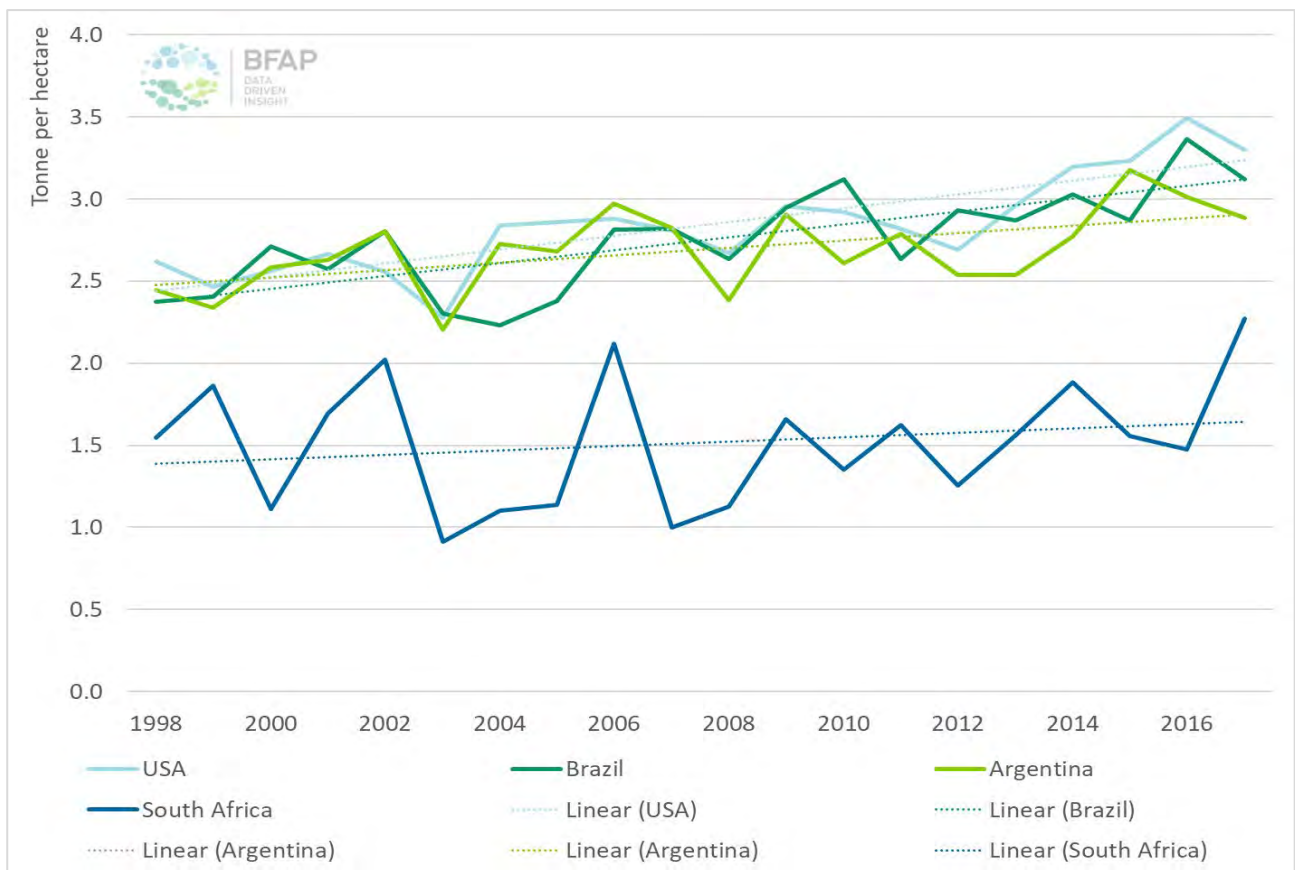
Therefore, combining these three trends and despite the significant variation in yields in recent years, South Africa managed to produce a soybean crop with an average yield of 2,29 tons/ha on 574 000 ha in 2017. It must however be said that the 2017 crop was grown under favourable climatic conditions, with some soybeans also planted on fallow areas carried over from 2016 due to the drought. In the current season, average yields have fallen back to an estimated 1,97 tons/ha due to less conducive climatic conditions. The view therefore is that although volatile weather conditions have not allowed average yields in recent years to reflect the full potential of improved seed varieties, improved farming practices and investment in suitable mechanisation, these investments are expected to start paying off in the next few years. This assumption rests on the premise that the investment will be maintained and the End Point Royalty system introduced successfully.



**Soybean production, consumption, trade and prices: 2007 - 2027**



Although seed companies have over the last number of years invested in bringing an increased number of soybean varieties (with a wider range of climatic adaptability) to the market, current market information indicates that companies are not willing to introduce the latest seed technology in South Africa without an End Point Royalty system. This could have a significant impact on the competitiveness of South African soybean farmers, who are facing very stiff competition from the major international soybean producers not only from a yield perspective, but also from the ability to produce a consistent bean quality. Considering a 20-year period, the average annual yield increase for soybeans in the United States was 1,46%, while yields increased by 1,33% in Brazil and 0,64% in Argentina (Table i). Despite the influence of recent droughts on average yields in the short term, South African soybean yields increased marginally at 0,43% per annum. On average over the 20-year period, South Africa's average soybean yield was 40% lower than the average achieved in the three leading soybean-producing countries.





20-year historic soybean yields

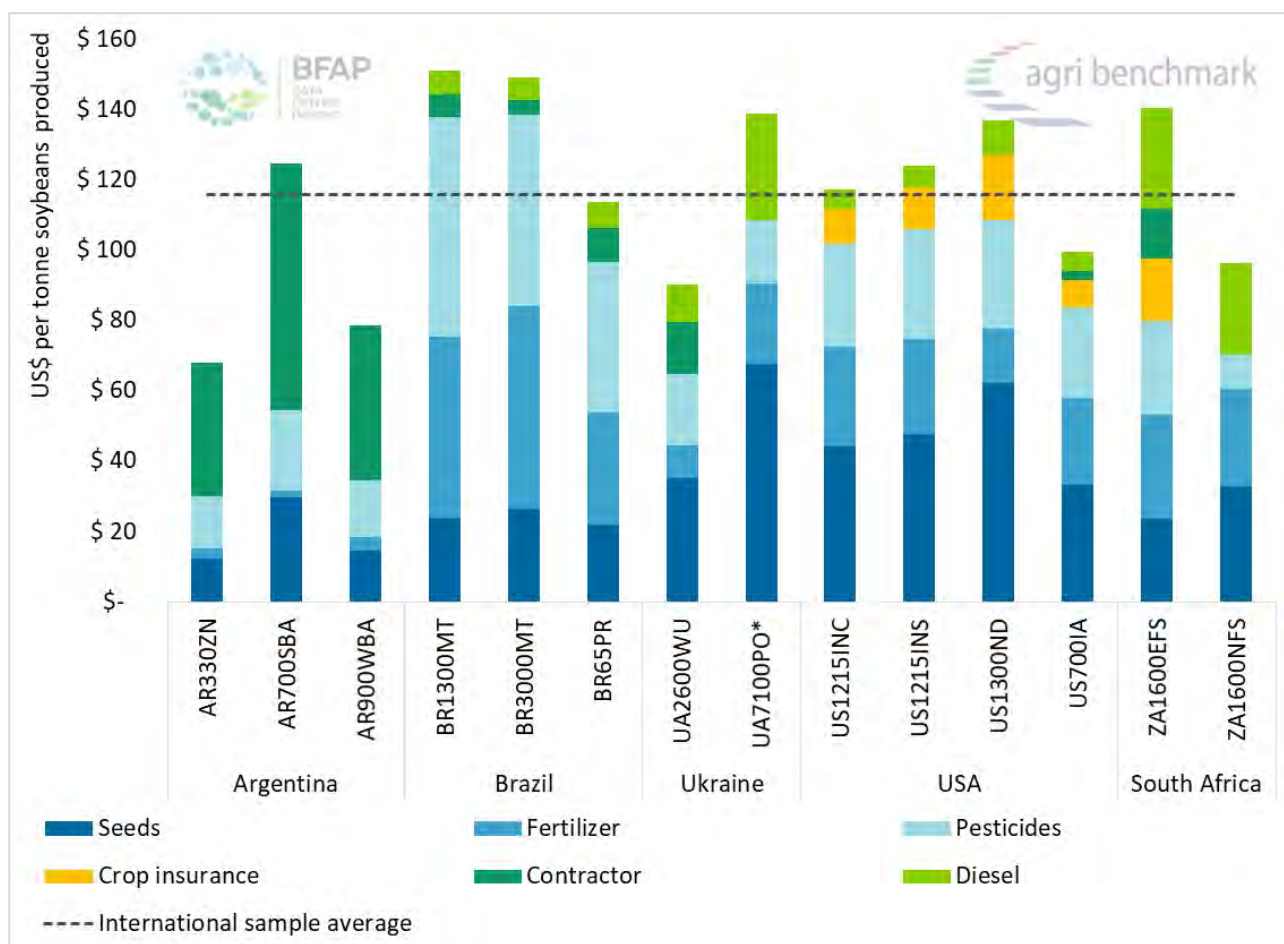


**Table i - Annual average soybean yield increase between 1998 and 2017**

| Country      | Percentage |
|--------------|------------|
| USA          | 1,46%      |
| Brazil       | 1,33%      |
| Argentina    | 0,64%      |
| South Africa | 0,43%      |

As was the case with maize, the exceptional soybean crop in the 2017 production season is also visible in other farm-level competitiveness indicators such as the cost of production. Figure 1 illustrates the cost to produce a ton of soybeans across the globe with South African farms located on the right. Previous analysis indicated that local farms are less competitive compared to international counterparts such as Brazil, Argentina and the United States of America. This is driven mainly by lower yields and higher cost for selected input items. The Eastern Free State prototype farm spent US\$140 on average to produce a ton of soybeans, whereas the Northern Free State farm, newly introduced into the BFAP network of prototype farms, spent an average of US\$97 per ton soybeans produced. The international sample spent an average US\$116 per ton soybeans produced, with an average yield of 3,16 tons per hectare. Argentine farms located in Zona Nucleo and Western Buenos Aires spent between US\$68 and US\$79 to produce a ton of soybeans with average yields of 4,1 and 3,5 tons per hectare respectively.





**Figure 1: Soybean direct expenditure for the 2017 production season**

Source: agri benchmark & BFAP 2018.

Domestically, it will remain of vital importance to pursue higher yields in a more productive manner, in order to enhance the competitiveness of producers. More importantly, and in particular for the Western production regions, it is essential to reduce annual yield volatility in order to reduce the relative production risk of soybeans against its alternatives. Soybean gross margins are projected to outperform maize in 2018 and also in several regions in 2019. However, the resilience of maize and sunflower in less favourable growing conditions reduces their production and financial risk at farm-level relative to that of soybeans, emphasising the need to also reduce soybean yield volatility.

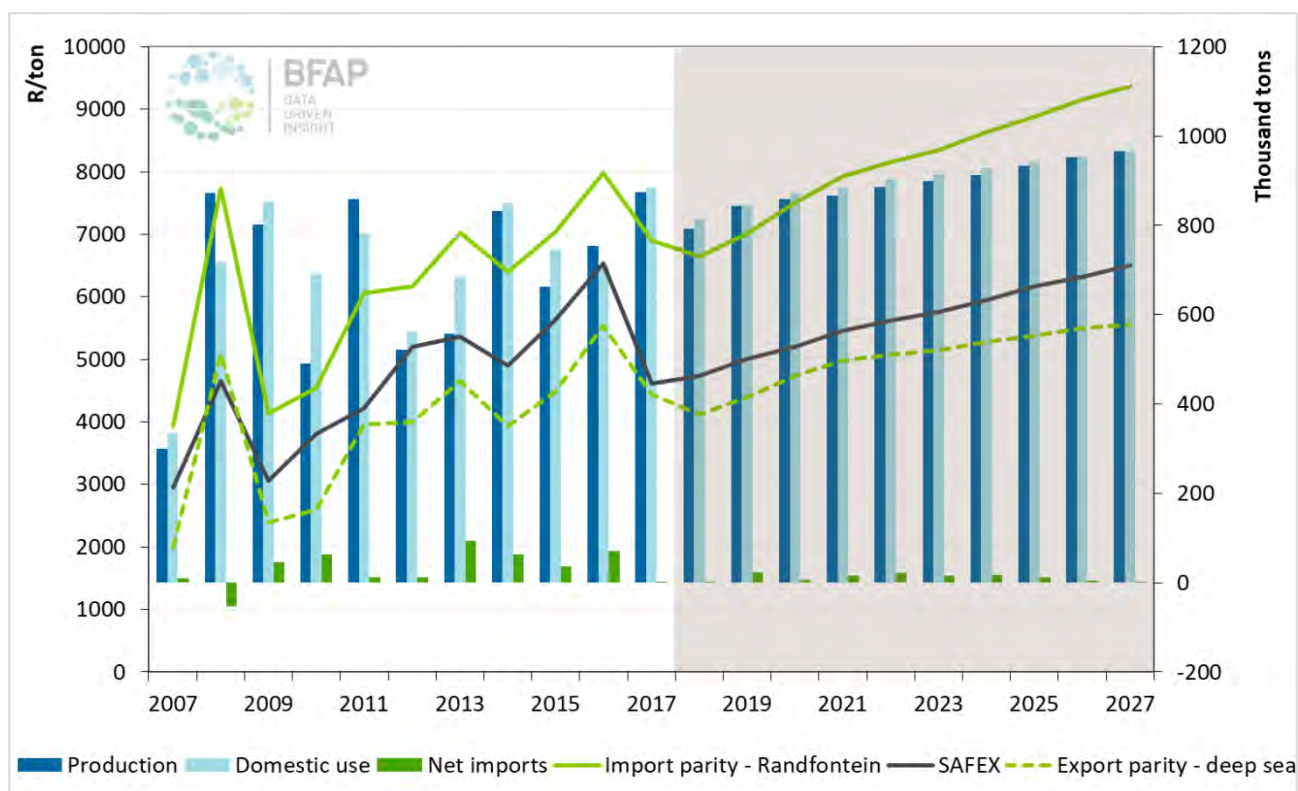
The area under sunflower production decreased by 12% in 2017 to 635 thousand hectares, which resulted in 874 thousand tons of sunflower seed





produced at an average yield of 1,38 tons per hectare. Over the outlook, the area under sunflowers is expected to decline marginally, yet additional demand will be comfortably met by increasing yields. Sunflower yields are projected to increase by an average of 2,2% per annum over the outlook period, reaching 1,65 tons per hectare by 2027. This projected yield growth is based on the assumption of stable rainfall and continuously improved cultivars. Over the past 5 years, average yields have not reflected the potential of current varieties, due to adverse weather conditions in the form of extreme droughts and temperatures in four out of the five seasons. Furthermore, the adoption of the latest release of high-yielding cultivars with Clearfield® technology that significantly reduces weed pressure and increases yields is rapidly gaining ground, which is expected to improve average yields going forward.

Sunflower supply and demand is expected to remain finely balanced over the next decade and consequently prices are projected to trade between export parity and the derived price for oil and cake. When the local market moves into a temporary surplus, prices tend to decline to export parity levels, which increases crushing margins and therefore crushing levels. In 2017, the average sunflower SAFEX price decreased by 30% to R4607 per ton, trading very close to export parity levels due to high stock levels following a bumper crop. Responding to the reduction in production levels, the sunflower price is expected to trade above export parity in 2018, at an annual average of approximately R4700 per ton. The long run equilibrium price over the projection period remains above export parity.



