PROTEIN RESEARCH FOUNDATION

2015/2016

RESEARCH REPORT

PROTEIN RESEARCH FOUNDATION

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 the 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 utilization.
- The promotion cost-effective research.
- The dynamic promotion of the implementation of research results.
- The effective sustainable utilisation of natural agricultural resources.
- The reducing of foreign exchange payable for imports and creating of job opportunities by replacing imported protein as far as possible with locally produced protein.

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1. INTRODUCTION

The PRF once again enjoyed a financial year (1 March 2015 - 29 February 2016) filled with highlights and successful activities in spite of a less favourable climate and significant financial insecurities.

The highlight of the year was, without doubt, the celebration of the PRF's 25th anniversary. This was celebrated in style in both Pretoria and Stellenbosch. The celebrations included the presentation of recognition awards to local and international contributors. As part of the process, events that marked milestones over the past 25 years were recalled and described. Many of those present at the celebrations remembered the history, with these reminiscences painting a memorable picture of the scope of work done by the PRF.

Publication of a commemorative book to coincide with the two functions took on such proportions that it became impossible to produce the book on time. The matter will be rectified in 2016 as most of the preparation and editing has been finalised.

Apart from the PRF's 25th anniversary celebrations the year was marked by various important activities, as explained below.

2. GENERAL OVERVIEW

Another below average year in the agricultural sector placed ever-increasing pressure on all producers. In addition, negative international opinions about the South African economy caused enormous fluctuation in the Rand which placed additional cost pressures on the agricultural community. These aspects also put the PRF's financial resources, and those of research funding in general, under pressure.

The impact of the severe drought over the past year will be remembered by all South Africans for a long time to come. Officially it has been the driest summer season in more than 100 years and the economic and social consequences are dire. The drought has hit the economy at a time when ratings agencies were reviewing the country's credit

status and the concern around the ability of the economy to grow and to generate jobs remains at the forefront. This also raises the question of the performance of the agricultural sector and its ability to contribute to the growth of the economy. The National Development Plan (NDP) is officially regarded as the blue-print for growth and transformation, where very ambitious targets have been set for the agricultural sector. Although these are all long-term targets for 2030 it is worthwhile taking stock of the performance of the sector following the launch of the NDP in 2011.

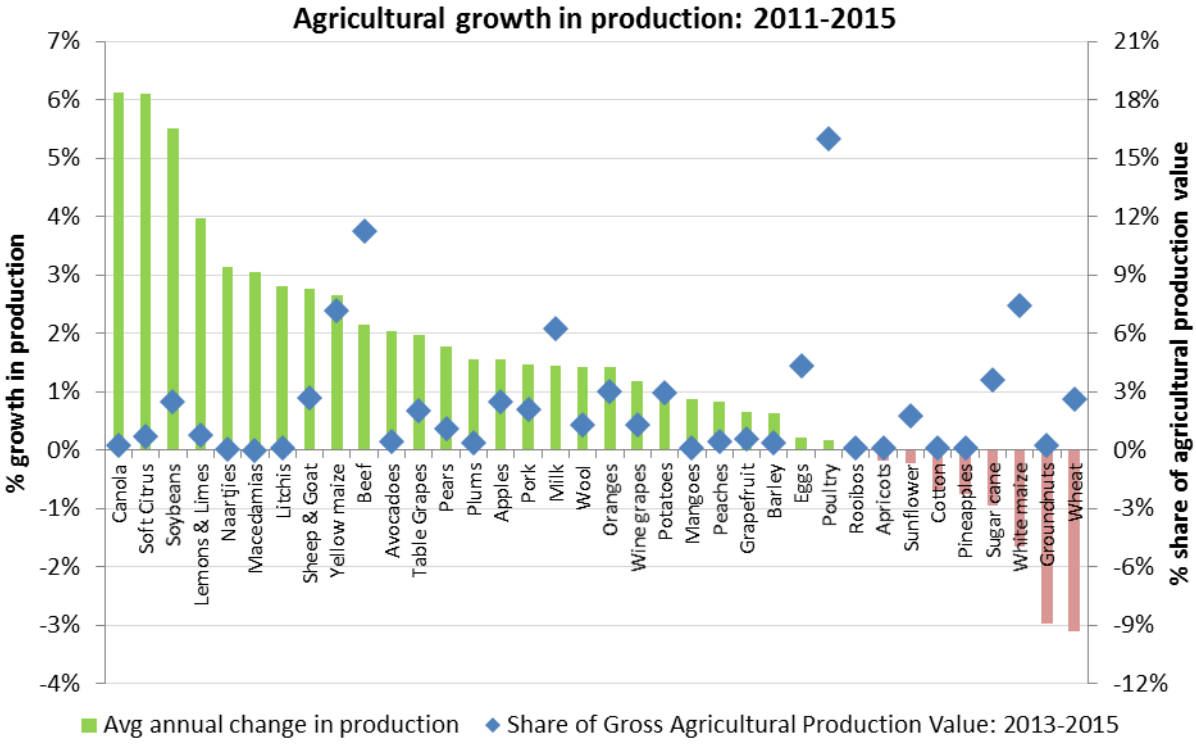

Figure 1: Agricultural performance: growth in production 2011-2016

Source: BFAP, 2016

Figure 1 presents the average annual growth rate in production of a range of agricultural industries and their share of the total value of agricultural production. The first important observation is that most of the industries that have been identified as potential winners, according to the NDP's growth and employment matrix, have performed well. From a PRF perspective it is most encouraging to find that canola is the industry that has come out as the top performer in the agricultural sector; growing production by an average annual rate of 6% p.a. Soybeans is in third position, growing production at more than 5% p.a. Sunflower production has stagnated over this period.

Over the years BFAP has consistently monitored the relative competitiveness of our industries with the leading global agricultural producers. Figure 2 compares South Africa's average yields for the main field crops over the past five years to those of our main competing countries on the export and import markets. It also compares the average annual growth rates of the past decade to the projected rates of the next decade as generated by the BFAP Baseline.

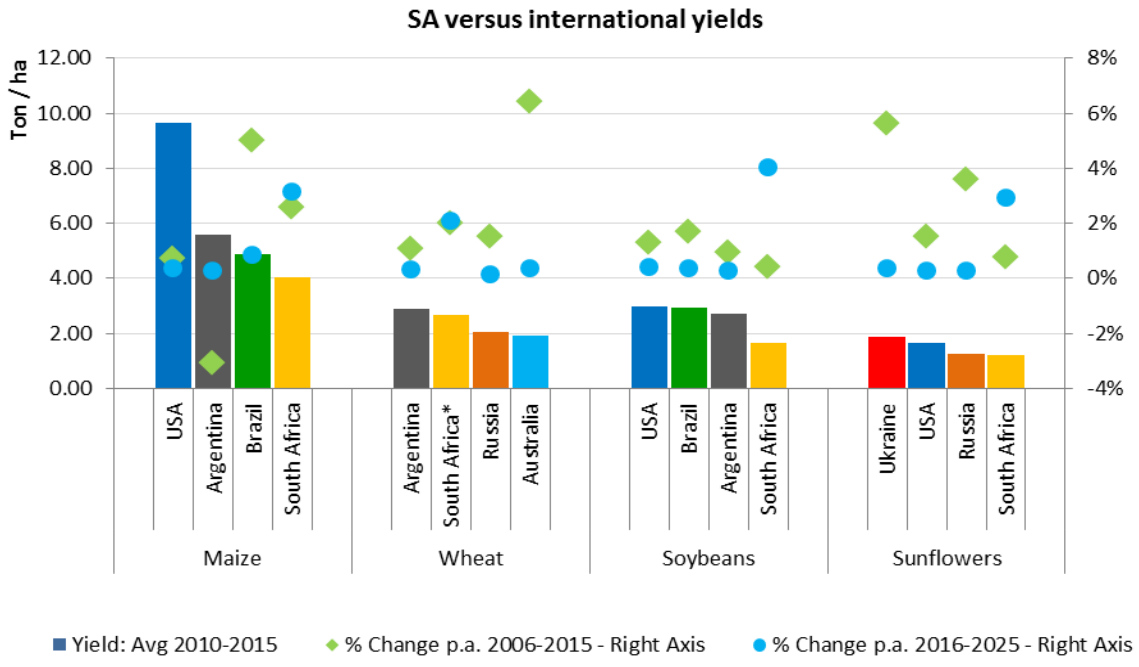

Figure 2: South Africa versus International yield comparisons 2005-2025
Source: BFAP, 2016

For maize and wheat, average annual growth rates have been in line with our main competitors. In fact, if it wasn't for the drought, the average annual rise in maize yields in South Africa would have exceeded 5% p.a. and therefore in line with Brazil. Overall, the growth in yields and therefore relative productivity has enabled the South African maize sector to be globally competitive at an export parity level, which implies that over the long run, domestic maize prices will also tend to trade closer to export parity levels. This is a critical driver for the competitiveness of all downstream industries, for example the feed and broiler industries.

For wheat, the growth rate might be slightly misleading since much of the marginal areas under dryland wheat production in the Free State has ceased production over this period. Some of this area has been planted to maize and soybeans whilst some has reverted to grazing. Yet growth rates of oilseed yields seem to have been lagging. In the case of soybeans the rapid expansion in hectares under production, as well as the drought that started in 2015 in the western parts of the country, did have an impact on average yields. There has also been little growth in the average yield of sunflower.

One can argue that these are very crude and simplified comparisons. However, it becomes far more interesting when the historic actual yields are compared to the projected global and local yields. The BFAP baseline projects a very bullish outlook with a rapid increase in oilseed yields over the outlook period due to significant investments and advances that are currently taking place in these industries, where the PRF also plays an important role. Comparing the projected growth rate for local soybeans of 4% p.a. over the next decade to the actual and projected growth rates (from the OECD Outlook 2016) for the USA, Argentina and Brazil, one realises that there is a big challenge that lies ahead for this industry. A projected growth rate of 4% p.a. will raise the average soybean yields from 1.54 t/ha over the past five seasons to 2.3 t/ha over the next 10 years.

In order to guide the research that is required to boost the overall productivity and competitiveness of an industry it is not only the average yields that matter but also the inputs required for every ton that is produced and the quality of the product that is delivered and further processed. Hence, a holistic approach of the full value chain is needed. To this extent, BFAP has been participating in a global benchmarking exercise for the past decade where farm level data related to the costs of production, farming practices, yields and revenue are collected annually over a wide range of countries. Figure 3 provides a detailed cost breakdown for canola (per ton produced) in various countries. The South African farm that is included in this analysis is a 2500 ha prototype/typical farming unit in the Overberg area with a mixed cropping system of wheat, barley, canola and a livestock enterprise. Figure 3 presents only an overview of the production costs and revenue related to the canola enterprise. From the analyses it is evident that despite the higher yields achieved in countries like Canada and Germany the South African farm is on par and competing on an average cost per ton basis. The

market revenue that our producers are receiving also compares well with the revenue received by the Canadian farmers, yet in Europe the market prices are generally higher. One of the main drivers behind higher canola prices in Europe is the biodiesel industry. In a sense, this analysis only tells part of the picture because in order to project the future expansion potential of canola in South Africa one has to compare the relative profitability of canola with alternative crops like wheat and barley in the various production regions.

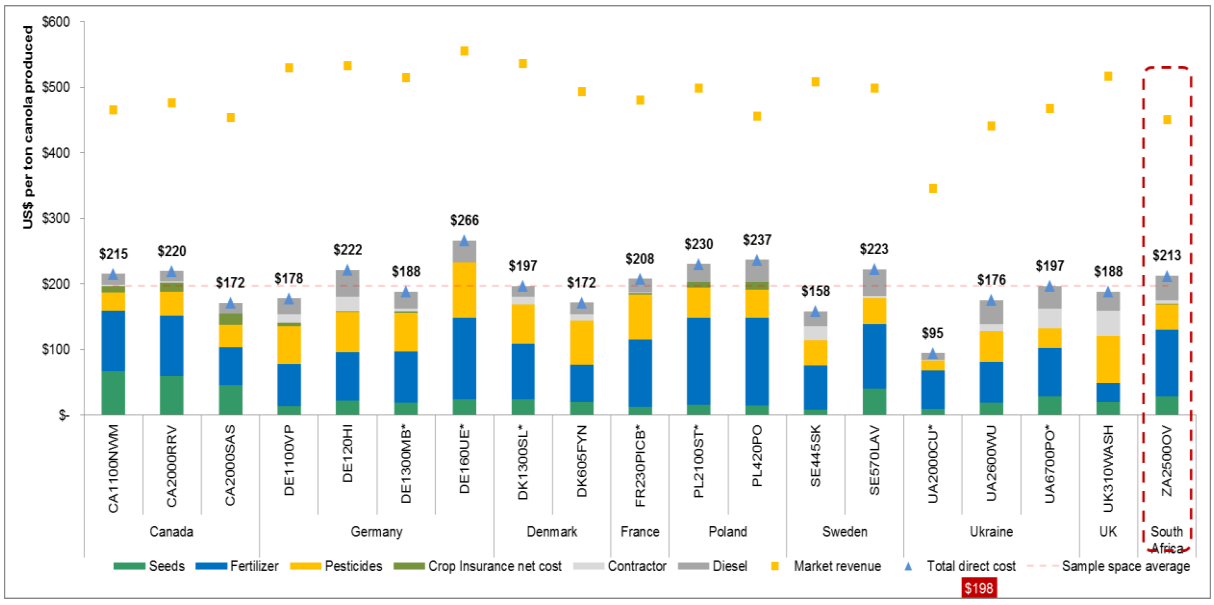

Figure 3: International benchmarking of canola production in the Overberg
Source: BFAP, 2016

As mentioned earlier, the highlights of the year were definitely the two functions in Pretoria and Stellenbosch, organised to celebrate the PRF's 25th anniversary. Special honorary awards were given to the first PRF Chairman, Dr R Bigalke as well as two EEAOC (Argentina) representatives, Dr D Ploper and Mr M Devani. The latter two have been very active contributors to the PRF. Two EMBRAPA representatives, Drs N Neumaier and M de Oliveira could not attend the gala function and the necessary recognition awards were handed to them at a subsequent meeting.

After 25 years of service to the PRF Board, the second-last founding member of the PRF, Mr JSG Joubert, retired in May. He has left many lasting impressions of his tenure with the Board and the PRF respectfully honours him for his work.

In the previous research report mention was made of the possibility of publishing our own Oilseeds magazine. We are particularly pleased to report that the first issue was published in March 2015, with consecutive quarterly issues having followed. The PRF acknowledges the work of the editor, Dr E Briedenhann, and the editing team for realising the vision.

The need for a corporate video had been identified some time ago, especially in view of the number of foreign visitors to the PRF. The first quotation has been approved and the PRF trusts that the corporate video will see the light early next year.

A significant amount of time has been spent tracing former bursary recipients thereby allowing the PRF to maintain contact with students who have completed their studies with financial assistance from the PRF. In the process, guidelines for awarding bursaries and project applications, including all commensurate aspects, were revised and updated.

Pamphlets about the crops that affect the PRF are updated regularly and the information is available, with significant volumes of associated information, on the PRF website.

The PRF wishes to refer to three standing items on the Board's meeting agenda. Firstly, the PRF compliments the Crop Estimates Committee because this committee always manages to implement new initiatives to keep the figures it publishes interesting and stimulating. Secondly, the PRF expresses considerable gratitude to SAGIS because it plays such an important role in crop production, and because of its willingness to assist and provide information. Thirdly, the PRF acknowledges the work done by Dr Lourens Du Plessis in publishing his quarterly reports on the bio-fuel industry and related matters. Unfortunately it seems as if the RSA missed the bio-fuel bus and, as a consequence, it was decided to cancel these very very informative reports after the first quarter of 2016, due to a lack of progress in this sector. Another industry that suffers under severe pressure is the broiler chicken industry. The PRF has no doubt that the chaotic situation in that industry will continue for an extended period before re-establishing stability. We wish this very important and comprehensive industry a speedy recovery.

3. POLICY RESOLUTIONS

The PRF Board conducts an annual internal audit of actions and activities through the use of think-tanks. These are conducted by the Technology Committee, the Management Committee and often by the entire Board. The past year was no exception and the Board approved various resolutions which would ensure improved PRF functioning to promote its objectives, but also to acknowledge significant contributions of individuals and institutions.

Pressure on both the soybean and canola industries convinced the Board to regroup the canola planning task team to form a Board Committee, known as the Canola Planning Committee (CPC) and to re-establish a Soybean Planning Task Team known as the Soybean Planning Committee (SPC). Based on practical considerations the SPC has not yet truly come to life and soybean planning activities are still referred to the Technology Committee. However, the CPC functioned well and Mr Franco le Roux of SOILL was co-opted as a CPC member until end 2016. The line function of the CPC is linked to the Management Committee.

Following the resolution approved during the previous year, which terminated the Super Soya Competition in KwaZulu-Natal, the PRF decided to establish a new Yield Competition with a single prize valued at R25 000.

The Research report for last year mentioned that the PRF was considering organising an International Soybean Symposium in 2015. That symposium was held in Delmas and at NAMPO Park outside Bothaville on 21 and 23 July (respectively). More details about this event are given in the section on soybeans.