**Sunflower production, consumption, trade and prices: 2007 – 2027**

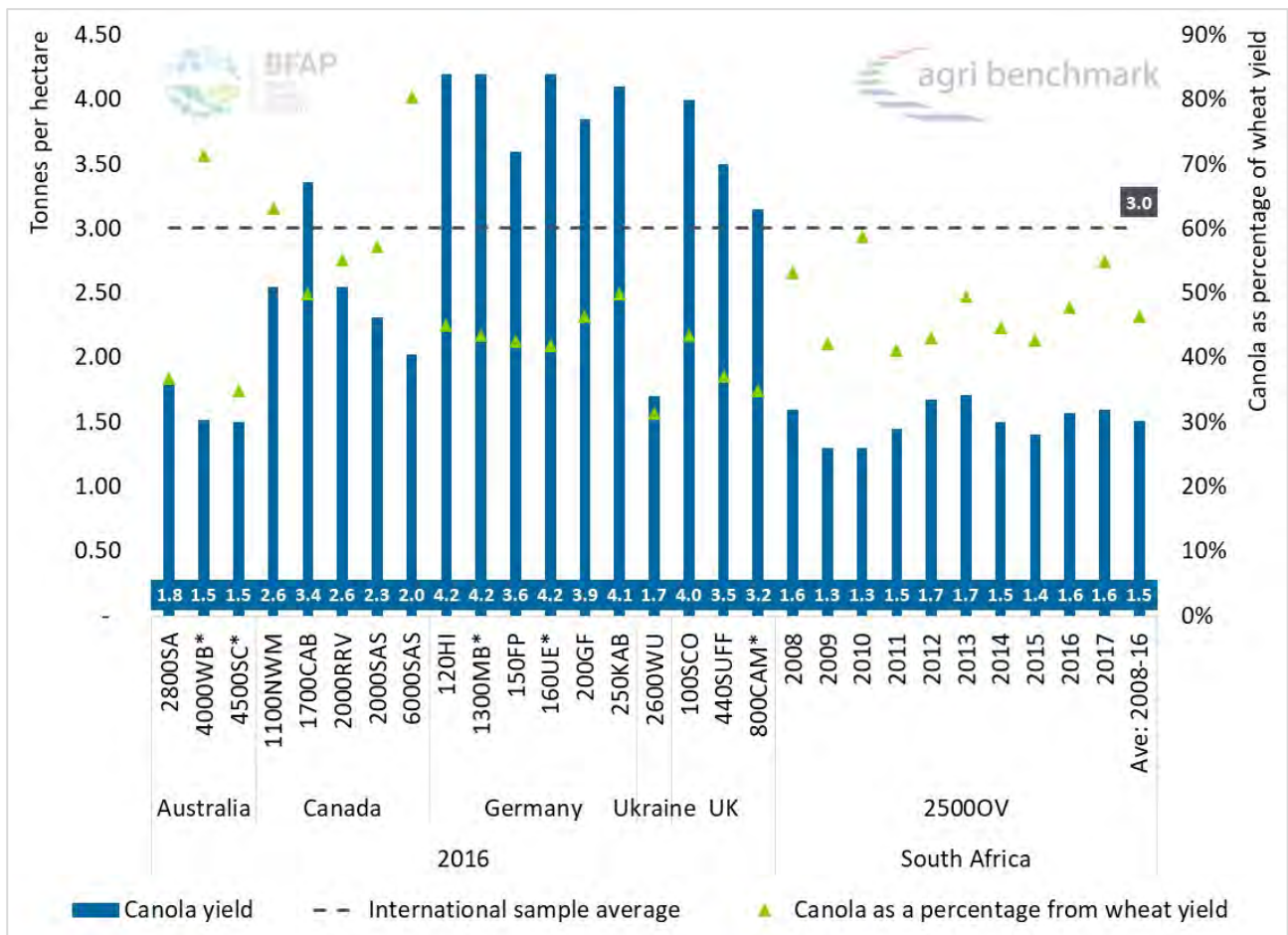
After more than doubling the area under canola production from 44 thousand hectares in 2012 to 95 thousand hectares in 2014, the industry has consolidated somewhat, with the area under production in the Western Cape fluctuating between 70 and 85 thousand hectares in recent years. Although concrete gains in yields (2,6% average annual increase) have been achieved due to the introduction of improved cultivars, effective technology transfer and improved farming practices, gains have been achieved from a small base and canola still faces stiff competition from wheat and barley on a gross margin per hectare basis. The real economic value of canola only comes into play when it is incorporated in a rotational cropping system. Sensitivity analysis around gross margins revealed that canola production has vast potential, but under higher yield assumptions.

In 2018, the canola production area is expected to decrease by approximately 10%, as late rains in the Southern Cape are affecting plantings. Industry specialists also suggest that there seems to be a concern around sufficient access to the higher yielding cultivars that have proven to



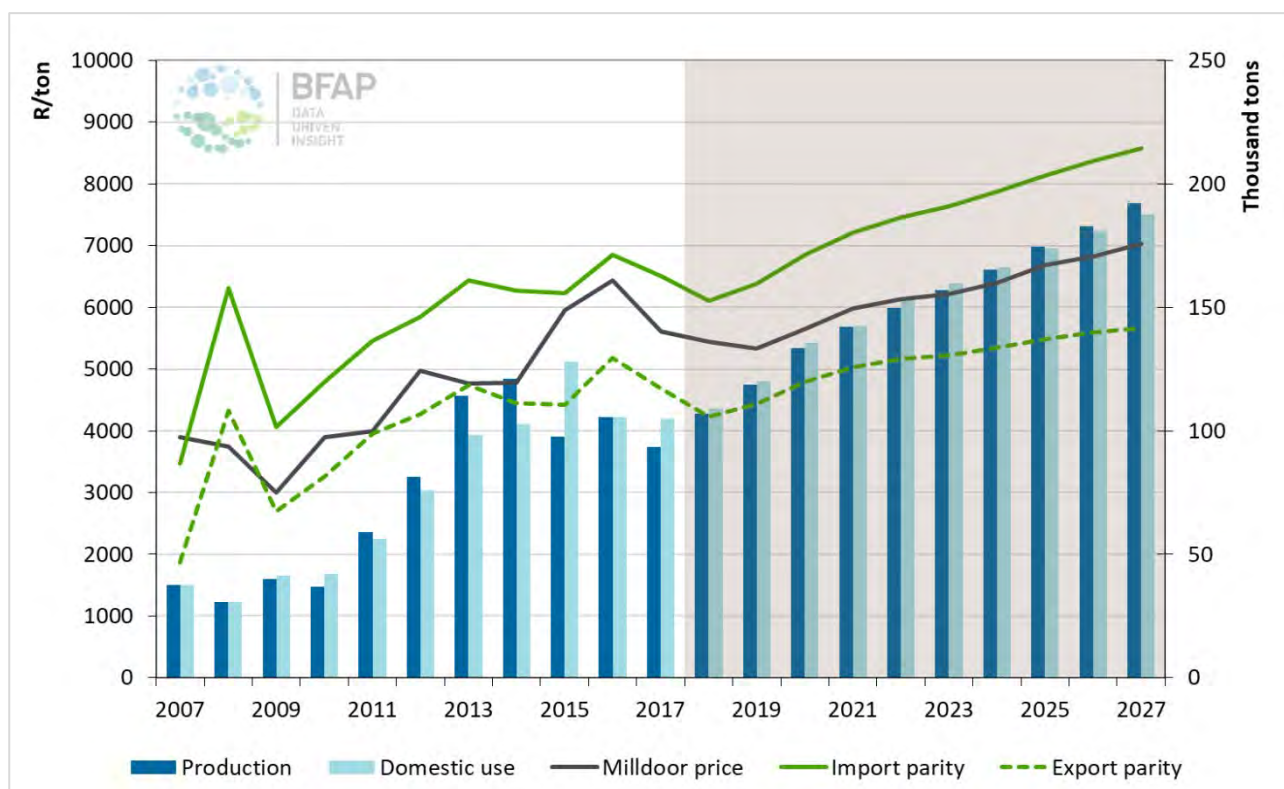
be effective in the past few seasons. Figure 2 illustrates that canola yields in the Southern Cape production region are lagging behind Northern Hemisphere producers. The international sample average amounts to 3 tons per hectare, whereas the average yield for the Overberg farm over the period from 2008 to 2016 equals 1,5 tons per hectare. When it is compared to other Southern Hemisphere countries such as Australia, the Southern Cape prototype farm performed relatively well. However, when the cost of production is considered, the Southern Cape farm lags well behind Australia. In the 2016 production season, the average cost to produce a ton of canola in the wheat belt and South Coast area of Australia ranged between US\$128 and US\$148 per ton, whereas the Southern Cape farm spent US\$174 per ton canola produced. The higher cost on the Southern Cape farm was mainly driven by the cost of seed and fertilisers.

Going forward, the canola production area is projected to increase by an average of 3,2% per annum to 115 thousand hectares by 2027. The average yield is projected to increase to 1,67 tons per hectare, resulting in a projected harvest of 192 thousand tons in 2027. Under the current projections, total current crushing capacity of 175 thousand tons will be reached by 2024. The average canola price decreased by 13% in 2017 to R5 600 per ton and is projected to continue trading between import and export parity over the outlook period, reaching R7025 per ton by 2027. This implies an average annual increase of 3%, less than general inflation and hence a modest decline in real terms.



**Figure 2: Canola yield trends across the globe**

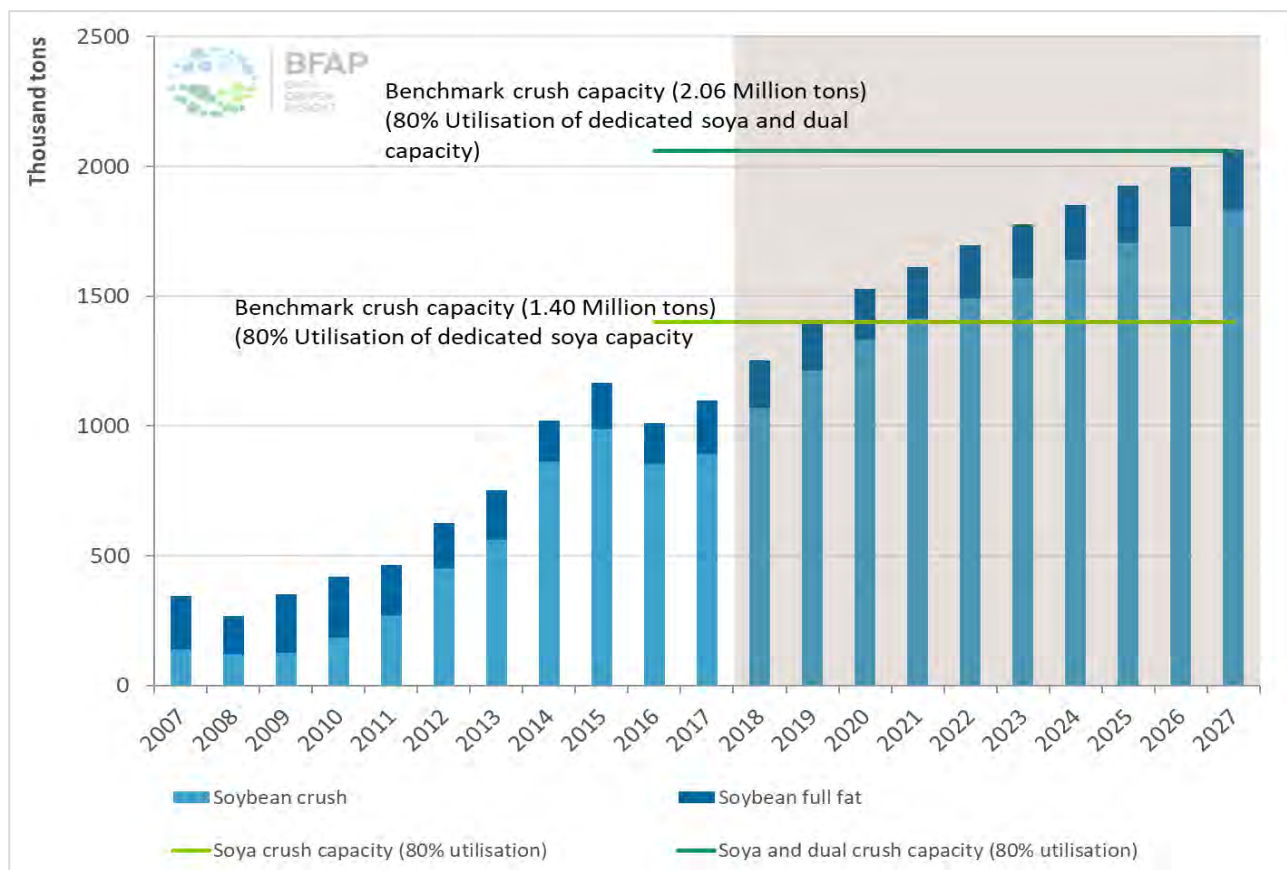
Source: agri benchmark, BFAP & Overberg Agri, 2018



**Canola production, consumption and prices: 2007 - 2027**

The combined effect of local oilcake production and concurrent imports of soybean oilcake from alternative sources at competitive prices is creating a situation whereby the domestic market at times finds a surplus of oilcake available. The net result is that the price formation of soybean seed is starting to change to reflect a derived price from cake and oil, rather than soybeans simply trading on its own fundamentals. It also implies that domestic crushing plants have to compete against imported oilcake produced mostly in mega plants in Argentina, where soybeans are sourced at export parity prices. This is putting significant pressure on domestic crushers to continuously improve efficiencies and capacity utilisation, and to beat the quality of imported oilcake.





**Soybean crush demand in South Africa: 2007 - 2027**

Despite its noted importance, prices are not the only driver in the evolution of the South African soybean cake market. The current (2017-2018) marketing year is a case in point, with soybean prices trading closer to export parity levels following an estimated crop of 1,4 million tons and positive crushing margins that should boost the uptake of soybeans in the crushing market. However, the demand for locally produced soybeans remains subdued, firstly due to a crushing plant on the Reef having to close down following an explosion and fire damage, which reduced the available crushing capacity by 150 thousand tons and secondly because some chicken producers in SA still prefer imported soybean cake above the locally produced cake. The result is that around 450 000 tons of soybean cake will likely be imported in the current season, despite the fact that South Africa can supply a significant share of this volume locally.

There are many debates around the local quality of the domestic soybean cake versus that of the imported cake. Results from comparison studies are



becoming increasingly available and typically illustrate that South African soybean cake is on par with imported cake. It is therefore anticipated that the current question around quality will be resolved, and it is only a matter of time before uptake of locally produced oilcake relative to imported oilcake will increase. The sensitivity around the quality of the soybean cake underlines the fact that the quality and consistency of oilseed that is delivered to the crushing plant also plays a significant role in the economics of the soybean value chain.



### **3. PROJECTS FINANCED 2017-2018**

#### **3.1 EVALUATION OF PRF SOYBEAN ELITE LINES UNDER SOUTH AFRICAN CONDITIONS; GP De Beer and WF van Wyk, Contractors, Protein Research Foundation**

During the past season (2017-2018), only two institutions participated in the soybean elite trials. They were EEAOC (Argentina) and EMBRAPA (Brazil).

Forty-five (45) lines obtained from these two institutions were compared to five (5) South African cultivars at six (6) localities in South Africa. The six localities were representative of the most prominent soybean growing areas in the country.