As mentioned above, honorary awards were given to Drs N Neumaier and M de Oliveira of EMBRAPA in Brazil and to Dr D Ploper and Mr M Devani of EEAOC in Argentina for their particular contributions to the South African soybean industry. The Board resolved to acknowledge the contributions of these individuals because of their significant assistance in securing a sound basis for the soybean industry in South Africa through the regular introduction of new soybean cultivars from Brazil and Argentina.

Last year it was mentioned that the PRF was considering withdrawing from the National Cultivar Trials involving both soybeans and canola. During the past year the Board finally resolved to award no further funding for these trials.

In the past the PRF has implemented a very specific policy for funding research that has worked well. Unfortunately, several large research institutions, possibly as a result of poor administrative functions, have failed to submit requests for the continued funding of projects and as a result have not submitted final reports, as required by the PRF. In view of these circumstances the Board resolved that final reports and any outstanding funding claims must be submitted within six months of completion of a project. Failure to comply with this requirement will lead to the forfeiture of outstanding project funding. The PRF believes that these new rules will facilitate more streamlined administration for both the recipient and the PRF.

4. SOURCES OF PROTEIN

4.1. International

International soybean production increased from 314 million tonnes at the beginning of the year to 318.9 million tonnes. At the end of the financial year (January 2016) the projected figures were 320 million tonnes soybeans, of which the USA would produce an estimated 105.8 million tonnes and Brazil about 100 million tonnes. During the past season South Africa surpassed the 1 million tonnes mark, a particularly positive achievement. Exports to China increased annually to levels previously almost unheard of. In August 2015 Brazil exported an unbelievable 8.71 million tonnes (for the month).

However, international sunflower production only amounted to 41.2 million tonnes for the past year.

Fish meal with a 67% protein content, achieved a price of US$2100 per tonne.

4.2. Local protein production

4.2.1 General

The Plant Production discipline forms an important base for increased protein production for animal feeds and represents the main objective of PRF actions.

This portfolio includes, *inter alia*, the following subject matter:

- Agronomy
- Crop physiology/Plant physiology
- Soil Science/Plant Food
- Herbicide Science
- Plant pathology
- Entomology
- Nematology

4.2.1.1 Research and Technology transfer

The PRF promotes research and technology transfer by providing funding for research through the Department of Agriculture, universities and others, including private companies and foreign institutions.

4.2.1.1.1 Agricultural Research Council (ARC)

The research capacity of the ARC had seen a constant decline since 1998 due to political interference in decision-making processes. As a result the number of projects submitted to the PRF for funding has been drastically reduced.

Only the ARC IGC at Potchefstroom and ARC NIPB at Stellenbosch continue to work with soybeans and canola.

4.2.1.1.2 Provincial Departments of Agriculture

Of all the Provincial Departements of Agriculture only the Department of Agriculture: Western Cape (DAWC) conducts canola projects of excellent quality that are being funded by the PRF.

4.2.1.1.3 Universities

The University of Stellenbosch (US) handles canola projects that are being funded by the PRF.

US also houses an office manned by Prof André Agenbag since he co-ordinates canola promotion in the Western Cape on behalf of the PRF.

4.2.1.1.4 Co-workers

The reduction in research capacity has forced the PRF to move its focus from research to technology transfer.

Currently there is more co-operation between local and multi-disciplinary companies. Local seed companies and institutions such as Du Pont/Pioneer, BASF, Bayer and others co-operate actively to resolve the issue of research capacity loss.

A typical example of this co-operation is the PRF's soybean Elite Programme. It is conducted at six (6) localities that represent the most important soybean growing areas:

- Stoffberg: - Representing the higher northern Highveld (cool area)
- UP (Hatfield): - Representing the southern Highveld (moderate to warm area)
- Brits: - Full irrigation, representing the warm northern irrigation areas (warm area)
- Potchefstroom: - Representing the western production area (moderate to cool area)
- Bethlehem: - Representing the eastern and northern Fee State (cool area)
- Ukulinga (Pietermaritzburg): - Representing KwaZulu-Natal (warm area)

Sixty (60) lines obtained from five different institutions in South America were planted with five local controls at the six (6) localities for evaluation in terms of adaptation to local conditions. The length of the growing season for the lines varied between MG 4.0 to MG 7.0.

Five (5) lines had already been registered locally, to be marketed as cultivars for the local market. A further four (4) lines are under current review by the Department of Agriculture (DAFF) for release as cultivars.

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

As in the past, these two co-workers were satisfied with the standards maintained during these trials. The PRF sent Messrs W Van Wyk and G De Beer on a study tour to South America in January/February 2016. Both benefited markedly from what they learned on the tour. It was money well spent.

The DAWC handles the Canola Elite Trials. These trials receive regular entries from local companies such as Agricol, K_2 Agri, Du Pont/Pioneer and Bayer. During the past

year a South American institution also submitted nine (9) lines for evaluation at the trials.

4.2.1.2 Congresses / Symposia

The Joint Congress (four subject associations; see below) and the Soil Borne Diseases Symposium were attended by PRF representatives. In addition the PRF organised a Herbicide Symposium for soybean producers at two localities (east and west) in South Africa.

4.2.1.2.1 Joint Congress

Four plant production subject associations present an annual joint congress:

- South African Association for Crop Production;
- Soil Science Association of South Africa;
- Southern African Association for Herbicide Sciences;
- Southern African Association for Horticulture.

This congress was presented in Bloemfontein from 18 to 21 January 2016. Dr Jan Dreyer attended the congress on behalf of the PRF and also submitted a report about the congress. Summaries of the papers and programme are available from the PRF offices.

The main speakers were:

- Dr Flen Taylor, Head of Research, University of the Free State “Challenges facing research at Universities”.

- Dr Lynn Sosnoskie, Weed Researcher, University of California; “Conservation tillage and its effects on weed ecology and management with a special emphasis on herbicide resistance and sustainable crop production”.

- Prof Chris C du Preez, Head of Soil Sciences Department, University of the Free State; “A glimpse into the past, present and future trends in soil science”.

- Prof Roland Schulze, University of KwaZulu-Natal; “Whither the weather or whether we wither? Peeping through the looking glass into a climate changed world.”

  According to Dr Taylor, the level universities strive to achieve is a so-called “platform university”. More emphasis will need to be placed on patents and intellectual property. To achieve this, talented researchers are required – something South Africa appears to be lacking.

  Dr Sosnoskie indicated that ‘Conservation farming still progresses actively in the USA, but resistant weeds create large problems in practices where producers use single action herbicides repeatedly. It creates herbicide resistant weeds. A holistic approach to weed control is essential’.

  According to Prof Du Preez the human factor is becoming an increasing trend in the agricultural research agenda. One aspect that is considered important internationally is the role of soil health in the well-being of man.

  In terms of weather, Prof Schulze noted that the expected global warming increase of 2^0 C by 2050 and 4^0 C increase by 2090 will lead to more instances of extreme weather. Production areas will have to change and the emphasis should shift to crops that are more drought resistant.

  The congress was well attended (about 500 delegates). Five (5) of the 143 papers related to soybeans. Once again the tendency for most papers to be delivered by students was notable.

  A more comprehensive report about the congress is available from the PRF offices.

4.2.1.2.2 Weeds Symposium

This symposium was organised by the PRF. Dr Jan Dreyer was the convenor and it was presented on 21 July 2015 at the Delmas Show Grounds and at NAMPO Park (Bothaville) on 23 July 2015.

The following speakers addressed the symposium:

- Mr GJH Scholtemeijer, Programme Manager at Delmas.
- Mr A Theron, Programme Manager at Bothaville.
- Prof Stevan Z Knezevic, University of Nebraska - “The effect of weed competition on soybean yield”.
- Prof Charlie Reinhardt - “Soybean herbicides, their mode of action and the control of resistance plants”
- Dr Brian De Villiers - “Water quality, additives and general practices for better weed control”.
- Mr Cobus Van Coller - “Practical aspects of weed control in soybeans”.

About 300 delegates attended the symposium which was considered by all to be a huge success.

From the reaction of the delegates the following aspects were particularly popular:

- The quantification of yield losses seems to be a new subject for most. Producers know that weeds cause losses but percentages and early stages were a revelation.
- The allelopathic influence of known weeds also caused widespread interest among the delegates. This aspect will, in all probability, place the control of weeds prior to planting higher on the priority list.
- Water quality and especially its adjustment, as well as the effect of salts on the efficacy of chemical control, could ensure better control and better yields.

- The papers were put into context thanks to the contribution of a producer (Mr van Coller) who vouched for the credibility of the information presented.

4.2.1.3 General

A significant number of articles have been published in magazines such as Die Landbouweekblad, Farmers Weekly, Grain South Africa, Oilseeds Focus, Canola Focus and others to promote soybean and canola production.

4.2.2 Soybeans

The overall PRF objective remains the production of more local protein for animal feeds to replace imported protein.

Over the past year soybean processing in South Africa increased monthly. The tonnage processed in March 2015 was 61 000 tonnes, with 71 000 tonnes in April and 89 000 tonnes in May. An incredible 115 000 tonnes was processed in July 2015.

In the 2013/14 reporting year protein demand and supply reached a breakeven point for the first time. However, in 2014/15 the scales tipped toward locally produced protein with 61% of the protein for animal consumption being produced locally. For the 2015/16 reporting year the figure increased to 68%, very much to the satisfaction of the PRF. We believe that the yield of both soybeans and canola will continue to grow in the next few years, allowing the gap between local production and self-sufficiency to shrink more. At the moment there are no significant differences of opinions about this. Differences only exist in terms of when it will happen. The PRF trusts that it will occur in the 2020 planting season, while BFAP expects it by 2024.

The soybean industry still experiences bottle necks, although it is going well. The most important problem remains the low average yield per hectare. Various speakers at the soybean symposium held during the past year concentrated on this aspect in particular. This was the motivation by the PRF for sending its soybean contractors, Messrs Wessel Van Wyk and Gawie De Beer, to visit South America, the aim being to afford them

broader exposure to soybean production than they can obtain in the South African soybean industry.

Several other interesting events within the soybean industry deserve mention. An article published in Die Landbouweekblad of June 2015 mentioned a producer in Thabazimbi, a Mr Kruger Robertse, who achieved a soybean yield of 7 tonnes per hectare. This is an exceptional achievement.

The Soybean Yield competition in KwaZulu-Natal also gained more momentum. According to the first indications, Pioneer wishes to change this competition into a national competition in which various regions will compete for prizes of significant value per region.

The end point royalties system that is being negotiated for wheat seems promising. The possibility that the new Roundup Ready 2 soybeans of Monsanto may be available before 2020 in South Africa seems to be a distinct possibility. Based on these aspects, the PRF retains its target of 1 million hectares and a yield of 2.5 million tonnes for soybeans by no later than the 2020 planting season.

The annual soybean web study done by Mr Jan du Preez created significant interest. Such studies definitely help to keep the South African soybean industry up to date with the latest developments in the world.

The past season's 687 300 ha and 1 059 850 tonnes of soybeans means that the crop rotation ratio between maize and soybeans was 80:20. The last few years saw dramatic progress in terms of the changes mentioned above. As such it seems as if the PRF's vision of 70/30 could be within reach.

Sunflower and soybeans achieved a record price of R7 000 per tonne due to the drought conditions of the new season. The price was previously unheard of in the South African soybean and sunflower industry.

The critical drought conditions of the 2015/16 season became clear by February 2016 and harvest estimates were adjusted to 519 800 ha and 724 600 tonnes respectively.

In spite of the drought and consequent poor agricultural conditions, several of the largest soybean seed companies entered the South African market, giving hope that significant growth remains possible as soon as the climatic conditions returned to normal.

In closing, it may be mentioned that the founding of the South African Soybean Association is progressing well and that everything that remains unclear about the soybean situation in South Africa will finally be clarified.

4.2.3 Canola

The 2015 season was awaited with great expectations, but also with a little concern. The 95 000 ha plantings in the 2014/15 season and the untimely interruption of the rainy season at the end of August 2014 had a negative impact on yields. These issues remained fresh in our memory and it was expected that a slight reduction in planted hectares might occur due to the lower than expected yields. The most significant impact on the 2015/16 plantings remained the effects of the rainy season that started very late. In the Swartland rain only fell on 30 May 2015. See Figure 4 Swartland and Figure 5 Southern Cape.

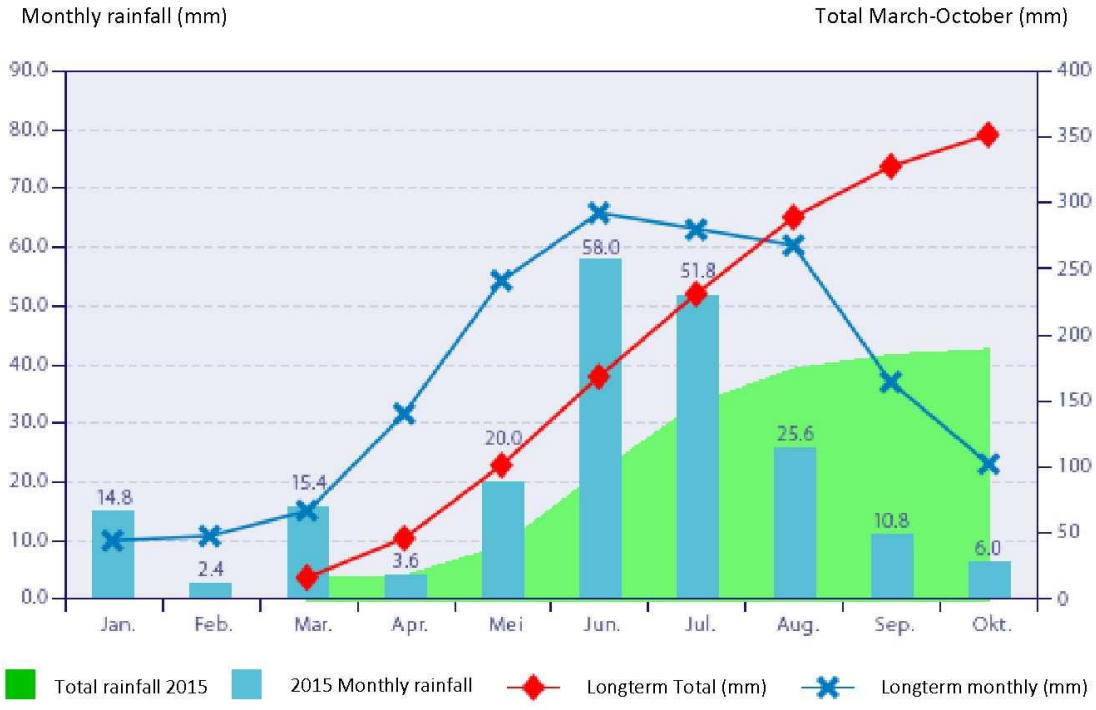

Figure 4: Langgewens Rainfall 2015

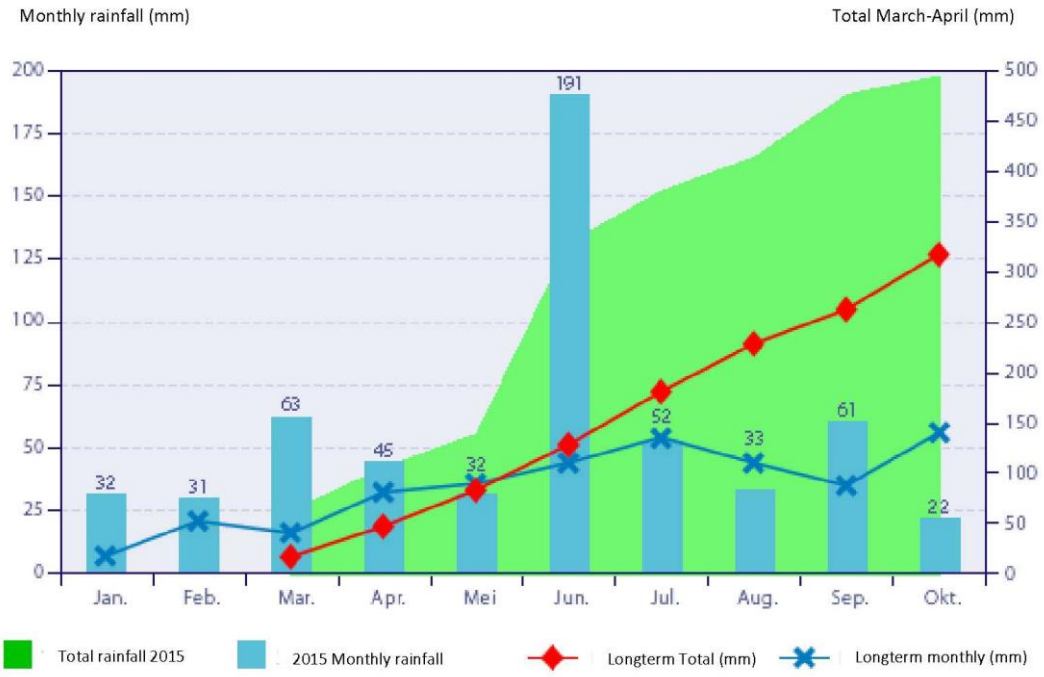

Figure 5: Rietpoel Rainfall 2015

These unfavourable planting conditions led to a significant reduction in planting, particularly in the Swartland area. The total area planted was only 78 050 ha.