The planting dates were as follows: Potchefstroom (30 October 2017); Bethlehem (1 November 2017); Stoffberg (1 November 2017); Ukulinga (10 November 2017); Atlanta (22 November 2017) and Pretoria (UP) (24 November 2017).

The maturity groups (MG) of the 45 lines varied between MG 4,0 and MG 7,0. The five registered cultivars were in the groups MG 4,0, MG 4, MG 4,5, MG 6,0 and MG 7,2.

Grain yields of more than 5,0 tons per hectare were achieved and only a few lines rendered higher yields than the registered cultivars. Six of the EEAOC lines and three of the EMBRAPA lines were selected for further tests by Sensako, aimed at possible registration as cultivars.

Apart from the grain yield, valuable physiological characteristics such as flower colour, growth pattern (determinate or indeterminate), leaf shape, lodging percentage, shattering percentage and other were recorded. These characteristics are used in association with grain yield when selecting cultivars.





This project has been terminated and will not be repeated in the forthcoming season. Positive results were achieved, with five lines registered as cultivars, and another four lines being considered for registration. Additional lines are being tested by Sensako, aimed at submission for registration.

### **3.2 STUDIES ON *LECANICILLIUM MUSCARIUM* AS A MYCOPARASITE OF THE SOYBEAN RUST FUNGUS, *PHAKOPSORA PACHYRHIZI*, AND ITS USE AS A BIOCONTROL AGENT AGAINST SOYBEAN RUST; KS Yobo, University of KwaZulu-Natal (UKZN)**

In this study, a Isolate N-08, a mycoparasitic fungus, was isolated from Assagay coffee farm, Cato Ridge, KwaZulu-Natal, South Africa, where it was observed parasitising *Hemileia vastatrix*, the causal agent of coffee rust. Based on morphological and molecular studies the Isolate N-08 was identified as *Lecanicillium muscarium* and it was deposited into the National collection of fungi (Accession number PPRI 13715).

Co-inoculation studies of *L. muscarium* and *P. pachyrhizi* were done in the UKZN Plant Pathology disease garden. The Environmental Scanning Electron Microscope (ESEM) observation of the interactions showed a mycophilic attraction of *L. muscarium* to *P. pachyrhizi* urediniospores. Long *L. muscarium* phialides were observed penetrating and wrapping tightly around *P. pachyrhizi* urediniospores.

*In vitro* studies to test the effect of the *L. muscarium* strain N-08 on *P. pachyrhizi*, the soybean rust fungus, were done. *L. muscarium* strain N-08 was observed colonising *P. pachyrhizi* under light microscope and ESEM. Laboratory experiments were conducted to assess the effects of different growing conditions (temperatures, artificial growing media, natural substrates and UV radiation) on colony growth and conidia production. Optimisation of growing conditions is one of the essential aspects which must be taken into consideration to produce an effective biocontrol agent. *L. muscarium* strain N-08 grows best at temperatures between 21 to 25°C. The highest radial growth was observed at 24°C (46.54 mm). V8 juice agar was the best media for colony



growth with the mean value of 42.75 mm followed by SDA with 37.86 mm. When the isolates were exposed to UV light, the results did not show a significant difference between different media on mycelia growth. The highest conidia production occurred on millet cereal ( $4.2 \times 10^9$  conidia/ml) followed by wheat bran ( $3.2 \times 10^9$  conidia/ml) and pearled barley ( $2.9 \times 10^9$  conidia/ml).

The optimal dose level for disease control was assessed in the greenhouse and in field trials. It was found that  $10^6$  and  $10^8$  conidia/ml was more effective and  $10^6$  conidia/ml was chosen as the optimum dose for the field application.

Effect of *L. muscarium* against soybean rust was evaluated in the field. Two field experimental trials (2014-2015 and 2015-2016) were run at Ukulinga Research Farm. Compared to the pathogen inoculated control, all of the three *L. muscarium* doses ( $10^4$ ,  $10^6$ ,  $10^8$  conidia/ml) and the fungicide control (Score) decreased disease severity by 73.3%, 88.2%, 89.1%, and 90% respectively. The Area Under the Disease Progress Curve (AUDPC) for the treatments were as follows: 1<sup>st</sup> trial, Score (172.2 units),  $10^8$  conidia/ml (186.2 units),  $10^6$  conidia/ml (202.16 units),  $10^4$  (457.8 units) and pathogen inoculated control (1716.8 units). 2<sup>nd</sup> trial, score (259.7 units),  $10^8$  (284.9 units),  $10^6$  (319.9 units),  $10^4$  (462.7 units) and the pathogen inoculated control (1053.5 units). Treated plots showed higher yield increase compared to the pathogen inoculated pathogen. However, dry seed weight did not significantly differ between the *L. muscarium* strain N-08 treated and Score fungicide treated plots.

### **3.3 CHEMICAL MANIPULATION OF VEGETATIVE GROWTH, REPRODUCTIVE DEVELOPMENT AND GRAIN YIELD IN CANOLA; GA Agenbag, University of Stellenbosch**

Canola (*Brassica napus* L.) is one of the most important sources of plant oil in the world and is rapidly becoming an important crop in South Africa as well. Despite yield per hectare increases during recent years due to the introduction of hybrid cultivars and improved production techniques, yield per hectare is still low compared to leading world producers such as Canada.



Lower than expected yields may be the result of several factors such as low and uneven plant populations, insect pests, poor plant nutrition management and weed control as well as harvesting losses. The highest yields in South Africa are achieved with early plantings on high fertility sites, but this practice often produces bulky crops, which when combined with high plant populations may result in lodging during pod development.

Research done in Australia showed that shorter plants are much more resistant to lodging than taller plants. By shortening the stem and changing the canopy structure with the use of plant growth regulators (PGR's), an even, compact pod canopy can be produced. As a result, competition for assimilates and light can be reduced, ripening will be more uniform, pod shattering will be reduced, and harvesting will be more efficient.

No PGR's are at present registered for use in canola in the RSA, but preliminary research done recently with the PGR's Primo Maxx® and Moddus® as well as liquid seaweed extract (Kelpak®) showed promising results in both pot and field trials.

For this reason two sets of field trials were conducted during the period 2015 to 2017 at 3 localities in the Swartland (2) and Southern Cape (1) canola producing areas. In the Swartland, a high rainfall locality, Altona, with a long term annual rainfall of 645mm and a medium rainfall locality, Langgewens (473mm annually), were used while Roodebloem (563mm annually) represented the climatic conditions in the Southern Cape. Two trials were conducted at each site. In the first, five spraying treatments, namely an unsprayed control compared to Kelpak® (liquid seaweed extract) at 2.0 and 4.0 l ha<sup>-1</sup> and Moddus® (trinexapac-ethyl) at 0.4 and 0.8 L ha<sup>-1</sup> were tested with the spraying treatments done at budding stage (start of stem elongation) or at budding and start of flowering. The different application rates represent the recommended and double the recommended rates. In the second set of trials the above mentioned spraying treatments were done in combination



with two plant densities, namely a low density (30-40 plants m<sup>-2</sup>) and a high density (> 70 plants m<sup>-2</sup>).

In the Swartland two extremely dry years (2015 and 2017) were experienced during the experimental period (2015-2017), while below average but well distributed rainfall was recorded in 2016. Rainfall at the Southern Cape locality of Roodebloem was close to the long term average during all experimental years.

In spite of generally poor growing conditions, in the Swartland especially, due to low rainfall during 2015, the chemical manipulation of canola growth with the use of Moddus® and Kelpak® showed very promising results. Moddus® as a plant growth regulator reduces plant height, while both chemicals stimulated reproductive growth as measured by the number of flowering stems and pods per plant. As a result, grain yields were also increased. Although no clear trends with regard to the effect of dosage rate, time of application and density of the canola crop were shown, results supported the findings of research conducted in Australia. Unfortunately, these promising results were not repeated during 2016 and especially 2017, indicating that results due to the application of these chemical might be very inconsistent.

#### **3.4 NITROGEN TOPDRESSINGS IN CANOLA; TIME OF APPLICATION AND RATES; GA Agenbag, University of Stellenbosch**

Previous research projects in the Western Cape showed that application rates of 80-120kg of N/ha and 15-30/kg S/ha are needed to produce canola grain yields of more than 2.0 tons/ha in soil with low organic C contents. These high fertiliser requirements increase production costs and often make nitrogen and sulphur fertilisation the most costly production factor in canola.

The efficiency of applications is affected by soil properties and climatic conditions and very importantly by time of application. Research done in Canada showed that although the nitrogen uptake by canola is the highest



from the 5-leaf to 50% flower (which in the Western Cape is reached at 80-90 days after planting), uptake remains high till 50% podded stage (120-130 days after planting). These results indicated that nitrogen topdressing during the flowering stage of canola may be important in high yielding canola crops.

In order to determine optimum nitrogen application strategies for different soil and climatic conditions, field trials were conducted during 2015 to 2017 at 3 localities in the Swartland (2) and Southern Cape (1) canola producing areas. Four nitrogen rates namely 60, 90, 120 and 150 kg N/ha were tested, with 20 kg N/ha applied at planting and the remaining nitrogen applied as a single top dressing at 30 days after planting (dap); divided between 30 and 60 dap or divided between 30, 60 and 90 dap (full flowering stage). Control plots did not receive any nitrogen fertiliser.

In contrast to 2015 and 2017 when extremely low rainfall was experienced, most canola producing areas in the Western Cape experienced rainfall during the 2016 growing season which was close to the long term average. These conditions together with generally low maximum temperatures during September resulted in high canola grain yields. Mean yields in trials varied between 1681 kg/ha at Langgewens (low rainfall locality) to 3300 kg/ha at the high rainfall locality of Altona. In the Southern Cape (Roodebloem locality) a mean yield of 1877 kg/ha was recorded.

At the high rainfall locality of Altona, the highest yield of 3420 kg/ha was obtained with a nitrogen application of 120 kg/ha, of which 20 kg/ N ha was applied at planting and the rest (100 kgN) divided between 30 and 60 days after planting.

At Roodebloem, the highest yield of 2228 kg/ha was also obtained with 120 kg/N ha, but at this locality it was achieved with only one topdressing at 30 days after planting. At Langgewens (low rainfall locality), the highest grain yield of 1779 kg/ha was obtained with only 90 kg/N ha, but with topdressings at 30, 60 and 90 days after planting.



During the low rainfall years of 2015 and 2017, the application of different nitrogen application rates and times of application had very little effect on the grain yield of canola.

### **3.5 GRAIN YIELD COMPETITION FOR CANOLA 2017; GA Agenbag, University of Stellenbosch**

The 2017 growing season for canola will certainly be remembered by especially canola producers in the Swartland area as one of the most difficult ones. The rainy season not only started late, but rainfall was also extremely low. Canola producers however showed that canola can be a winner even under these difficult conditions.

Mr Andries Louw, farmer at Sondagsfontein outside the town of Durbanville won the Swartland competition, while the Southern Cape competition was for the second successive year won by Mr Pieter Beukes from Yahshua Boerdery near Caledon.

Given the very low rainfall received, Mr Louw obtained an excellent grain yield of 2,215 ton per hectare on a field of 54,7 hectare growing the DuPont-Pioneer canola cultivar 45Y88. Mr Beukes, not only won for the second successive year but, as in 2016, harvested more than 3,0 ton per hectare. He produced his winning yield of 3,159 ton per hectare on a field of 35 hectare with the cultivar 45Y88.

In spite of very harsh conditions, fifty percent of the six competitors in the Swartland produced grain yields of more than 1,8 ton per hectare, while 10 out of the twelve competitors in the Southern Cape produced grain yields of more than 2,00 ton per hectare.



### **3.6 CANOLA TECHNOLOGY TRANSFER; GA Agenbag, University of Stellenbosch**

The timely transfer of technology and information on the production of canola is very important to ensure that producers are optimising their production techniques to obtain maximum yields. For this reason canola information days are organised annually by the PRF. During 2018, the fourth annual canola information day was held during February for agricultural advisors of the agro-chemical industry and for the first time a few interested canola producers were also allowed to attend. The program for the day included a range of production-related subjects, but special attention was given to integrated weed control and the harmful effect of herbicide residue that can remain in the soil after having been applied to previously grown crops. The harmful effect of these residues may go unnoticed, while having a decreasing effect on the canola yield potential.

### **3.7 AN EVALUATION OF CONTINUOUS CASH CROP PRODUCTION (INCLUDING SMALL GRAINS, CANOLA AND OTHER ALTERNATIVE BROADLEAF CROPS) UNDER CONSERVATION AGRICULTURE PRINCIPLES ON THE HIGH POTENTIAL SOILS OF THE RIVERSDALE FLATS; JA Strauss, Western Cape Department of Agriculture**

2017 was the sixth year of production in the trial. Six cash crop systems were tested, including shortened canola rotations and cover crops. Riversdale received very little summer rainfall which resulted in a very dry start to the 2017 production season. Only 35mm fell from January to the end of April. In 2017 a new weather station was installed at the research site which is managed by the Department of Agriculture. A total of 126mm rain was received from April to the end of September.

**Wheat production** - SST0127 was planted at Riversdale at 79kg/ha. A total of 53kg N/ha was applied to each plot (23kg N/ha at planting and 30kg N/ha topdressing). Wheat yields at Riversdale averaged 1444 kg/ha. This was 2943 kg/ha less than in 2016.



**Canola production** - Atomic TT was planted at Riversdale at 3,8 kg/ha. A total of 25kg N/ha was applied to each plot. All the nitrogen was supplied at plant and no topdressings were made due to the climatic conditions. Canola yields at Riversdale averaged 1211 kg/ha. The oil content was just below 40% at all the plots.

**Barley production** - Agulhas was planted at Riversdale at 62 kg/ha. Barley yields at Riversdale averaged 1211 kg/ha. This average yield was 2933 kg/ha less than in 2016. Yields varied between 765 kg/ha and 1431 kg/ha.

**Lupin production** - Mandelup was available and was planted at Riversdale at 100 kg/ha. No lupin plots were harvested due to poor germination and weed problems in the very low rainfall year.

**Cover crops** - Saia oats and a bitter lupin mix was planted at Riversdale at 29 kg/ha and 100kg/ha, respectively. No other input cost was incurred during the season except the herbicide cost to kill the cover crop.

**Economics** - Although 2017 proved to be a very poor production year, all systems tested show a positive gross margin above directly allocated production costs.

### **3.8 DEVELOPMENT AND EVALUATION OF PROTEIN AND PHOSPHOROUS FEED INGREDIENTS FROM FISH PROCESSING BY-PRODUCTS; N Goosen, University of Stellenbosch**

The research in this project aimed to develop technology to transform low value fish by-products into higher value and high quality protein and phosphorous animal feed ingredients, and to evaluate the performance of these ingredients in animal feeding studies. Optimal utilisation of limited marine resources is increasingly seen as a way of improving sustainability measures and increasing economic returns from the available resource. South Africa, which has rich fisheries resources, can benefit from unlocking





the economic potential from its natural fish stocks and thereby contribute to growth in the agricultural sector and wider economy.

The final year of the project focused on evaluating two feed ingredients which were developed in the first three years of the project, in actual animal trials: hydrolysed fish protein and calcium phosphate minerals. These ingredients were evaluated as dietary sources of protein and phosphates, using the African catfish (*Clarias gariepinus*) as model species. Findings were very promising and it was shown that both ingredients can sustain high animal production efficiency, and that the hydrolysed proteins have additional benefits in that animal immunity is improved. The findings confirm the technical feasibility of the approach to derive value-added feed ingredients from low-value fish processing by-products, and future studies will aim to take the technology to pilot scale and to determine economic viability of the technology.

The results from the project have been well received so far. The quality and relevance of the work was acknowledged during two international conferences during 2017 (World Aquaculture in Cape Town, June 2017, and Aquaculture Europe in Dubrovnik, Croatia, October 2017), and interaction with other researchers and industry in this field has been positive. Currently, two peer reviewed journal publications are under review in leading international journals, and a further two publications are planned for submission before the end of 2018. The project resulted in the successful graduation of three postgraduate students, and in generating significant new knowledge in the field of by-product utilisation in the South African context.

### **3.9 MANAGEMENT STRATEGIES FOR SOYBEAN SOILBORNE DISEASES IN SOUTH AFRICA; YT Tewoldemedhin and SC Lamprecht, ARC Research Institute for Plant Protection**

Seed treatment is a very important part of integrated management strategies against soilborne diseases of field crops. Surveys conducted in the major



soybean production areas during 2010-2011, 2011-2012 and 2012-2013 showed that many important soilborne pathogens are present in soybeans in South Africa. Many of these pathogens, such as species within *Fusarium*, *Pythium* and *Rhizoctonia*, affect seedling survival and establishment of soybean crops. In order to protect seedlings against these pathogens, glasshouse trials were conducted during 2014-2015 and 2015-2016 to evaluate fungicide seed treatments against damping-off and root rot caused by the most important soilborne pathogens. Three of the most effective treatments were selected for evaluation under field conditions. The current study therefore included the evaluation of the seed treatments Evergol (TR1), Celest XL+Apron XL (TR2), Maxim Quatro (TR3) and untreated seed (TR4) on three soybean cultivars viz DM 6.8i.RR, PAN 1454R and SSS 5052 in the cool (Bethlehem), moderate (Potchefstroom) and warm (Groblersdal) production areas. The field trials at Groblersdal and Potchefstroom were irrigated and the trial at Bethlehem was planted under dryland conditions. Soil was also collected from the trials to conduct similar tests under glasshouse conditions to evaluate the seed treatments on the three cultivars. The survival of seedlings at the three localities was recorded six weeks after planting. Seed treatment did not significantly affect survival of seedlings at each locality, however survival rates of seedlings from untreated seed at Bethlehem and Potchefstroom was lower than survival recorded for the other treatments. In non-pasteurised soil from Bethlehem and Potchefstroom under glasshouse conditions, all three treatments (TR1, TR2 and TR3) significantly improved survival of seedlings, but in Groblersdal soil there was no significant difference in survival of seedlings from untreated seed compared to seed treated with the different treatments. Although the survival of seedlings was highest six weeks after planting at Groblersdal, the grain yields were highest at Potchefstroom. It therefore appears that survival of seedlings is not always correlated with yield under field conditions and that other factors also affect yield. However, all three seed treatments increased grain yield at Bethlehem and Groblersdal and only TR1 increased yield with 2,1% at Potchefstroom. The increases in grain yield at Bethlehem were 15,3% (TR1), 13,9% (TR2) and 14,0% (TR3), and at Groblersdal yield increases were 22,2% (TR1), 11,6% (TR2) and 5,0% (TR3). Although these



increases were not statistically significant, they are biologically significant and not only show the huge impact that seed treatments can have on yield, but also show that the same seed treatment can have a different effect at different localities. Treatment of seed with Evergol (TR1) significantly reduced growth of seedlings under glasshouse conditions, especially on seedlings younger than two weeks old. There were differences in the sensitivity of cultivars to growth reduction, with PAN 1454R being more sensitive than the other two cultivars. However, despite the growth reduction in young seedlings, this seed treatment proved to be very effective in improving survival of seedlings and grain yield and also appears to be more effective for the control of *Fusarium* species that are pathogens of soybean seedlings than Celest XL + Apron XL (TR2). Soil pasteurisation and seed treatments TR1, TR2 and TR3 significantly reduced cotyledon and root rot severity for all three cultivars under glasshouse conditions. Treated seed plated to determine the effect of seed treatments on the incidence of seedborne fungi showed that, of the seven potential pathogens isolated from untreated seed, *Colletotrichum* spp. could still be isolated from TR1 and TR2 treated seed and *Fusarium equiseti* and *Diaporthe longicolla* from TR2 treated seed. Surface disinfestation eliminated many of the seedborne fungi, however, *Colletotrichum* spp., *F. equiseti*, *F. verticillioides* and *D. longicolla* could still be isolated from surface disinfested seed. It is also important to note that fungi that were seedborne such as *Colletotrichum* spp., *F. verticillioides* and *P. longicolla* were often isolated at higher frequencies from seedlings planted in pasteurised compared to non-pasteurised soil which demonstrates the transmission of these pathogens from seed to seedlings. It is well-known that there is a complex of soilborne pathogens that affect soybean in field soil and that these complexes differ in different production areas and are affected by different soils and climatic conditions. From the results it is also clear that there were cultivar by seed treatment interactions for certain parameters, indicating that certain treatments may be more beneficial to certain cultivars than others and certain seed treatments are better suited to certain production areas than others. The challenge was to identify a seed treatment that will benefit establishment and yield of most cultivars in most production areas under both dryland and irrigation systems.



Although all three seed treatments improved grain yield of soybean under dryland (Bethlehem) and irrigation (Groblersdal) conditions, treatments TR1 and TR2 seemed to be more effective in increasing grain yield than TR3 and can contribute significantly to management of soilborne pathogens of soybean and therefore sustainable production of soybean in South Africa.

### **3.10 PERFORMANCE OF A DUAL DISC AND TINE PLANTER, SOIL QUALITY, RESIDUE MANAGEMENT AND RATE OF NITROGEN PLACEMENT WITH SEED FOR CANOLA PRODUCTION; PA Swanepoel, PJG le Roux and GA Agenbag, University of Stellenbosch**

Canola is an important crop for farmers implementing conservation agriculture (CA). Farmers implementing CA seek to minimise soil disturbance before, during and after planting. Although most farmers rely on tine openers to establish canola, disc openers are becoming more popular. Soil quality in these canola production areas is relatively low. The aim of this study was to compare tine and disc openers and the effects of soil quality and crop residue on canola production. Trials were conducted in 2016 and 2017 at Langgewens Research Farm in the Swartland. Contrary to what was expected, no difference in disturbance was recorded between tine and disc openers, so if the aim is to minimise soil disturbance, either a tine or disc opener can be used. During the first year of the trial the opener had an effect on canola plant population, while during the second year no differences between treatments were recorded. Tine openers performed better on high quality soil, while disc openers performed better on low quality soil. Residue can become a problem when establishing canola with both the tine and disc openers, and establishment was the best at low residue levels. The poorer canola establishment with the disc opener during 2016 might be due to fertiliser application as fertiliser was applied with seeding, which may have caused chemical injury to the seed. Overall the tine opener produced more biomass than the disc opener during the first year of the trial, while similar biomass production was achieved during the second year. Treatments had no effect on thousand seed mass (TSM) in 2016, while in 2017 a higher TSM



was obtained on low quality soil with high residue levels than on high quality soil with low residue levels. The treatments had no effect on yield in both 2016 and 2017. For validation of small plot trial data, similar treatments were conducted on field scale, comparable to the farmer's situation. Results from these fields confirmed the results from the small plots.

### **3.11 PROJECTED PROTEIN REQUIREMENTS FOR ANIMAL CONSUMPTION IN SOUTH AFRICA; D Strydom and W de Jager, University of the Free State, E Briedenhann, Protein Research Foundation**

#### Introduction

The Protein Research Foundation's (PRF) main objective is the replacement of imported protein with domestically produced protein. After investigating numerous alternatives for many years, the focus changed to where the largest impact could be made namely soybeans and canola.

The growth in the domestic availability of oilcake is a good measure by which the PRF could ascertain if it was achieving its objectives, by way of supporting the industry with research, new technology and technology transfer. In order for the PRF to continue to emulate the great progress that has been made and still meet future targets they require the projections of future oilcake demands and what will be required to obtain self-sufficiency.

#### Results

On the local market, South Africa progressed in terms of substituting imported soya oilcake with local oilcake. South Africa produced 69% of the total requirement in 2017; in 2007 this was only at a 27% level. In terms of total oilcake the local share in consumption increased from 37% in 2007 to 72% in 2017. It is projected that the local share will increase to 82% in 2020 and 87% in 2026.



### Historical usages of total oilcake (Local and imported soybeans processed in South Africa)

| Year | Local Oilcake (ton) | Total Oilcake (ton) | Local % |
|------|---------------------|---------------------|---------|
| 2001 | 454 192             | 1 021 862           | 44      |
| 2002 | 482 448             | 1 149 224           | 42      |
| 2003 | 472 312             | 1 210 396           | 39      |
| 2004 | 489 413             | 1 121 460           | 44      |
| 2005 | 416 736             | 1 212 593           | 34      |
| 2006 | 572 231             | 1 414 338           | 40      |
| 2007 | 608 370             | 1 635 525           | 37      |
| 2008 | 494 557             | 1 758 185           | 28      |
| 2009 | 565 181             | 1 664 927           | 34      |
| 2010 | 701 030             | 1 743 137           | 49      |
| 2011 | 624 912             | 1 857 391           | 34      |
| 2012 | 766 927             | 1 856 360           | 41      |
| 2013 | 760 321             | 1 877 671           | 40      |
| 2014 | 913 356             | 1 889 979           | 48      |
| 2015 | 1 197 604           | 1 914 330           | 63      |
| 2016 | 1 238 120           | 1 965 291           | 63      |
| 2017 | 1 300 865           | 1 798 372           | 72      |

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

### Local vs imported soya oilcake

|      | Local Soya Oilcake        | Local Soybean             | Total Soya Oilcake | Local Soya                                 | % Local |
|------|---------------------------|---------------------------|--------------------|--------------------------------------------|---------|
|      | (From local soybeans) ton | Production (required) ton | Requirements ton   | Production (required) ton self-sufficiency |         |
| 2017 | 731 913                   | 914 891                   | 1 127 098          | 1 408 872                                  | 64,9    |
| 2020 | 1 138 666                 | 1 423 332                 | 1 425 515          | 1 781 893                                  | 79,8    |
| 2026 | 1 248 353                 | 1 560 441                 | 1 454 144          | 1 817 680                                  | 85,5    |

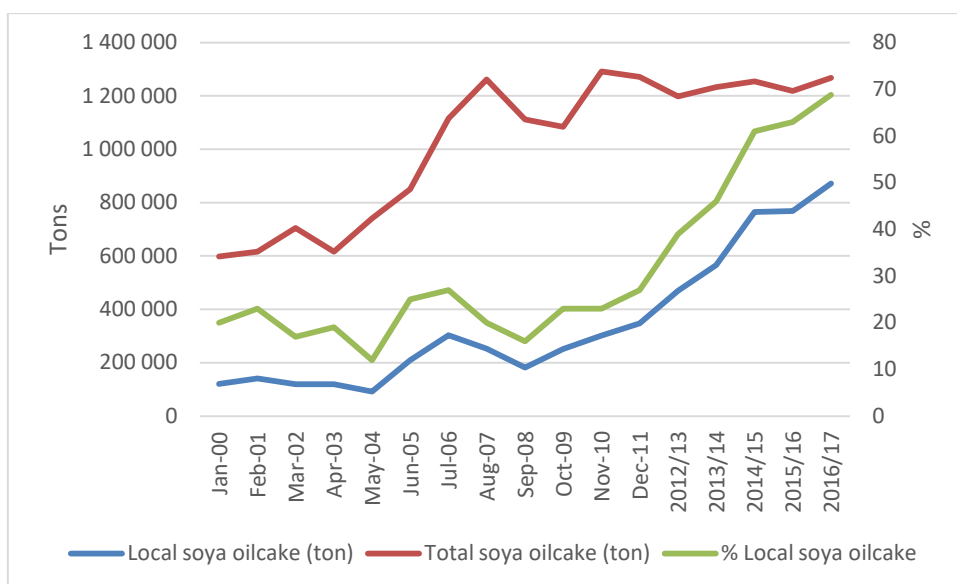


Oilcake requirements in South Africa are estimated at 1 798 372 tons in 2017 versus a local production of 1 300 865 tons locally produced or 72% of desired requirements.

Soya oilcake produced in South Africa in 2017 provided 64,9% of the country's soya oilcake requirements. The growth in oilcake consumption decreased mainly due to a lag effect of the drought but more importantly the outbreak of bird flu, which has decreased a large amount of layer birds and consequently layer feed.

According to the model, feed requirements will increase to 13 152 948 tons in 2026 and 12 767 149 tons in 2020 from the base of 11 137 923 tons. Oilcake requirements will increase from 1 798 372 tons to 2 135 339 in 2020 and 2 212 549 tons in 2026. Soya oilcake requirements will reach 1 425 515 tons by the year 2020 and 1 454 144 tons by 2026.

Estimates from BFAP of soybean production indicate that self-sufficiency will increase to 85,5% by 2026 because of soybean production increasing to 1,6 million tons. In order for 100% self-sufficiency in oilcake consumption a production of 1,8 million tons soybeans is required. Keep in mind that this is for soya oilcake production and excludes the full fat consumption. This is purely based on supply and demand, which excludes factors such as logistical challenges and feed consumption preferences.



**Growth in self-sufficiency in terms of soya oilcake**

## Conclusion

South African feed consumption decreased drastically in 2017, mainly due to the lag effect of the drought but more importantly the outbreak of bird flu within the borders of South Africa. However, given the major increase in production of local soybeans self-sufficiency also increased drastically. In terms of total oilcake consumption, South Africa's level of self-sufficiency currently stands at 69%. This is expected to increase to 87% in 2026, indicating the progress South Africa is making in substituting imports.

### Self-sufficiency of total oilcake and oilcake

|               | 2017 | 2020 | 2026 |
|---------------|------|------|------|
| Total Oilcake | 72%  | 82%  | 87%  |
| Soya Oilcake  | 69%  | 82%  | 87%  |





### **3.12 RESEARCH, REMEDIAL MEASURES TECHNIQUE, SOYA PLANTINGS, BOTHAVILLE AND RUSTENBURG, SOUTH AFRICA, SA Oosthuyse, Hort Research SA**

The technique as previously explained was again carried out on the farms of Ferdi Meyer (Rustenburg) and Jan Botma (Bothaville). There was a difference in that plants were removed from the plantings once the beans were close to maturity. Groups of plants differing in size were removed along a line through each stand. Soil occupied by the roots was also removed. This was done at 20 sites per stand. The plants were analysed for performance parameters, including bean yield, pod yield, root dry weight and plant dry weight. Application of the technique yielded the following results:

#### **(a) Ferdi Meyer, Rustenburg**

Here bean yield was strongly related to and positively correlated with exchangeable soil potassium levels. Cation exchange capacity and soil manganese levels also correlated with bean yield. There was the indication that magnesium levels in the soil were negatively affecting performance. High soil magnesium concentration is an inherent problem of the growing region. The effect of increasing soil K to 200 kg/mg is to be assessed next season, as well as the application of micro-nutrient adherents to the potassium granules applied.

#### **(b) Jan Botma, Bothaville**

The soil at this stand is practically sand. In considering bean yield, the analyses indicated a relationship with cation exchange capacity and soil zinc levels. Coated (adherent) micro element granule fertiliser application is to be recommended, as well as spreading fertilisation over the growing period, in view of poor nutrient retention by the soil (sand). The effect of these adjustments is to be assessed next season.