Unfortunately the late start of the season was the least of the problems. Fig. 1 shows that 2015 was a particularly poor rainfall year in the Swartland area. It received only 51% of its normal rainfall, with little or no rain during the second half of the season. The Southern Cape area had more normal rainfall and above average harvests were realised. This natural disaster caused the average harvests to decline to 1.19 t/ha with a total of only 93 000 ton being harvested.

Valuable information and results were obtained in this abnormal year. From the Canola Yield Competition results it was clear that canola is a very drought-tolerant crop. The average yields obtained in the Southern Cape during abnormal seasons vary between 1.28 and 2.4 t/ha. Yields in the drought-stricken Swartland varied between 0.7 and 2.1 t/ha.

The impact on wheat harvests was even more significant with only a third of normal yields being realised. See Fig.'s 6 and 7 for the results of this dry year on the long-term yield data per hectare.

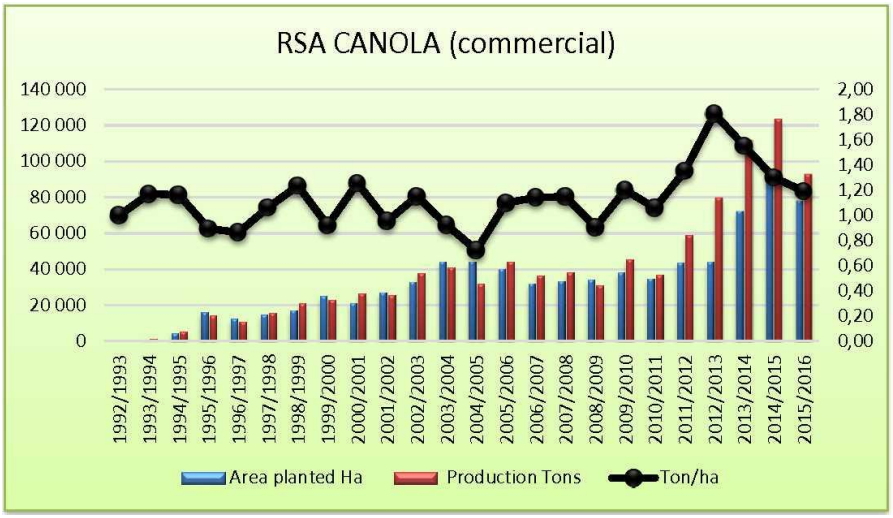

Figure 6. Long term trend in area planted, total production and yield in canola production in South Africa

RSA CANOLA (Commercial)			
Marketing year	Area planted Ha	Production Tons	Ton/ha
1992/1993	400	400	1,00
1993/1994	1 000	1 170	1,17
1994/1995	4 500	5 230	1,16
1995/1996	16 000	14 320	0,90
1996/1997	12 600	10 880	0,86
1997/1998	14 800	15 720	1,06
1998/1999	17 000	21 000	1,24
1999/2000	25 000	23 000	0,92
2000/2001	21 145	26 549	1,26
2001/2002	27 000	25 750	0,95
2002/2003	33 000	37 975	1,15
2003/2004	44 200	40 770	0,92
2004/2005	44 250	32 000	0,72
2005/2006	40 200	44 200	1,10
2006/2007	32 000	36 500	1,14
2007/2008	33 200	38 150	1,15
2008/2009	34 000	30 800	0,91
2009/2010	38 060	45 660	1,20
2010/2011	34 820	36 900	1,06
2011/2012	43 510	58 800	1,35
2012/2013	44 100	79 650	1,81
2013/2014	72 165	112 000	1,55
2014/2015	95 000	123 500	1,30
2015/2016	78 050	93 000	1,19

Figure 7. Long term trend in area planted, total production and yield in canola production in South Africa

The focus on canola growing management remains of critical importance. The PRF will have to continue the technology transfer actions, although results of the training initiatives are clearly visible in practice on farms. Technology transfer remains an extremely important factor to give the canola industry additional thrust. Important progress had been made with the planning of a canola symposium in 2016. The main speaker, Dr John Kirkegaard, already accepted the invitation to visit South Africa. A general principle of the matters that enjoy current attention, is that the average oilseeds yield per hectare in South Africa is too low. In view of that, the theme for the 2016 canola symposium will be “Producing 5 tonnes canola crops”. Co-operation with other international groups will be sought in an attempt to obtain important input from

international experts. The Canola Planning Committee is investigating the possibility of setting a producer challenge to produce 5 tonnes per hectare canola under irrigation.

The availability of seed is a positive success story for the PRF. The struggle over many years with seed companies to have the best cultivars available timeously has at last yielded good results and is bearing fruit. The perception among farmers that seed of lesser quality was being imported from Australia has been put to rest and the results are obvious in the variety of cultivars now available. Now it is in the best interests of producers to place seed orders early to maintain this position.

The PRF vision and determination to broaden our horizons in terms of new cultivars from countries other than Australia was proven with the Bayer Belinda cultivar from Europe, planted commercially for the first time in 2015. It is a huge success. An encouraging aspect is the report of 38 cultivars being entered for the Elite Trials conducted by the Department of Agriculture in the Western Cape. The canola industry looks forward to the introduction of more good new cultivars to add to the available spectrum.

The programme launched by the PRF to train chemical representatives to plan and manage canola, especially in the Swartland area, has yielded excellent results. These are visible in cultivar choices, weeds management and timely spraying to prevent sclerotinia. This training action took place in February in the Swartland area and 55 chemical representatives attended the training course. In a similar action, the annual visits of the canola work group to both the Southern Cape and the Swartland National Cultivar Trials continue. In many aspects this is an ideal showcase for the latest cultivars that are being registered in South Africa. There are attempts to invite interesting speakers on a continuing basis to address the canola work group on matters of particular interest.

Weeds management remains a challenge. The availability of Roundup Ready cultivars is essential for the future and will need to be actively pursued if the PRF is to realise its canola target of 150 000 hectares in 2020, at a yield of 250 000 tonnes.

In 2015 the PRF initiated its Canola Yield Competition. After careful consideration the existing Super Canola Competition, which had run since 2000 mainly as a training aid, was terminated. With the focus now only on yield and the prize money of R25 000 per region the competition proved to be a huge success from its inception. Prof Andre Agenbag argued that credibility and exact measurements within the competition were not negotiable and with the assistance of his co-workers these were carried out with great precision. The Southern Cape winner was A G Joubert en Seuns of Kweekkraal, Riversdal with a yield of 2.41 t/ha. The Swartland winner was Andre Brink of Groot Phesantekraal with a yield of 2.19 t/ha.

Cultivar trials were conducted in the summer rainfall areas at Groblersdal, Beestekraal, Brits and Vaalharts. Planting was handled by a new PRF contractor, Mr Willie Jonker. The trials focussed particularly on planting time, cultivars, sowing density, nitrogen fertiliser and irrigation. Frost, high temperatures and sclerotinia remain a challenge. The positive attitude of producers toward canola reaffirms the involvement of the PRF in this field. Pioneering work however must still be done.

Valuable work is being done during the cultivar evaluation programme of Mr Piet Lombard of the DAWC. One of the 2015 highlights was the visit of Dr Hector Milisich, associated with INTA in Argentina. His cultivars were evaluated in the programme which is the result of the PRF's search for better cultivars.

The income/cost estimates for calculating gross canola margins are being kept up to date by Mr SG Ferreira. In co-operation with the PRF co-workers, agricultural economists at the Western Cape Agricultural businesses, they ensure that information remains relevant, on time and accurate. This tool is used with good results in the marketing of canola.

Canola Focus remains an exceptional aid for communicating with producers and conveying information. The decision to distribute Canola Focus only electronically works well. Very few requests for hard copies have been received.

The 2015 highlight was definitely the visit to the 14th International Rapeseed Congress in Saskatoon, Canada. Messrs Scholtemeijer, Theron, Cumming and Prof Agenbag attended the congress. Liaison with role players could add significant value in the future. (See tour report on the PRF web page).

Liaison of immeasurable value was established during the visit of Messrs Scholtemeijer and Theron to North America (see tour report). These contacts may be the key to realising the PRF vision.

4.2.4 Sunflower

Sunflower remains a crop whose plantings either increase or decrease based on climatic conditions. In the 2015 season only 568 000 ha were planted compared to 598 950 ha in 2014. The negative climatic conditions at the beginning of 2016 gave rise to an increase in planted areas to 687 500 hectares and the initial estimated yield of 663 000 tonnes has been increased to an estimated 687 150 tonnes. In spite of concerted attempts by the Oilseeds Advisory Committee (OAC) to push sunflower production there are no indications that there will be an increase in dedicated sunflower producers in the near future.