### **3.13 THE INFLUENCE OF PLANTING DATE AND ROW WIDTH ON RECOMMENDED PLANTING DENSITY AND YIELD OF SOYA BEANS IN THE NORTH EASTERN FREE STATE, JP van Zyl, Department of Agricultural Development, VKB**

#### Participating farmers and trial localities

- Izak Dreyer (Vrede Ascent)
- Jaco van Dyk (Vrede/Memel)
- SW Graaff (Frankfort/Jim Fouche)
- Jan Nell (trial was not planted due to unforeseen circumstances)

#### Experimental site summary

##### **(a) Izak Dreyer**

- 2 x row widths: 0.38 m and 0.76 m
- 1 x planting date: early
- 4 x plant densities: 100 000, 200 000, 270 000, 400 000 plants/ha
- 4 x cultivars
  - SSS 4945 (NIG 4.5)
  - SSS 5449 (MG 5)
  - SSS 6560 (MG 6)
  - SSS 5202 (MG 5.2)

##### **(b) Jaco van Dyk**

- 1 x row widths: 0.76 m
- 1 x planting date: early
- 4 x plant densities: 200 000, 300 000, 400 000, 500 000 plants/ha
- 3 x cultivars



- SSS 4945 (MG 4.5)
- SSS 5449 (MG 5)
- SSS 6560 (MG 6)

**(c) SW Graaff**

- 2 x row widths: 0.30 m and 0.60 m
- 2 x planting dates: early and late
- 4 x plant densities: 200 000, 300 000, 400 000, 600 000 plant/ha
- 4 x cultivars
  - SSS 4945 (MG 4.5)
  - SSS 5449 (MG 5)
  - SSS 6560 (MG 6)
  - SSS 5202 (MG 5.2)

**Results**

All trials were harvested, and yields determined. Final processing of results will be done when the statistical analysis is made available.

**3.14 INCOME AND COST BUDGETS FOR SUMMER AND WINTER CROPS IN SOUTH AFRICA; D van der Westhuizen, The Bureau for Food and Agricultural Policy (BFAP)**

Background

The Protein Research Foundation (PRF), Grain South Africa (GSA) and the Bureau for Food and Agricultural Policy (BFAP) currently have their individual cost of production programs which focus on the key summer and winter crops produced in South Africa's key agro-ecological zones. Given the existing activities associated within the organisations and the extent of the coverage of South African agricultural production, it is envisaged that by



collaboration and integration of existing activities by the PRF, GSA and BFAP will add immense value to the individual organisations' annual output. The main objective is hence to consolidate the three programs, generate comprehensive crop income and cost budgets for the key summer and winter growing regions and lastly to generate sensitivity analysis for these crops based on the latest macroeconomic trends, BFAP Baseline underlying assumptions and international and domestic updates.

In 2017, winter crop income and cost budgets were generated and submitted in April 2017. Thereafter, a number of stakeholder engagements occurred to refine methodology and output. A similar exercise was conducted for the summer crops and the BFAP team met with the Soybean Work Group members. In September, a first draft of the income and cost budgets was circulated among the soybean workgroup. The budgets should be finalised by beginning October.

#### Specific objectives

Generate crop income and cost budgets for key summer grains and oilseeds in selected regions in South Africa: Dryland: Mpumalanga/ Eastern Highveld, Eastern Free State, Northern and Western Free State, North West and KwaZulu-Natal. Irrigation: Northern Cape, Brits, Limpopo and Bergville. Generate crop income- and cost budgets for key winter grains and oilseeds in selected regions in South Africa: Dryland: Eastern Free State, Southern Cape and Western Cape. Irrigation: Northern Cape, Brits, Limpopo and Bergville. Generate sensitivity analysis for the above identified crops based on the latest market trends and projections.



### **3.15 PRF WEBSITE; M du Preez and Y Papadimitropoulos, Protein Research Foundation and Tigme.com**

The website of the Protein Research Foundation is a dynamic, growing source of technology transfer for both producers and researchers alike.

Currently, the website hosts a total of 908 pages. This number does not include additional dynamically created pages, such as the Research Database Index sections, where visitors "create" new pages according to each respective index link clicked. If counted, these additional "pages" will put the total number of website pages very close to the 1,000 mark.

Specific attention was given to ensure that website content is mobile-first, meaning that content can be read just as easily on the screens of mobile devices as on large computer monitors.

This was a complicated task since many pages on the PRF website contains data driven information, often with complex data tables that had to be re-interpreted for mobile screens.

#### Search functionality

The built-in search functionality on the website has been markedly improved. Visitors have full access to all content published and can easily search through the hundreds of pages for specific content, research projects, publications or the names of researchers. Search results are returned categorised by Projects, Researchers, General Content and News.

#### Marketing via SEO (Search Engine Optimisation)

Although time was invested during 2017-2018 to update SEO meta info - unique page titles, page descriptions and keywords of each page - to improve search engine visibility, more attention will be given to prepare the website for emerging trends and technologies .

In previous years it was enough to program simple, single keywords to provide quick information to search engine spiders about pages and help



them return accurate search results. Over the past two years the keyword system has morphed into what is known as long-tail keywords: longer and more distinct keyword phrases specific to a particular page that visitors are more likely to use when doing a search.

Lately, the focus shifted from keywords - even long-tail ones - to page content as search engines are "taught" through algorithms to read and interpret actual page content, rather than just compare a set of meta keywords. A major SEO trend predicted to start in the 2018-2019 period and gaining momentum in 2019-2020 is the move by search engines to suggest results based on a visitor's browsing habits. This trend makes it more important than ever to implement correct terminology and phraseology as part of the written page content.

#### Visitor statistics

| <u>Reporting Year</u> | <u>Unique Visitors</u> | <u>Unique Visitors</u> |              |                        |
|-----------------------|------------------------|------------------------|--------------|------------------------|
|                       | <i>Raw values*</i>     | <i>Google values</i>   |              |                        |
|                       |                        | <i>Visitors</i>        | <i>Pages</i> | <i>Pages per visit</i> |
| 2004                  | 1 691                  |                        |              |                        |
| 2005                  | 3 285                  |                        |              |                        |
| 2006                  | 4 552                  |                        |              |                        |
| 2007                  | 5 404                  | 3 041                  | 10 838       | 2.79                   |
| 2008                  | 11 104                 | 5 274                  | 18 829       | 2.82                   |
| 2009                  | 10 194                 | 6 610                  | 27 341       | 3.18                   |
| 2010                  | 11 812                 | 6 054                  | 23 347       | 2.98                   |
| 2011                  | 12 357                 | 5 511                  | 24 258       | 3.29                   |
| 2012                  | 16 306                 | 6 909                  | 28 206       | 3.12                   |
| 2013                  | 54 739                 | 8 767                  | 34 284       | 2.97                   |
| 2014                  | 54 590                 | 10 189                 | 39 363       | 3.03                   |
| 2015                  | 35 653                 | 12 519                 | 45 078       | 3.60                   |
| 2016                  | 31 674                 | 8 733                  | 53 811       | 4.47                   |
| 2017                  | 49 417                 | 6 901                  | 20 514       | 2.18                   |



Google values show a rapid decline in page views since the upgraded website has been launched. This is due to the fact that the website menu was changed from a static menu system to a dynamic menu system. With the static menu system the visitor generated a page view with each click of a menu item when opening up sub-levels of website sections. This resulted in Google statistics showing high page views (clicks). The new menu system eliminates “false” page views, giving a more accurate representation of visitor behaviour.

### The future and the web

The World Wide Web is on the tip of a major technological evolution from screen based viewing to interactive worlds. We will see more and more integration with virtual reality (VR) and augmented reality (AR) as visitors will be immersed in a 3D world where content will be displayed in digitally created environs.

Push notifications - those card-like blocks that pop up in the bottom-right corner of your computer screen - will be an important feature in this digital landscape where users opt-in to receive timely updates from sites they subscribe to, allowing the website owner to effectively re-engage them with customised, relevant content. This feature will greatly benefit the Protein Research Foundation, since website content is updated on a regular basis.



## 4. STUDY GRANTS AND BURSARIES

The PRF bursary scheme was approved in 1994 and the first bursary for postgraduate studies was awarded for the 1995 academic year. We are proud to look at a period of 23 years that included a total of 77 bursaries awarded to deserving candidates for Masters' and Doctorate studies. The aim of the bursary scheme is to train deserving candidates to allow them to contribute to high quality scientific research after completing their studies. This includes, in particular, research aimed at promoting the production of protein for animal consumption.

Students are also encouraged to publish research results, in co-operation with their mentors. This includes publication in scientific journals or popular magazines or both. Management summaries of theses and manuscripts are also published on the PRF website and data base.

Bursaries for Masters' studies are awarded for a period of two study years and three years in case of Doctorate studies. Bursaries awarded for this year were approved by the Bursary Committee (a sub-committee of the Marketing Committee) and were as follows:

### 4.1 MSc Studies

4.1.1 **Mr PJG Le Roux** (Second application). "Die evaluasie van tand- en skyf-oopmakers om canola te vestig op grond met verskillende fisiese, chemiese en biologiese toestande (grondkwaliteit)", Stellenbosch University

4.1.2 **Mr E du Toit** (First application). "Developing nitrogen fertiliser management strategies for canola under conservation agriculture practices in the Western Cape", Stellenbosch University





4.1.3 **Mr FP du Toit** (First application). “Optimering van wisselboustelsels vir die Swartland met spesifieke verwysing na canola”, Stellenbosch University

4.1.4 **Ms J van der Merwe** (First application). “Evaluation of canola oilcake as alternative locally produced protein source for slaughter ostriches”, Stellenbosch University

4.1.5 **Ms L Jordaan** (First application). “Die gebruik van chemiese middels en bedekking met polimere om die nie-degradeerbare proteïenfraksie van 'n verskeidenheid plaaslike geproduseerde plantproteïenbronne te verhoog”, Stellenbosch University

4.1.6 **Ms P Mbedzi** (First application). “Initial screening of Soybeans for Simple Sequence Repeats conferring resistance to *Sclerotinia sclerotiorum*”, Stellenbosch University

## 4.2 PhD Studies

4.2.1 **Ms L van Emmenes** (Third application). “The use of fly larvae meal as an alternative protein source in the diets of monogastric animals, farmer, consumer and environment”, Stellenbosch University.

4.2.2 **Ms T Kahlu** (First application). “The localisation of cysteine proteases and their inhibitors during the development and senescence of soybean nodules”, Stellenbosch University. (student withdrew)

## 4.3 Completed theses received

During the year under review, the following theses were received from bursary recipients that completed their studies successfully.

4.3.1 **Mr FP Du Toit**, “A financial analysis of combining crop rotation systems with appropriate potential soils in the middle Swartland”. MSc, Stellenbosch University



## **5. ACHIEVEMENT AWARDS TO PROMOTE THE PRF VISION AND MISSION**

Each year the PRF also recognises individuals for their special contributions to support the PRF's vision and mission, as well as attaining its objectives.

Awards are categorised as follows:

- Best doctoral thesis;
- Best Master's thesis;
- Best article published in a scientific journal;
- Individual who has made an exceptional contribution in promoting the PRF vision and mission;
- A Board Member that contributed significantly to promote the PRF's activities over a period of time;
- An organisation/individual that played an exceptional role in assisting the PRF to achieve its objectives.

During the year under review, an award was presented to Ms NJ Parry in the category Best Master's thesis.

The award was presented at an appropriate event during the year under review.

## **6. CONCLUSION**

It is with true gratitude that the PRF presents this research report. The results achieved fall within the requirements and objectives that the PRF set. This requires recognition of a large number of institutions and individuals.

The success is based on hard work and dedication of PRF Board Members and staff, but definitely also the work done by co-workers and contractors. We also express unqualified appreciation to local and international co-workers, researchers and institutions, the press, fund managers, auditors, lawyers and web masters. We trust that this co-operation will continue in the New Year and over many years to come leading to far-reaching and ever greater achievements.

**ANDRIES P THERON**

**CHAIRPERSON**



## **ANNEXURES**

### **I LIST OF APPROVED PROJECTS IN 2017-2018**

|    |                                                                                                                                                                                                                                     |                                            |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| 1. | Evaluation of PRF soybean elite lines under South African conditions<br>GP De Beer and WF van Wyk                                                                                                                                   | Protein Research Foundation                |
| 2. | Studies on <i>Lecanicillium muscarium</i> as a microparasite of the soybean rust fungus, <i>Phakopsora pachyrhizi</i> , and its use as a biocontrol agent against soybean rust<br>KS Yobo                                           | University of KwaZulu-Natal                |
| 3. | Chemical manipulation of vegetative growth, reproductive development and grain yield in canola<br>GA Agenbag                                                                                                                        | University of Stellenbosch                 |
| 4. | Nitrogen topdressings in canola: time of application and rates<br>GA Agenbag                                                                                                                                                        | University of Stellenbosch                 |
| 5. | Grain Yield competition for canola 2017<br>GA Agenbag                                                                                                                                                                               | University of Stellenbosch                 |
| 6. | Canola Technology transfer<br>GA Agenbag                                                                                                                                                                                            | University of Stellenbosch                 |
| 7. | An evaluation of continuous cash crop production (including small grains, canola and other alternative broadleaf crops) under conservation agriculture principles on the high potential soils of the Riversdale flats<br>JA Strauss | Department of Agriculture:<br>Western Cape |



|     |                                                                                                                                                                                          |                                                              |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 8.  | Development and evaluation of protein and phosphorous feed ingredients from fish processing by-products<br>N Goosen                                                                      | University of Stellenbosch                                   |
| 9.  | Management strategies for soilborne soybean diseases in South Africa<br>YT Tewoldemedhin and SC Lamprecht                                                                                | ARC Research Institute for Plant Protection                  |
| 10. | Performance of a dual disc and tine planter, soil quality, residue management and rate of nitrogen placement with seed for canola production<br>PA Swanepoel, PJG le Roux and GA Agenbag | University of Stellenbosch                                   |
| 11. | Projected protein requirements for animal consumption in South Africa<br>D Strydom, W de Jager and E Briedenhann                                                                         | University of the Free State and Protein Research Foundation |
| 12. | Research, remedial measures technique, soya plantings, Bothaville and Rustenburg, South Africa<br>SA Oosthuyse                                                                           | Hort Research SA                                             |
| 13. | The influence of planting date and row width on recommended planting density and yield of soya beans in the North Eastern Free State<br>JP van Zyl                                       | Department of Agricultural Development, VKB                  |
| 14. | Income and cost budgets for summer and winter crops in South Africa<br>SG Ferreira                                                                                                       | Bureau for Food and Agricultural policy (BFAP)               |
| 15. | PRF Website<br>M du Preez and<br>Y Papadimitropoulos                                                                                                                                     | Protein Research Foundation                                  |

**II LIST OF PROJECTS FINALISED DURING 2016/2017**

|    |                                                                                                                                                                |                            |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| 1. | Etiology and population structure of <i>Macrophomina phaseolina</i> (charcoal rot) in sunflower and soybeans in South Africa<br>E Jordaan and JE van der Waals | University of Pretoria     |
| 2. | Investigating the potential of indigenous nematodes to control invasive molluscs in canola<br>A Pieterse, JL Ross and AP Malan                                 | University of Stellenbosch |



### III SHORT- AND MEDIUM-TERM DEMAND AND USAGE OF FISHMEAL AND OILCAKE

TABLE 1: FISHMEAL AND OILCAKE BALANCE SHEET (2014/2015 - 2016/2017) APRIL TO MARCH

|                    | FISH MEAL (TON) |           |           | OIL CAKE (TON) |           |           |
|--------------------|-----------------|-----------|-----------|----------------|-----------|-----------|
| Year               | 2015/2016       | 2016/2017 | 2017/2018 | 2015/2016      | 2016/2017 | 2017/2018 |
| Requirements/Sales | 20 000          | 20 000    | 12 000    | 1 981 986      | 1 678 146 | 1 693 241 |
| Available/Produced | 78 000          | 78 000    | 70 000    | 1 299 277      | 1 090 900 | 1 277 200 |
| Shortage/Imports   | -58 000         | -58 000   | -58 000   | 682 709        | 587 246   | 416 041   |

2017/2018 - Estimate

Source: Fishing industry;

TABLE 2: FISHMEAL AND OILCAKE USAGE (2015/2016 - 2017/2018) APRIL TO MARCH

|                  | FISH MEAL (TON) |               |               | OIL CAKE (TON)   |                  |                  |
|------------------|-----------------|---------------|---------------|------------------|------------------|------------------|
| Year             | 2015/2016       | 2016/2017     | 2017/2018     | 2015/2016        | 2016/2017        | 2017/2018        |
| AFMA Members     | 12 178          | 11 856        | 12 676        | 1 385 703        | 1 315 436        | 1 324 264        |
| Non-AFMA Members | 7 822           | 8 144         | 7 324         | 596 283          | 362 710          | 368 977          |
| <b>Total</b>     | <b>20 000</b>   | <b>20 000</b> | <b>20 000</b> | <b>1 981 986</b> | <b>1 678 146</b> | <b>1 693 241</b> |

Source: AFMA website [www.afma.co.za](http://www.afma.co.za)

2017/2018 - Estimate

\* Non-AFMA Members figures can also include unused stocks

TABLE 3: THE MAIN RAW MATERIAL USAGE BY AFMA-MEMBERS  
(APR - MARCH) (2015/2016 - 2017/2018)

| RAW MATERIALS               | TOTAL<br>(TON)<br>(2015/2016) | INCLUSION<br>RATE (%) | TOTAL<br>(TON)<br>(2016/2017) | INCLUSION<br>RATE (%) | TOTAL<br>(TON)<br>(2017/2018) | INCLUSION<br>RATE (%) |
|-----------------------------|-------------------------------|-----------------------|-------------------------------|-----------------------|-------------------------------|-----------------------|
| Sunflower oilcake           | 308 633                       | 4,58                  | 301 513                       | 4,30                  | 306 519                       | 4,76                  |
| Groundnut oilcake           | 573                           | 0,03                  | 0                             | 0,01                  | 0                             | 0,00                  |
| Soya oilcake                | 936 283                       | 12,78                 | 866 555                       | 13,03                 | 859 964                       | 13,35                 |
| Full fat soya               | 72 415                        | 1,17                  | 87 510                        | 1,01                  | 90 442                        | 1,40                  |
| Cottonseed oilcake          | 8 888                         | 0,32                  | 10 033                        | 0,12                  | 10 845                        | 0,17                  |
| Full fat cottonseed         | 7 845                         | 0,16                  | 10 852                        | 0,11                  | 9 709                         | 0,15                  |
| Canola oilcake              | 38 109                        | 0,37                  | 29 160                        | 0,53                  | 29 315                        | 0,46                  |
| Full fat canola             | 546                           | 0,00                  | 640                           | 0,00                  | 320                           | 0,00                  |
| Copra and Palm kernel       | 11 568                        | 0,36                  | 8 720                         | 0,16                  | 8 550                         | 0,13                  |
| Maize germ oilcake          | 843                           | 0,02                  | 453                           | 0,01                  | 0                             | 0,00                  |
| <b>Total oilcake</b>        | <b>1 385 703</b>              | <b>19,79</b>          | <b>1 315 436</b>              | <b>19,29</b>          | <b>1 324 264</b>              | <b>20,56</b>          |
| <b>Total maize products</b> | <b>3 595 160</b>              | <b>51,69</b>          | <b>3 363 649</b>              | <b>50,05</b>          | <b>3 262 770</b>              | <b>50,66</b>          |
| <b>Total fish meal</b>      | <b>12 178</b>                 | <b>0,31</b>           | <b>11 856</b>                 | <b>0,17</b>           | <b>11 896</b>                 | <b>0,18</b>           |
| <b>Feed</b>                 | <b>6908424</b>                |                       | <b>6322188</b>                |                       | <b>6440516</b>                |                       |

Source: AFMA website [www.afma.co.za](http://www.afma.co.za)

AFMA raw material usage April 2017-March 2018 extrapolated from first 3 months of usage

<sup>1</sup>Note: Total oilcake in Table 3 include all oilcake and not only specific oilcake items listed in table 3



**TABLE: FISHMEAL - LOCAL PRODUCTION AND IMPORTS (2014/2015 - 2017/2018) APRIL TO MARCH**

| Year              | LOCAL (RSA + NAMIBIA) FISH MEAL PRODUCTION (TON) |               |               |               | IMPORTED FISH MEAL (TON) |           |           |
|-------------------|--------------------------------------------------|---------------|---------------|---------------|--------------------------|-----------|-----------|
|                   | 2014/2015                                        | 2015/2016     | 2016/2017     | 2016/2018     | 2015/2016                | 2016/2017 | 2016/2018 |
| <b>RSA</b>        | 65 000                                           | 62 000        | 64 600        | 90 000        |                          |           |           |
| <b>Namibia(i)</b> | 13 000                                           | 13 000        | 13 000        | 0             |                          |           |           |
| <b>Total</b>      | <b>78 000</b>                                    | <b>75 000</b> | <b>77 600</b> | <b>90 000</b> | <b>0</b>                 | <b>0</b>  | <b>0</b>  |

Source: AFMA; SA Fishmeal Marketing Company

2016/2017-Estimate.

(i) Includes Russian trawlers operating in Namibian waters

**TABLE 5: OILCAKE LOCAL PRODUCTION AND IMPORTS (2014/2015 - 2016/2017)**

| Year                           | LOCAL OIL CAKE PRODUCTION (TON) |                  |                          | IMPORTED OIL CAKE (TON) |                          |                          |
|--------------------------------|---------------------------------|------------------|--------------------------|-------------------------|--------------------------|--------------------------|
|                                | 2015/2016                       | 2016/2017        | 2017/2018<br>(Projected) | 2015/2016               | 2016/2017<br>(Projected) | 2017/2018<br>(Projected) |
| <b>OIL CAKE:</b>               |                                 |                  |                          |                         |                          |                          |
| <b>Groundnuts oilcake</b>      | 0                               | 0                | 0                        | 0                       | 0                        | 0                        |
| <b>Sunflower oilcake</b>       | 280 368                         | 264 279          | 332 000                  | 67 887                  | 0                        | 0                        |
| <b>Soya Cake</b>               | 750 898                         | 647 754          | 695 200                  | 587 692                 | 552 246                  | 404 800                  |
| - Full fat                     | 121 763                         | 94 769           | 140 000                  |                         |                          |                          |
| <b>Cotton Cake</b>             |                                 |                  |                          | 59 468                  | 9 000                    | 1 946                    |
| - Full fat                     | 19 098                          | 19 098           | 50 000                   | 25 898                  | 11 000                   | 295                      |
| <b>Other</b>                   |                                 |                  |                          |                         |                          |                          |
| <b>Canola</b>                  | 51 150                          | 51 000           | 50 000                   | 0                       | 0                        | 0                        |
| <b>Lupins</b>                  | 6 000                           | 14 000           | 10 000                   | 0                       | 0                        | 0                        |
| <b>Copra &amp; Palm Kernel</b> |                                 |                  |                          | 24 713                  | 15 000                   | 9 000                    |
| <b>Total</b>                   | <b>1 229 277</b>                | <b>1 090 900</b> | <b>1 277 200</b>         | <b>765 658</b>          | <b>587 246</b>           | <b>416 041</b>           |

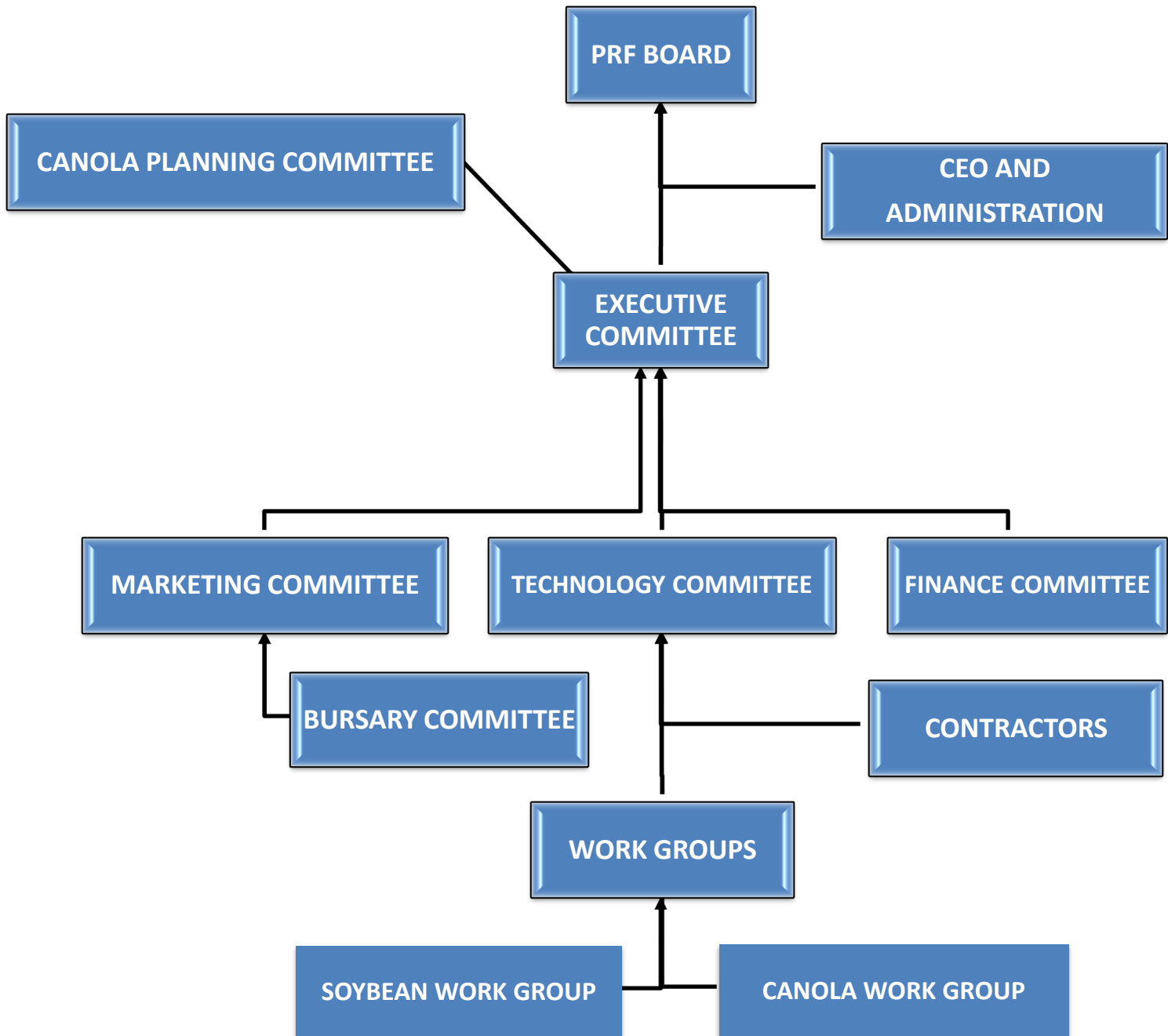
Source: SAGIS [www.sagis.org.za](http://www.sagis.org.za)

Estimate 2017-2018. The projected local production figures for soya and cotton reflect fullfat and oilcake.

South African Supply and Demand Estimate Report NAMC January 2018



## IV PRF STRUCTURES







V LIST OF BURSARY APPLICATIONS: 1995 - 2017

| NO. | STUDENT                                                  | QUALIFICATIONS                                     | INSTITUTION                  | PROPOSED RESEARCH AREA | TITLE OF THESIS                                                                                                                              | DEGREE | THESIS RECEIVED | CROP CODE |
|-----|----------------------------------------------------------|----------------------------------------------------|------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------|-----------|
|     | <b>1995</b>                                              |                                                    |                              |                        |                                                                                                                                              |        |                 |           |
| 1   | Ms E Upton<br><b>Promotor: Dr J Coetzee</b>              | BSc (Agric),<br>BSc (Agric) (Hons)                 | Stellenbosch University      | Animal nutrition       | Development and evaluation of polymer coated urea as a potential slow-release urea supplement for ruminants.                                 | MSc    | Received 2000   | H         |
| 2   | Mr GE Schroeder<br><b>Promotor: Mr AJ van der Walt</b>   | BSc (Agric),<br>BSc (Agric) (Hons),<br>MSc (Agric) | University of Pretoria       | Dairy cow nutrition    | Availability and partitioning of amino acids from various heat processed Protein sources to the Mammary gland of Lactating Dairy Cows.       | PhD    | Received 1998   | H         |
|     | <b>1996</b>                                              |                                                    |                              |                        |                                                                                                                                              |        |                 |           |
| 3   | Mr HM Böhme<br><b>Promotor: Prof CW Cruywagen</b>        | BSc (Agric),<br>BSc (Agric) (Hons)                 | Stellenbosch University      | Animal nutrition       | Evaluering van die insluiting van 'n kommersiële stadig vrystellende ureum-melasseproduk (Ureïed) in lekkie vir skape op laergraadse ruvoer. | MSc    | Received 1998   | H         |
| 4   | Ms MB Young<br><b>Promotor: Prof RM Gous</b>             | BSc (Agric)                                        | University of KwaZulu-Natal  | Poultry nutrition      | An evaluation of effective energy in the formulation of diets for laying hens.                                                               | MSc    | Received 2000   | P         |
| 5   | Mr AV Ferreira<br><b>Promotor: Prof JH van der Merwe</b> | BSc (Agric),<br>BSc (Agric) (Hons),<br>MSc (Agric) | University of the Free State | Animal nutrition       | The essential amino acid requirements of South African mutton merino lambs                                                                   | PhD    | Received 2000   | H         |
| 6   | Mr CA Loëst<br><b>Promotor: Dr HJ van der Merwe</b>      | BSc (Agric),<br>BSc (Agric) (Hons),<br>MSc (Agric) | University of the Free State | Animal nutrition       | Amino acid profile of lamb carcass and duodenal digesta content                                                                              | PhD    | Received 2000   | H         |