4.2.5 Fishmeal and other sources of protein

The estimated fishmeal production for 2015/16 in South Africa, Namibia and Angola, Table 1, illustrates a very stable production over the last four years, with most fishmeal being exported. In 2015, 84% of fishmeal produced was exported. Ruling international prices of fishmeal are substantially higher than in South Africa due to the application of fishmeal in aquaculture diets affording a higher value for which little or no market exists in South Africa.

Table 1: Local and imported fishmeal 1 April 2012 to March 2016

	2012/2013	2013/2014	2014/2015	2015/2016
Local Production *	84 000	78 000	75 000	77 600
Exports	49 000	58 000	55 000	65 000
Available SA	35 000	20 000	20 000	12 600

- RSA, Namibia, Russian Trawlers, included

Other non-fishmeal and non-oilseed meal protein contributions to the feed industry during 2015/16 are estimated as follows:
Blood meal 9000 tons, Feather meal 22 000 tons, maize gluten (60%) 19 000 tons, meat and bonemeal 5 000 tons, poultry by-product 76 000 tons, giving a total of 131 000 tons.

4.3. Oil Crushing Industry

The local crushing capacity of soybeans increased from 600 000 tons in 2012 to 1.35 million tons in 2013 and now stands at an estimated 2.2 million tons. Sunflower crushing capacity is estimated at 1.8 million tons while canola crushing capacity is estimated at 120 000 tons.

Due to the shortage of soybeans in relation to crush capacity import parity prices of soybeans have been the norm. Crush margins have been under significant pressure, often being negative, resulting in profitability of the crushing industry being lower than normal.

The transition from imported Argentinean soybean meal to local production continues. A select number of soybean crushing plants has improved quality to compete with imported product.

The breakdown of oilseeds processed in 2015/16 is as follows:
Soya for human consumption, 24 000 tons; full fat soya, 122 000; soybeans for oilcake, 988 000 tons; sunflower seed for oilcake, 737 000 tons; canola seed, 125 000 tons (Figure 8)

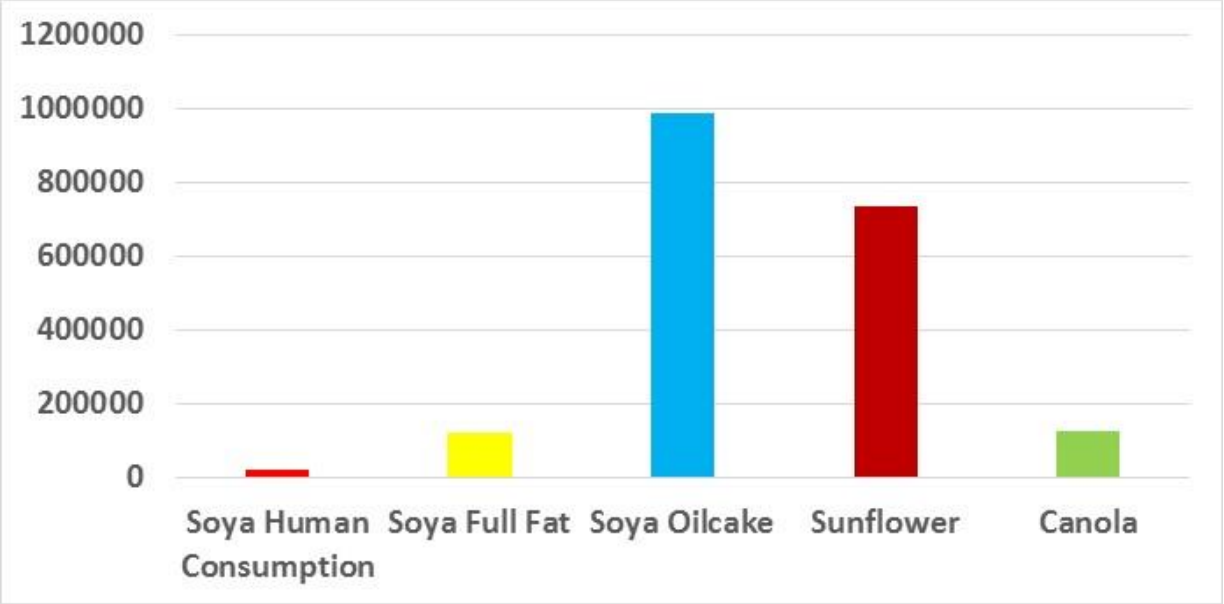

Figure 8: Oilseeds processed in South Africa in 2015/16

4.3.1 Producers of full fat soya

The value of full fat soya in poultry feeds is estimated at 1.15 times that of soybean meal. The fact that South Africa was a net importer of soybeans in 2015/16 (125 000 tons) resulted in soybean prices tending towards import parity putting pressure on the economic feasibility of using full fat soya in feeds. Full fat soya usage has been relatively constant at 115 000 tons in 2015/16. Full Fat soya is likely to retain its share of the soya market in feeds but is unlikely to increase.

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4.4. Protein consumers

4.4.1 Animal feed manufacturers

Animal feed requirements

Compound feed produced by 131 countries in the world out of 32 241 feed mills is an estimated 995 million tons, growing by 1.6% in 2015. When on-farm mixing is included this volume is estimated to be 1.3 billion tons. Poultry feed, at 47% of market share, dominated the total feed production globally. South Africa is currently ranked 22nd among global feed producers.

Feed sales in the formal feed industry in South Africa (AFMA) grew by 4.9% in 2014/15 but this was reduced in 2015/16 to only 2.9% and is expected to be even lower in 2016/17. The reduction in broiler feed sales illustrates the challenge currently being experienced in the poultry industry with regard to increased import volumes mainly from the European Union.

AFMA feed sales (plus concentrates) were 7 183 107 tons for 2015/16 which makes up 61.2% of the total calculated national feed production of 11 736 738 tons. The largest sector of AFMA remains poultry feed which makes up 61%. This is in line with global trends. Nationally, including non-compound feed, the share of poultry feed is lower at 39%. National feed production during 2015/16 is given in Table 2.

Table 2 National Animal Feed Production during 2015/16 (tons)

Feed Type	*AFMA Feed	**National Feed production
Dairy	1000422	2136384
Beef & Sheep	1304786	3512035
Pigs	320185	905977
Layers	1080971	1276342
Broilers	3322282	3323278
Dogs	99799	325789
Horses	41646	135670
Ostriches	15735	116063
Aquaculture	5281	5200
TOTAL	**7183107**	**11736738**

*** AFMA Statistics plus concentrates converted to compound feed**

**** Calculated volumes based on APR Model**

4.4.2 Poultry, pigs and other consumers of protein

4.4.2.1 SAPA Administration

The South African Poultry Association (SAPA) has undergone a radical transformation mainly to get the Government to play ball regarding the importation of poultry products into the Country. Only two organisations now exist within SAPA, namely, an Egg Organisation and a Broiler Organisation. All previous bodies have been absorbed into these two organisations, making the Association considerably more efficient. As a result, only two AGM's were held at AVI Africa in 2016 prior to the Congress itself.

4.4.2.2 Egg Organisation

The Chairman of the Egg Organisation, Robin Barnsley, reported that members of the organisation pay a membership fee of R400 and then a voluntary levy of 1 c/doz eggs sold. At present only 70 producers are members of the Organisation. This is an Industry in distress due to a weakened consumer demand, rising input costs, a volatile and weakening Rand and increasing interest rates. This is partly because we have had the lowest annual rainfall in 112 years and as a result raw material prices have risen exponentially which has increased the cost of egg production, and this cannot be passed on to the consumer. Pressure is being exerted on margins with retailers' margin increasing to 65% resulting in the producer getting a reduced share. The average producer price is R14 per doz. and the retailer gets R23/doz.

At R16.65/kg eggs are the least expensive source of animal protein. Broilers cost R18.43, pork R22.83 and beef, between R27 and R34/kg. The PPI for eggs lagged far behind the other indexes (such as CPI) until August 2015 after which it increased rapidly and is now above the average.

The layer flock consists of 24.9 m hens; the gross value of eggs is R9.8 billion, which is 8.6 % of animal products in South Africa. Per capita consumption of eggs is very low at 150, compared with New Zealand at 220, USA at 260 and Mexico at 352 eggs p.c. The Egg Organisation stopped generic advertising in 2015 due to pressure from its members

which was clearly a mistake, given the low per capita consumption of eggs in this country.

4.4.2.3 Broiler Organisation

The Chairman of the Broiler Organisation, Marthinus Stander reported that the broiler industry is in a very fragile state of affairs because of portion dumping, the worst drought in decades, rocketing feed prices, AGOA-related pressures, and new brining regulations. These have resulted in cutbacks in production, consolidation and closure of small to medium businesses. There have also been disruptions to imports of grandparent stock caused by Avian Influenza outbreaks in Europe and the USA. However, it has been a fairly prosperous year for the broiler chick industry as demand exceeded supply.