| NO. | STUDENT                                                    | QUALIFICATIONS                               | INSTITUTION                 | PROPOSED RESEARCH AREA                              | TITLE OF THESIS                                                                                                                                                | DEGREE | THESIS RECEIVED | CROP CODE |
|-----|------------------------------------------------------------|----------------------------------------------|-----------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------|-----------|
| 7   | 1997                                                       |                                              |                             |                                                     |                                                                                                                                                                |        |                 | P         |
|     | Ms L McLouglin<br><b>Promotor: Prof RM Gous</b>            | BSc (Agric)                                  | University of KwaZulu-Natal | Broiler breeder nutrition and simulation modelling. | An investigation of factors influencing rate of lay, egg weight and embryonic growth in Broiler breeder hens.                                                  | MSc    | Received 2000   |           |
| 8   | Mr PDR van Heerden<br><b>Promotor: Prof GHJ Kruger</b>     | BSc, BSc (Hons), MSc                         | PU for CHE                  | Plant production                                    | Physiological and chemical basis of dark chilling and superimposed drought stress in Glycine max                                                               | PhD    | Received 2000   | S         |
| 9   | 1998                                                       |                                              |                             |                                                     |                                                                                                                                                                |        |                 | S         |
|     | Ms A Booysen (Arnoldi)<br><b>Promotor: Prof GHJ Krüger</b> | BSc, BSc (Hons)                              | PU for CHE                  | Plant production                                    | Factors affecting biological nitrogen fixation as assessed by the ureide technique in Glycine max L and its implication on soybean production in South Africa. | MSc    | Received 2001   |           |
| 10  | Ms GJM Coetzee<br><b>Promotor: Dr LC Hoffman</b>           | BSc (Agric)                                  | Stellenbosch University     | Poultry nutrition                                   | Effects of feeding omega-3 fatty acids and Vitamin E on the chemical composition and microbial population of Broiler meat.                                     | MSc    | Received 2000   | VV        |
| 11  | Mr CM Coetzer                                              | BSc (Agric), BSc (Agric) (Hons), MSc (Agric) | Kansas State University     | Animal nutrition                                    | Methionine metabolism in growing cattle.                                                                                                                       | PhD    | Received 2001   | H         |



| NO. | STUDENT                                           | QUALIFICATIONS                     | INSTITUTION                  | PROPOSED RESEARCH AREA | TITLE OF THESIS                                                                                                                                           | DEGREE | THESIS RECEIVED   | CROP CODE |
|-----|---------------------------------------------------|------------------------------------|------------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------|-----------|
|     | 1999                                              |                                    |                              |                        |                                                                                                                                                           |        |                   |           |
| 12  | Mr J van E Nolte<br>Promotor: Dr AV Ferreira      | BSc (Agric)                        | Stellenbosch University      | Animal nutrition       | An evaluation of degradable protein and non-protein intake and digestion by Dohne merino sheep fed wheat straw.                                           | MSc    | Received 2001     | H         |
| 13  | Mr PGW Wessels<br>Dr PJ Pieterse                  | BSc (Agric)                        | Stellenbosch University      | Plant production       | Soil Nitrogen Dynamics and spring wheat (Triticum Aestivum) production in different cropping systems in the Swartland.                                    | MSc    | Received 2001     | C         |
| 14  | Mr WD Jonker<br>Promotor: Prof GHJ Kruger         | BSc                                | PU for CHE                   | Plant production       | Invloed van vog- en ligstremming op die ontwikkeling en Bioproduktiwiteit van Glycine max (L.) merr. Genotipes van verskillende volwasseheidsgroeperings. | MSc    | Received 2000     | S         |
|     | 2000                                              |                                    |                              |                        |                                                                                                                                                           |        |                   |           |
| 15  | Mr GDJ Scholtz<br>Promotor: Prof HJ van der Merwe | BSc (Agric),<br>BSc (Agric) (Hons) | University of the Free State | Plant production       | Models for lucerne quality grading.                                                                                                                       | MSc    | Received 2002     | LU        |
| 16  | Mr S Tyiso<br>Promotor: Prof MT Smith             | BSc,<br>HDE,<br>BSc (Hons),<br>MSc | University of KwaZulu-Natal  | Plant production       | Lipid Peroxidation and the antioxidant system in soybean seed maturation and germination.                                                                 | PhD    | Received 2004     | S         |
| 17  | Mr JR Sara<br>Promotor: Prof RM Gous              | BSc,<br>BSc (Hons),<br>MSc         | University of KwaZulu-Natal  | Mariculture            | An investigation into the Protein Requirement of Marine Prawn Fenneropenaeus indicus (H. Milne Edwards)                                                   | PhD    | Received May 2007 | VV        |





| NO. | STUDENT                                                                 | QUALIFICATIONS                     | INSTITUTION                            | PROPOSED RESEARCH AREA                                                                                                                                                                                                                                         | TITLE OF THESIS                                                                                                                                                                                | DEGREE | THESIS RECEIVED | CROP CODE |
|-----|-------------------------------------------------------------------------|------------------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------|-----------|
| 18  | Mr JD Thornton<br><b>Promotor: Dr AV Ferreira</b>                       | BSc (Agric)                        | Stellenbosch University                | Animal nutrition                                                                                                                                                                                                                                               | The effect of dietary protein degradability on the performance of Saanen Dairy Goats.                                                                                                          | MSc    | Received 2003   | H         |
|     | 2001                                                                    |                                    |                                        |                                                                                                                                                                                                                                                                |                                                                                                                                                                                                |        |                 |           |
| 19  | Ms S Nel<br><b>Promotor: Dr J Albertyn</b>                              | BSc,<br>BSc (Hons)                 | University of KwaZulu-Natal            | Poultry nutrition                                                                                                                                                                                                                                              | Cloning of the xyna gene from thermomyces lanuginosus and expression in saccharomyces cerevisiae.                                                                                              | MSc    | Received 2002   | P         |
| 20  | Mr SG de Jager<br><b>Promotor: Prof CC du Preez</b>                     | BSc (Agric),<br>BSc (Agric) (Hons) | University of the Free State           | Plant production                                                                                                                                                                                                                                               | Groei en ontwikkeling van sojaboon cultivars by verskillende rywydtes.                                                                                                                         | MSc    | Received 2004   | S         |
| 21  | Mr M de Beer<br><b>Promotor: Prof LG Ekermans</b>                       | BSc (Agric)                        | Stellenbosch University                | Poultry nutrition                                                                                                                                                                                                                                              | The influence of processing of Soya-beans and Sunflower seed on their Energy and Amino Acid availability for poultry.                                                                          | MSc    | Received 2003   | P         |
| 22  | Ms L Brundyn<br><b>Promotor: Dr AV Ferreira</b>                         | The utilisation                    | Stellenbosch University                | Animal nutrition                                                                                                                                                                                                                                               | The utilisation of and supplementation to stubble lands for South African mutton merino ewes.                                                                                                  | MSc    | Received 2003   | H         |
|     | 2002                                                                    |                                    |                                        |                                                                                                                                                                                                                                                                |                                                                                                                                                                                                |        |                 |           |
| 23  | Ms H Fourie<br><b>Promotors: Prof D de Waele &amp; Prof AH McDonald</b> | BSc,<br>HOD,<br>BSc (Hons),<br>MSc | Catholic, University of Leuven, België | A. Identification and verification of soybean genotypes resistant to M. incognita race 2 (greenhouse, micro plot and field trials).<br>B. Identification and validation of genetic markers associated with this resistance trait (breeding and biotechnology). | In vivo evaluation of resistance to <i>Meloidogyna incognita</i> race 2 (Nematode: <i>Tylenchida</i> ) and identification of genetic markers for this trait in soybean ( <i>Glycine max</i> ). | PhD    | Received 2005   | S         |



| NO. | STUDENT                                                            | QUALIFICATIONS             | INSTITUTION                 | PROPOSED RESEARCH AREA                                                   | TITLE OF THESIS                                                                                                           | DEGREE | THESIS RECEIVED         | CROP CODE |
|-----|--------------------------------------------------------------------|----------------------------|-----------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------|-------------------------|-----------|
| 24  | Ms MM Viljoen<br><b>Promotor:</b><br><b>Prof GHJ Kruger</b>        | BSc,<br>BSc (Hons)         | PU for CHE                  | Plant production                                                         | The influence of dark chilling on the endogenous rhythms of photosynthesis and sucrose synthesis in Glycine max(L.) Msrr. | MSc    | Received 2004           | S         |
|     | 2003                                                               |                            |                             |                                                                          |                                                                                                                           |        |                         |           |
| 25  | Ms LR Breytenbach<br><b>Promotor:</b><br><b>Dr M Ciacciariello</b> | BSc (Agric) (Hons)         | Stellenbosch University     | Poultry production                                                       | The influence of processing of lupins and canola on apparent metabolizable energy and broiler performance.                | MSc    | Received February 2006  | P         |
|     | 26                                                                 |                            |                             |                                                                          |                                                                                                                           |        |                         |           |
| 26  | Mr SG Payne<br><b>Promotor:</b><br><b>Dr M Ciacciariello</b>       | BSc (Agric) (Hons)         | Stellenbosch University     | Poultry nutrition                                                        | The Phosphorus availability of feed phosphates in broilers.                                                               | MSc    | Received June 2005      | P         |
|     | 27                                                                 |                            |                             |                                                                          |                                                                                                                           |        |                         |           |
| 27  | Ms JB Griffiths<br><b>Promotor:</b><br><b>Prof CW Cruywagen</b>    | BSc (Agric) (Hons)         | Stellenbosch University     | Ruminant nutrition                                                       | The effect of extrusion on the degradability parameters of various vegetable protein sources.                             | MSc    | Jan-06                  | H         |
|     | 28                                                                 |                            |                             |                                                                          |                                                                                                                           |        |                         |           |
| 28  | Mr D Backhouse<br><b>Promotor: Prof RM Gous</b>                    | BSc (Agric)                | University of KwaZulu-Natal | Poultry nutrition (specifically broiler breeder nutrition and lighting). | The effect of photoperiod and feeding time on broiler breeder eggshell quality and oviposition time.                      | MSc    | Received 2005           | P         |
|     | 2004                                                               |                            |                             |                                                                          |                                                                                                                           |        |                         |           |
| 29  | Ms ER Malleson<br><b>Promotor:</b><br><b>Prof LJ Erasmus</b>       | BSc (Agric) Veekunde       | University of Pretoria      | Animal nutrition                                                         | Fishmeal Supplementation to high producing jersey cows grazing ryegrass or kikuyu pasture.                                | MSc    | Received March 2008     | H         |
|     | 30                                                                 |                            |                             |                                                                          |                                                                                                                           |        |                         |           |
| 30  | Ms Z Bester<br><b>Promotor:</b><br><b>Prof LJ Erasmus</b>          | BSc (Agric) Animal Science | University of Pretoria      | Dairy cow nutrition                                                      | Evaluation of a liquid rumen protected methionine source using different techniques                                       | MSc    | Received September 2011 | H         |
|     |                                                                    |                            |                             |                                                                          |                                                                                                                           |        |                         |           |





| NO. | STUDENT                                                 | QUALIFICATIONS             | INSTITUTION                 | PROPOSED RESEARCH AREA                                                                                         | TITLE OF THESIS                                                                                                                                             | DEGREE | THESIS RECEIVED        | CROP CODE |
|-----|---------------------------------------------------------|----------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|-----------|
| 31  | Ms N Smith<br><b>Promotor: Prof TS Brand</b>            | BSc (Agric) Animal Science | Stellenbosch University     | Animal nutrition                                                                                               | The effect of dietary inclusion of canola oilcake, full-fat canola and sweet lupins on the production performance and fat composition of broilers and pigs. | MSc    | Received 2005          | P         |
|     | 2005                                                    |                            |                             |                                                                                                                |                                                                                                                                                             |        |                        |           |
| 32  | Mr W Visagie<br><b>Promotor: Dr F van de Vyver</b>      | BSc (Agric) Animal Science | Stellenbosch University     | Animal nutrition                                                                                               | The digestibility and degradability of feeds and protein sources in dohne - merino sheep and boer goats                                                     | MSc    | Received January 2010  | H         |
| 33  | Mr J Fourie<br><b>Promotor: Dr M Ciacciariello</b>      | BSc (Agric)                | Stellenbosch University     | Poultry nutrition                                                                                              | The effects of a multiple-enzyme combination in maize-soya diets for broiler chickens.                                                                      | MSc    | Received August 2007   | P         |
| 34  | Ms M Kritzinger<br><b>Promotor: Dr Helet Lambrechts</b> | BSc (Agric)                | Stellenbosch University     | Poultry nutrition                                                                                              | Alternatives to replace antibiotics in broiler diets: Effects on protein utilization and production performance                                             | MSc    | Received November 2009 | P         |
|     | 2006                                                    |                            |                             |                                                                                                                |                                                                                                                                                             |        |                        |           |
| 35  | Ms MR Modiba<br><b>Promotor: Prof I Ncube</b>           | BSc Microbiology           | University of Limpopo       | Animal Nutrition: Use of fermentation Technologies to develop Jatropha curcas seed meal into animal stockfeed. | Evaluation of solid state fermentation in the detoxification of Jatropha curcas seed press cake                                                             | MSc    | Received November 2009 | H         |
| 36  | Mr SF Magoda<br><b>Promotor: Prof RM Gous</b>           | BSc (Agric)                | University of KwaZulu-Natal | Poultry nutrition (alternative protein source for Laying Hens).                                                | Poultry nutrition (alternative protein source for Laying Hens).                                                                                             | MSc    | Received June 2010     | P         |
| 37  | Mr H Nienaber<br><b>Promotor: Prof LJ Erasmus</b>       | BSc (Agric), BSc (Hons)    | University of Pretoria      | Dairy cow nutrition                                                                                            | Effect of roughage to concentrate ratio on ruminal fermentation and protein degradability in dairy cows.                                                    | MSc    | Received August 2008   | H         |



| NO. | STUDENT                                              | QUALIFICATIONS                                         | INSTITUTION                  | PROPOSED RESEARCH AREA                                                         | TITLE OF THESIS                                                                                                                                        | DEGREE | THESIS RECEIVED     | CROP CODE |
|-----|------------------------------------------------------|--------------------------------------------------------|------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------------|-----------|
|     | 2007                                                 |                                                        |                              |                                                                                |                                                                                                                                                        |        |                     |           |
| 38  | Ms M. Strydom<br><b>Promotor: Dr TS Brand</b>        | BSc (Agric)                                            | Stellenbosch University      | Ostrich nutrition                                                              | The effect of different levels of supplementary feeding on the production of finisher ostriches ( <i>Struthio camelus</i> ) grazing irrigated lucerne. | MSc    | Received April 2011 | P         |
| 39  | Ms BK Theeruth<br><b>Promotor: Prof RM Gous</b>      | BSc (Animal & Poultry Science)<br>MSc (Animal Science) | University of KwaZulu-Natal  | Evaluating an optimisation routine for the profitable feeding of growing pigs. | Selecting suitable mathematical functions to describe the time course of anorexia during pathogen challenge                                            | MSc    | Received April 2009 | V         |
| 40  | Mr DB Strydom<br><b>Promotor: Dr P Taljaard</b>      | B.Com                                                  | University of the Free State | Biofuel production                                                             | The economic impact of maize-based ethanol production on the South African Animal Feed Industry                                                        | MSc    | Received March 2009 | P         |
|     | 2008                                                 |                                                        |                              |                                                                                |                                                                                                                                                        |        |                     |           |
| 41  | Mr TL Khetani<br><b>Promotor: Dr M Ciacciariello</b> | BSc (Agric)                                            | University of KwaZulu-Natal  | Poultry nutrition                                                              | The effects of maternal dietary lysine intake on broiler breeder offspring performance                                                                 | MSc    | Received June 2011  | P         |
| 42  | Ms PT Mabulwana<br><b>Promotor: Dr PW Mokwala</b>    | BSc (Botany & Microbiology),<br>BSc Honour (Botany)    | University of Limpopo        | Soybean production                                                             | Determination of drought stress tolerance among soybean varieties using morphological and physiological markers                                        | MSc    | Received July 2013  | S         |
|     | 2009                                                 |                                                        |                              |                                                                                |                                                                                                                                                        |        |                     |           |
| 43  | Mr SB Ruck<br><b>Promotor: Dr NC Tyler</b>           | BSc Honours (Animal Science)                           | University of KwaZulu-Natal  | Poultry nutrition                                                              | The response of broiler breeder hens to dietary lysine: hatchability, embryo growth and subsequent offspring performance                               | MSc    | Received March 2012 | P         |