The issue of brining has still not been resolved. SAPA's concern was that, by reducing brining levels, chicken would be made less affordable to poorer consumers. DAFF seems to have accepted that the proper point of measurement is at the processing plant, not in supermarkets. SAPA submitted revised proposals to DAFF in early 2016 and it is hoped that the matter can be resolved this year.

The Breeder flock consists of 6.7 m hens, 1062 m chicks were hatched and 1005 m broilers processed. The gross value of poultry meat is R38.8 billion or 34% of animal products. Commercial producers sell 1.7 m tons of poultry meat per annum, 1.65m being broilers, 33 000 being breeder culls and 38 000 layer culls. Subsistence farmers produce 69 000 tons amounting to a total production 1.79 m tons. Consumption of poultry is 2.23 m tons, or 40.3 kg per capita.

Poultry imports amounted to 478 000 tons, 457 000 being frozen broilers from Brazil (50 %), the E.U. (41.7 %), the Netherlands (13 %) and Belgium (7.4 %). Of the total imports, bone-in portions account for 42 %. This amounted to an increase of 24% from 2014. Of the imports from Brazil 61% is mechanically deboned meat (MDM), whereas over 80% of EU imports are bone-in portions.

Exports of broilers amounted to 72 444 tonnes (+9.2% from 2014) worth R1.232 billion. The increase is modest compared with the increase from 25 350 t in 2013 to 66 355 t in 2014, an increase of 262%.

4.4.2.4 SAPPO

Feed prices have increased by between 50 and 60% in the past year thereby increasing the cost of production, with little change in the price paid for the product. The Industry is in recession.

African Swine Fever (ASF) broke out in two places in South Africa. A concerted effort is being made to prevent the disease from spreading to the wild pig (warthog) population, which would affect trade of pigs and pig products from the country.

The Alzu group has taken over the PIC South Africa franchise, together with all the PIC farms and assets as from 1 June 2016. Alzu is a multi-dimensional and integrated organisation with vested interests in agriculture and various other operations in different industries. Alzu pig genetics (Pty) Ltd trading as PIC South Africa will have its corporate headquarters in Middelburg, Mpumalanga.

SARS latest audited figures for 2016 have shown that a total of 6 375 ton pork was imported in the first three months of this year. In 2015 total imports were 3 586 ton. Ribs previously made up more than 70% of the total imports but this has changed and now only represents 47% of imports with other cuts representing 50%. The main exporting countries were Spain (34%), Germany (31%) and Canada (10%).

4.4.3 Human consumption

Processing soybeans for human consumption (food) remains extremely limited. There are no data available regarding domestic use. Local processing of soybeans increased a little in the 2015/16 season, from 23 170 tonnes in 2014/15 to 24 323 tonnes. Refined soybean products are mostly imported, but there is no information available about volumes. Hopefully more information will be available when the statutory measures in terms of oilseeds products become effective in the next financial year.

5. PROJECTS FINANCED 2015/16

During 2015/2016, the Protein Research Foundation funded 15 research projects (see Annexure I), same as the previous year. Six (6) of the 15 projects were new, while 9 were continuations of existing projects. A total of 20 funding applications were received. Three (3) were declined and one (1) project did not materialize.

Seven (7) projects (See Annexure II) were finalised during the year, but the final reports are expected only in the first half of 2013.

For 2016/2017, the PRF received 23 applications. Two (2) of those were new applications. These applications will be elucidated in the next research report.

6. PROJECTS COMPLETED SUCCESSFULLY OR THAT SHOWED PROGRESS (ANNEXURES I AND II)

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

The PRF soybean Elite trials (2015/16) were planted at the following six (6) localities:

- Stoffberg - Representative of the northern Highveld.
- University of Pretoria (Hatfield) - Representative of the southern Highveld.
- Brits - Representative of the northern irrigation area.
- Potchefstroom - Representative of the western production area.
- Bethlehem - Representative of the eastern and northern Free State.
- Ukulinga (Pietermaritzburg) - Representative of KwaZulu-Natal (warm area).

The number of controls used in the trials was reduced from five to four local cultivars. Only one of the previous five was retained (LS 6164 R - M.G 6.0). The following four (4) were used:

LS 6240 R	-	M.G. 4.0
DM 5953 RSF	-	M.G. 5.0
LS 6164 R	-	M.G. 6.0
PAN 1729 R	-	M.G. 7.0

In 2015/16, seventy one (71) lines (genotypes) obtained from seed institutions, mainly from South America (Brazil, Argentina and Uruguay), were planted with the four South

African cultivars (controls) at the six mentioned localities. The maturity groups varied from 3.7 to 8.5.

The past season was one of the hottest and driest recorded for some years. The extreme daytime high temperatures caused severe stress for the plants. In spite of supplementary irrigation plants at the Potchefstroom site suffered damage due to the extreme daytime temperatures that often reached 40°C and caused clear moisture stress in the plants.

A number of the 71 lines showed high yields and therefore have potential to be included in additional local trials that may lead to their possible registration as cultivars in South Africa.

Two of the South African controls showed broad adaptability and were winners or runners-up at most of the localities. Cultivar DM 5953 RSF showed remarkably high yields:

Pretoria	7.2 tonnes/ha
Bethlehem	5.2 tonnes/ha
Stoffberg	5.1 tonnes/ha

The project creates opportunities for participating seed institutions to consider their material for local registration. Because this project broadens the selection of soybean cultivars in South Africa it should be continued.

6.2 NATIONAL SOYBEAN CULTIVAR TRIALS; AS de Beer, L Bronkhorst, HSJ Vermeulen, NN Mogapi, TC Ramatlotlo and S Seutlwadi, ARC Grain Crop Institute, Potchefstroom

A total of 29 commercially available cultivars were evaluated for the 2014/15 season in 22 field trials scattered over the production area representing the cool, moderate and warm areas. Only GMO cultivars were included and Roundup applications were used during the execution of the trials. A randomised complete-block design with three replicates was used for all field trials. Date of flowering (50% flowering), date of harvest maturity, length of growing season, plant height, pod height, green stem, lodging, shattering, 100 seeds mass, undesirable seed, protein - and oil percentage and seed

yield were determined and the yield probability of cultivars calculated. Yield probabilities served as the guideline for cultivar selection. The mean number of days from planting to 50% flowering of cultivars for the cool-, moderate and warm areas was 74, 59 and 43 respectively. The overall mean oil content for cultivars was 19.8% for the cool, 20.8% for the moderate and 22.1% for the warm areas.

The overall mean protein content was 38.1% (cool), 37.7% (moderate) and 39.8% (warm). The overall mean yield was 2435 kg ha-1 for the cooler areas, 2199 kg ha-1 for the moderate and 3154 kg ha-1 for the warm areas. Cultivars with a high yield probability are important in the selection of cultivars by producers due to the reliability of the expected future yield. Cultivars which had high yield probability over the reporting period were PAN 1454R, LS 6146R and LS 6453R LS 6248R, PAN 1583R, PAN 1500R for the cooler areas, PAN 1583R, LS 6164R, LS 6161R, LS 6261R and PAN 1614R for the moderate area as well as PAN 1664R, LS 6164R and LS 6161R for the warmer areas.

6.3 ETIOLOGY AND POPULATION STRUCTURE OF *MACROPHOMINA PHASEOLINA* (CHARCOAL ROT) IN SUNFLOWER AND SOYBEANS IN SOUTH AFRICA;

E Jordaan and JE van der Waals, University of Pretoria

This research aims to answer questions about the *Macrophomina phaseolina* populations in sunflower and soybean growing regions in South Africa, and whether they could be grouped according to geography, environment and/or cropping practices. More than 100 isolates have been obtained from infected sunflower and soybean plants. Single sclerotia isolations were made. Isolates were stored at -18^{0}C using the toothpick method. The population will be identified using multiple gene analysis. Isolates are currently being prepared for screening and we hope to complete this by the end of July 2016. *In vitro* trials focused on growth rate of the pathogen under different temperatures, pH and on Potato Dextrose Agar amended with copper and chlorate (two products known to cause growth inhibition). Some isolates were compared for their pathogenicity and virulence on sunflower and soybean on seed germination. The *in vitro* results, two pot trials, a grower survey, and prediction modelling will be used to create a holistic picture of charcoal rot on soybeans and sunflower in SA.

A countrywide survey will be conducted to determine growers' perceptions, the occurrence of this disease and the subsequent control practices that are in place, if any, so as to provide a picture of how charcoal rot is affecting production in South Africa. The survey questionnaire has been compiled and we are currently looking at ways to reach the soybean and sunflower producers.