| NO. | STUDENT                                                             | QUALIFICATIONS                         | INSTITUTION                 | PROPOSED RESEARCH AREA | TITLE OF THESIS                                                                                                               | DEGREE | THESIS RECEIVED         | CROP CODE |
|-----|---------------------------------------------------------------------|----------------------------------------|-----------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------|-------------------------|-----------|
| 44  | Ms J Patel<br><b>Promotor:</b><br><b>Dr M Ciacciariello</b>         | BSc Honours (Animal & Poultry Science) | University of KwaZulu-Natal | Poultry nutrition      | The effect of dietary lysine, crude protein, energy and feed allocation on broiler breeder hen performance.                   | MSc    | Received January 2015   | P         |
| 45  | Mr TR Olivier<br><b>Promotor: Prof TS Brand</b>                     | BSc (Agric)                            | Stellenbosch University     | Monogastric voeding    | Determination of the nutrient requirements of breeding ostriches                                                              | MSc    | Received May 2010       | P         |
| 46  | Mr EJ van der Westhuizen<br><b>Promotor: Prof TS Brand</b>          | BSc (Agric)                            | Stellenbosch University     | Animal science         | The effect of slaughter age on the lamb characteristics of merino, South African mutton merino and dorper lambs.              | MSc    | Received May 2010       | H         |
|     | <b>2010</b>                                                         |                                        |                             |                        |                                                                                                                               |        |                         |           |
| 47  | Ms MM Minnaar<br><b>Promotor:</b><br><b>Prof GHJ Kruger</b>         | BSc (Hons)                             | Northwest University        | Planr production       | Constraints on photosynthesis and antioxidant metabolism in winter and summer crops induced by sulphur dioxide fumigation     | MSc    | Received June 2013      | C         |
| 48  | Ms AM Jooste<br><b>Promotor:</b><br><b>Prof WA van Niekerk</b>      | B.Sc (Agric)                           | University of Pretoria      | Animal nutrition       | The effect of supplementing slow release nitrogen (optigen II) and FME on the degradability of poor quality roughage in sheep | MSc    | Received September 2012 | H         |
| 49  | Ms S Greaves<br><b>Promotor:</b><br><b>Dr C Jansen van Rensburg</b> | B.Sc (Agric)                           | University of Pretoria      | Pig production         | Growth and immunity of weaner piglets supplemented with dietary tryptophan, threonine and glutamine.                          | MSc    | Received May 2015       | V         |
| 50  | Mr WJ Kritzinger<br><b>Promotor: Prof TS Brand</b>                  | B.Sc (Agric)                           | Stellenbosch University     | Ostrich production     | Allometric description of ostrich ( <i>Struthio camelus var. Dometricus</i> ) growth and development                          | MSc    | Received April 2012     | P         |





| NO. | STUDENT                                             | QUALIFICATIONS                                          | INSTITUTION                  | PROPOSED RESEARCH AREA | TITLE OF THESIS                                                                                                                                                                        | DEGREE | THESIS RECEIVED        | CROP CODE |
|-----|-----------------------------------------------------|---------------------------------------------------------|------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|-----------|
|     | 2011                                                |                                                         |                              |                        |                                                                                                                                                                                        |        |                        |           |
| 51  | Mr PD Carstens<br><b>Promotor: Prof TS Brand</b>    | B.Sc Agric                                              | Universiteit van Stellenboch | Ostrich production     | Studies to develop a mathematical optimisation model to describe the effect of nutrition on the growth of ostriches ( <i>Struthio camelus</i> var. <i>domesticus</i> )                 | MSc    | Received July 2014     | P         |
| 52  | Mr FV Meyer<br><b>Promotor: Prof RM Gous</b>        | B.Sc (Agric) Animal Science                             | University of Pretoria       | Pig nutrition          | The response of weaned piglets to varying dietary levels of synthetic valine and leucine                                                                                               | MSc    | Received August 2012   | V         |
| 53  | Ms M du Plessis<br><b>Prof KJ Kunert</b>            | B.Sc (Biotechnology)<br>B.Sc (Hons) Plant biotechnology | University of Pretoria       | Soybean production     | Cysteine proteases activity and gene expression studies in soybean nodules during development and drought stress                                                                       | MSc    | Received July 2013     | S         |
| 54  | Ms SL von Waltsleben<br><b>Promotor: Dr N Tyler</b> | B.Sc (Agric)                                            | University of KwaZulu-Natal  | Poultry nutrition      | The effect of dietary crude protein on fertility of broiler breeder males                                                                                                              | MSc    | Received June 2013     | P         |
|     | 2012                                                |                                                         |                              |                        |                                                                                                                                                                                        |        |                        |           |
| 55  | Ms MP Genis<br><b>Promotor: Prof LC Hoffman</b>     | BSc (Agric)                                             | Stellenbosch University      | Ruminant nutrition     | The effect of dietary energy content and the provision of a <i>Beta</i> -adrenergic agonist in the diet on the production and meat quality of South Africa mutton merino feedlot lambs | MSc    | Received July 2014     | H         |
| 56  | Ms L van Emmenes<br><b>Promotor: Dr E Pieterse</b>  | BScAgric (Animal Science as a major) 2011               | Stellenbosch University      | Poultry nutrition      | Evaluation of phytase enzymes on performance, bone mineralisation, carcass characteristics and small intestinal morphology of broilers fed maize soya bean diets.                      | MSc    | Received February 2015 | P         |



| NO. | STUDENT                                                                  | QUALIFICATIONS                                           | INSTITUTION                  | PROPOSED RESEARCH AREA | TITLE OF THESIS                                                                                                                                    | DEGREE | THESIS RECEIVED           | CROP CODE |
|-----|--------------------------------------------------------------------------|----------------------------------------------------------|------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------------------|-----------|
| 57  | Mr R Steyn<br><b>Promotor: Dr D Strydom</b>                              | BSc (Agric) Hons                                         | University of the Free State | Oil production         | When does a market qualify as a niche market: A canola case study                                                                                  | MSc    | Received December 2014    | C         |
| 58  | Ms GA Tesselaar<br><b>Promotor: Prof TS Brand</b>                        | BScAgric (Animal Science with Conservation Ecology) 2010 | Stellenbosch University      | Ostrich production     | Development of a mathematical optimization model for breeding ostriches: Identification of possible factors affecting feed intake and production   | MSc    | Received February 2015    | P         |
|     | <b>2013</b>                                                              |                                                          |                              |                        |                                                                                                                                                    |        |                           |           |
| 59  | Mr LL Eksteen<br><b>Promotor: Prof GA Agenbag</b>                        | BScAgric (2012)                                          | Stellenbosch University      | Canola production      | Reducing height and lodging in canola ( <i>Brassica napus</i> L.) using plant growth regulators                                                    | MSc    | Received November 2014    | C         |
| 60  | Ms TC Maluleke<br><b>Promotor: Dr BJ Vorster</b>                         | BSc Genetics (2011)<br>BSc Hons (2012)                   | University of Pretoria       | Plant production       | Plant Cystatins and insect resistance: Inhibition of insect midgut cysteine proteases by plant cystatins and their role in plant insect resistance | MSc    | studies not completed yet | D         |
| 61  | Ms M Cilliers ( <i>nee</i> Du Plessis)<br><b>Promotor: Dr BJ Vorster</b> | B.Sc (2009)<br>B.Sc Hons (2010)<br>M.Sc (2012)           | University of Pretoria       | Soybean production     | The response of C1 and C13 cysteine proteases in soybean nodules to drought                                                                        | PhD    | Received December 2017    | S         |
| 62  | Ms GC Buitendach<br><b>Promotor: Mr FH de Witt</b>                       | B.Sc Animal Science (2009)<br>B.Sc (Hons) 2011           | University of the Free State | Animal Nutrition       | Effect of long-term exposure to different dietary fatty acids on production and egg quality of layers                                              | MSc    | Received August 2015      | P         |





| NO. | STUDENT                                                           | QUALIFICATIONS                                                          | INSTITUTION                  | PROPOSED RESEARCH AREA | TITLE OF THESIS                                                                                                                                                                    | DEGREE     | THESIS RECEIVED            | CROP CODE |
|-----|-------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------|-----------|
|     | <b>2014</b>                                                       |                                                                         |                              |                        |                                                                                                                                                                                    |            |                            |           |
| 63  | Mr MN Engelbrecht<br><b>Promotor:</b><br><b>Prof CW Cruywagen</b> | BSc (Agricultural economics)                                            | Stellenbosch University      | Animal nutrition       | The effect of supplements containing different protein and energy sources and essential oils on the performance of pasture finished heifers                                        | <b>MSc</b> | studies completed Dec 2015 | <b>H</b>  |
| 64  | Miss T Khahlu<br><b>Promotor: Dr BJ Vorster</b>                   | BSc (Biotechnology) (2010-2012)                                         | University of Pretoria       | Soybean production     | Drought tolerance markers in soybean                                                                                                                                               | <b>MSc</b> | studies not completed yet  | <b>S</b>  |
| 65  | Mr HCvdW Leicester<br><b>Promotor:</b><br><b>Prof LJ Erasmus</b>  | BSc Animal Science (2011)<br>BSc Honours (2012)                         | University of Pretoria       | Animal nutrition       | Effects of yeast based direct fed microbial supplementation on the performance of high producing dairy cows.                                                                       | <b>MSc</b> | Received September 2015    | <b>H</b>  |
| 66  | Ms E Jordaan<br><b>Promotor:</b><br><b>Prof J van der Waals</b>   | BSc (Agric Plant Pathology (2008)<br>MSc (Agric) Plant Pathology (2014) | University of Pretoria       | Plant pathology        | Epidemiology and population on structure of Macrophomina phaseolina (Charcoal rot) on sunflower and soybean in South Africa (TBC)                                                  | <b>PhD</b> | studies not completed yet  | <b>S</b>  |
|     | <b>2015</b>                                                       |                                                                         |                              |                        |                                                                                                                                                                                    |            |                            |           |
| 67  | Mr W de Jager<br><b>Promotor:</b><br><b>Dr Dirk Strydom</b>       | BSc Agric Animal Science and Agricultural Economics (2013)              | University of the Free State | Protein utilisation    | Forecast estimates of protein for animals in South Africa                                                                                                                          | <b>MSc</b> | Received 15 December 2016  | <b>D</b>  |
| 68  | Ms L van Emmenes<br><b>Promotor: Dr E Pieterse</b>                | BSc Agric (Animal Science (2011)<br>MSc Agric (Animal Science) (2014)   | Stellenbosch University      | Protein utilisation    | The use of fly larvae meal as an alternative protein source in the diets of monogastric animals. Exploring the potential benefits for the animal, farmer, consumer and environment | <b>PhD</b> | studies not completed yet  | <b>D</b>  |



| NO. | STUDENT                                                         | QUALIFICATIONS                            | INSTITUTION             | PROPOSED RESEARCH AREA | TITLE OF THESIS                                                                                                                                                                     | DEGREE | THESIS RECEIVED           | CROP CODE |
|-----|-----------------------------------------------------------------|-------------------------------------------|-------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------------------|-----------|
| 69  | Ms KZ Neethling<br><b>Promotor:</b><br><b>Prof CW Gruywagen</b> | BSc (Agric)                               | Stellenbosch University | Animal nutrition       | The effect of different energy and nitrogen sources on <i>In Vitro</i> fibre digestion and gas production kinetics of high and low quality forages                                  | MSc    | Received 2017             | D         |
| 70  | Ms JA Engelbrecht<br><b>Promotor:</b> Prof T Brand              | BSc (Animal Science) (2014)               | Stellenbosch University | Ostrich production     | The evaluation of lupins ( <i>Lupinus angustifolius</i> ) as alternative protein source to soybean oilcake meal in ostrich ( <i>Struthio camelus</i> var. <i>domesticus</i> ) diets | MSc    | Received 2017             | C         |
| 71  | Mr A Coetzee<br><b>Promotor:</b><br><b>Prof GA Agenbag</b>      | BSc Agric (2011-2014)                     | Stellenbosch University | Canola production      | Determining the optimal rate and time of nitrogen topdressing applications for canola ( <i>Brassica napus</i> ) in the Swartland and Southern Cape production areas                 | MSc    | Received 2017             | C         |
|     | 2016                                                            |                                           |                         |                        |                                                                                                                                                                                     |        |                           |           |
| 72  | Mr PJG le Roux<br><b>Promotor:</b><br><b>Dr P Swanepoel</b>     | BSc (Agric)                               | Stellenbosch University | Canola production      | Establishment, growth and yield of canola ( <i>Brassica napus</i> L.) as affected by seed-drill opener, soil quality and stubble                                                    | MSc    | studies not completed yet | C         |
|     | 2017                                                            |                                           |                         |                        |                                                                                                                                                                                     |        |                           |           |
| 73  | Mr E du Toit<br><b>Promotor:</b> Dr P Swanepoel                 | BSc (Agronomy and Agricultural economics) | Stellenbosch University | Canola production      | Developing nitrogen fertiliser management strategies for canola under conservation agriculture practices in the Western Cape                                                        | MSc    | studies not completed yet | C         |



| NO. | STUDENT                                                           | QUALIFICATIONS                                                          | INSTITUTION             | PROPOSED RESEARCH AREA | TITLE OF THESIS                                                                                                                                                                     | DEGREE | THESIS RECEIVED           | CROP CODE |
|-----|-------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------------------|-----------|
| 74  | Mr FP du Toit<br><b>Promotor: Dr WH Hoffmann</b>                  | BSc Agric (Landbou analise) (2012)                                      | Stellenbosch University | Canola production      | A financial analysis of combining crop rotations systems with appropriate potential soils in the middle Swartland                                                                   | MSc    | Received February 2018    | C         |
| 75  | Ms J van der Merwe<br><b>Promotor: Prof TS Brand</b>              | BSc (Agric )(2016)                                                      | Stellenbosch University | Ostrich production     | Evaluation of canola oilcake as alternative locally produced protein source for slaughter ostriches                                                                                 | MSc    | studies not completed yet | C         |
| 76  | Ms L Jordaan<br><b>Promotor: Prof TS Brand/ Prof A van Reenen</b> | BSc (Agric)                                                             | Stellenbosch University | Protein utilisation    | Die gebruik van chemiese middels en bedekking met polimere om die nie-degradeerbare proteïen fraksie van 'n verskeidenheid plaaslike geproduseerde plant proteïen bronne te verhoog | MSc    | studies not completed yet | D         |
| 77  | Ms P Mbedzi<br><b>Promotor: Dr BJ Vorster</b>                     | MSc (Plant Science) 2016)<br>BSc (Hons) (2015)<br>BSc (Genetics) (2014) | University of Pretoria  | Plant science          | Initial screening of Soybeans for Simple Sequence Repeats Conferring Resistance to <i>Sclerotinia sclerotiorum</i> (Lib.) de Bary                                                   | MSc    | studies not completed yet | S         |

|    |            |    |
|----|------------|----|
| P  | PLUIMVEE   | 23 |
| H  | HERKOUERS  | 21 |
| V  | VARKE      | 3  |
| S  | SOJABONE   | 12 |
| C  | CANOLA     | 4  |
| LU | LUCERNE    | 1  |
| VV | VISVOEDING | 2  |
| D  | DIVERSE    | 2  |



**VI LIST OF RESEARCH PROJECTS: 1976 - 2017 (Separate addendum)**