With the use of climate prediction models we will attempt to predict the impact of these changing climatic conditions on disease development in future. Parameters for disease incidence have been compiled and will soon be sent for analyses.

A pot trial to investigate the effect of drought on charcoal rot will also give an indication of the yield reduction caused by charcoal rot. Another pot trial will evaluate nitrogen fertilization to determine the effect of the nitrogen source used and the quantity of nitrogen added to the soil on disease development. Long and short growers for sunflower and soybean will be included in the nitrogen trials. As we have to wait for the growing seasons, these trials will only commence in August 2016.

Future research from this project could be focused on resistance breeding, or screening for tolerant sunflower and soybean cultivars. This research can aid in the forecasting of disease incidence and severity, and to establish control methods. An article on the proposed research has already been published in Oilseeds Focus (June 2016). Upon completion of the project results will be published in peer review articles in scientific journals, articles in local media such as Farmers Weekly and Oilseeds focus, and presented at farmer days.

6.4 DETERMINING ROOT-KNOT NEMATODE RESISTANCE IN SOYBEAN GENOTYPES IN SOUTH AFRICA; H Fourie, North West University

The purpose of this study is to evaluate soybean cultivars from other countries to determine resistance against the local population of *Meliodogyne incognita* and *M.javanica*, compared to South African cultivars as controls, by using one that shows high resistance and one that is severely susceptible.

According to previous data, cultivar LS 5995 was selected as the highly resistant cultivar and LS 6248 R as the highly susceptible cultivar. Twenty one (21) Brazilian lines (genotypes) were evaluated in glass house studies, compared to the two standards.

The evaluation tests were conducted successfully, as LS 6248 R (susceptible control) showed high infestation. However, not one of the 21 lines showed any measure of resistance. Even the resistant cultivar showed Rf values higher than 1, but both evaluations indicated the lowest infestation (Rf values).

6.5 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

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 parasitizing *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 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 colonizing *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. Optimization 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^{o}C. The highest radial growth was

observed at 24ºC (46.54 mm). V8 juice agar was the best medium for colony growth with the mean value of 42.75 mm followed by SDA (Sabouraud dextrose agar) 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 x 10^9 conidia/ml) followed by wheat bran (3.2 x 10^9 conidia/ml) and pearled barley (2.9 x 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 were 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 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: 1st 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). 2nd 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.

6.6 CULTIVAR EVALUATION OF OIL AND PROTEIN SEEDS IN THE WINTER RAINFALL AREA; PJA Lombard, L Smorenburg and JA Strauss, Department of Agriculture: Western Cape

The Western Cape Department of Agriculture conducted a range of cultivar trials during the 2015 season in the Swartland and Southern Cape. In the Southern Cape eight trials were planted and six data sets were used (bad establishment occurred at Rietpoel and herbicide damage at Roodebloem). In the Swartland eight trials were planted and only one trial was not harvested (insect damage).

The past season in the Swartland was characterized by extremely dry conditions during August and September. The rainy season starts on May 30, there were two months of effective rainfall. In the Swartland the average rainfall for April to September was 45% to 57% of the long-term average. In the Southern Cape above-average rainfall occurred. May was dry in the central and western parts of the Rûens. In the eastern parts trials were planted in April with good soil moisture.

During August and September, the minimum and maximum temperatures at Langgewens were above average. At Rietpoel the maximum temperature for July was 2.5 °C lower than the long term average. The minimum temperature in August and September was however 1°C warmer than the long term average.

In the Swartland the average yield was 1320 kg ha-1 compared to 2468 kg ha-1 in 2014. Plants in all the trials in the Swartland emerged at the same time after the first rain on May 30.

The new conventional hybrid cultivar Diamond (1721 kg ha-1) was the top performer in the Swartland. Diamond was followed by Tango (1519 kg ha-1) and CB Agamax (1441 kg ha-1). The above cultivars are all early to medium cultivars and were better adapted to the short growing season. The CL-cultivar 44Y89 (1643 kg ha-1) had the 2nd highest yield in the Swartland trials and was significantly higher than other cultivars within the CL group. In the TT group, the hybrid cultivar, Hyola 559 (1273 kg ha-1) was the best performer. The yield of Hyola 559 was not significantly better than CB Atomic and Granite TT.

The yield of the TT-cultivars in the Swartland and Southern Cape was 24% and 18.1% respectively lower than the conventional varieties.

In Rûens the average yield ranged from 1714 kg ha-1 at Witsand to 2121 kg ha-1 in Napier. The conventional cultivar Belinda (2278 kg ha-1) had the highest average yield in the conventional group and was followed by the cultivar Diamond. The CL-cultivar 45Y88 (2346 kg ha-1) was the highest yielding cultivar in the CL group. It was also the variety with the highest yield in the Southern Cape. The cultivar 44Y89 was 2nd in the

CL group, its yield was not significantly lower than 45Y88. In the TT group CB Atomic HT (1800 kg ha-1) produced the highest yield followed by Hyola 555 and Granite.

6.7 CHEMICAL MANIPULATION OF VEGETATIVE GROWTH, REPRODUCTIVE DEVELOPMENT AND GRAIN YIELD IN CANOLA; GA Agenbag and E Kempen, 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. Although yield per hectare has increased in 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 trails. For this reason field trials were conducted during 2015 at 3 localities in the Swartland (2) and Southern Cape (1) canola producing areas. Three spraying treatments (control, Kelpak® and Moddus®) in combination with four plant densities, 30, 60, 90 and 120 plants m^{-2} were tested.

Both Kelpak® and Moddus®) resulted in significant increases in grain yield at the higher rainfall localities of Altona and Roodebloem and especially so in plots with higher plant populations. At both localities yield increases of 300-400 kg ha^{-1} were obtained when compared to the control (unsprayed) plots. Although similar trends were seen at the lower rainfall locality of Langgewens no significant yield increases were recorded.

6.8 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 80-120 kg of N ha^{-1} and 15-30 kg S ha^{-1} are needed to produce canola grain yields of more than 2.0 ton ha^{-1} 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 d after planting), uptake remains high till 50% podded stage (120-130 d after planting). These results indicate that nitrogen topdressing during the flowering stage 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 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^{-1} were tested, with 20 kg N ha^{-1} applied at planting and the remaining nitrogen applied as a single top dressing 30 d 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.

Although the Western Cape canola producing area experienced very low rainfall and a short rainy season during 2015 which hampered yields especially in the lower rainfall locality of Langgewens, mean grain yields of canola varied between 1682 kg ha^{-1} at Langgewens, 1890 kg ha^{-1} at Roodebloem and 3294 kg ha^{-1} in the high rainfall locality of Altona. At Langgewens the highest grain yield of 1723 kg ha^{-1} was recorded with an

application of 90 kg N ha^{-1}, while at Roodebloem (2013 kg ha^{-1}) and Altona (3363 kg ha^{-1}) highest yields were recorded with 120 kg N ha^{-1}. Due to the generally poor yields and poor response to nitrogen applications under low rainfall conditions at Langgewens, the timing of the topdressings with nitrogen did not affect grain yields. However, at Roodebloem best results were obtained with an application of 20 kg N ha^{-1} at planting and the remainder applied at 30 dap. At the high rainfall locality of Altona, where grain yields of more than 3000 kg ha^{-1} were recorded, highest yields were recorded with 20 kg N ha^{-1} applied at planting and the remainder of the nitrogen application splitted between 30 and 60 days after planting. Because of abnormal rainfall conditions during 2015 it will be important to test the different strategies for at least three years at each locality before any conclusions can be drawn.

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

The year 2015 was the 4th year of production on the new trial. Six cash crop systems are tested including shortened canola rotations and cover crops. A total of 60 plots were planted. The 6 systems tested are replicated 3 times and all crops within each system are represented on the field each year. Riversdale received late summer rainfall in the pre-season which resulted in enough available moisture to plant early in April. The rest of the 2015 rainfall during the production season from April to September was higher than the 2014 season but still around 40 mm less than the long term average. The rain was well spread throughout the season and a cool September stretched the season which resulted in excellent yields.

The canola cultivar 44Y87 was planted at Riversdale at 3 kg/ha. A total of 53 kg N/ha was applied to each plot (23kg N/ha at planting and 30kg N/ha top-dressings). Canola yields at Riversdale averaged 1420 kg/ha with all plots showing oil yield above 40%. This average yield was 10 kg/ha less than in 2014.

The wheat cultivar SST027 was planted at Riversdale at 74 kg/ha. A total of 53 kg N/ha was applied to each plot (23 kg N/ha at planting and 30 kg N/ha top-dressings). Wheat yields at Riversdale averaged 3598 kg/ha. This was 941 kg/ha more than in 2014.

The barley cultivar Erica was planted at Riversdale at 53 kg/ha. Barley yields at Riversdale averaged 3610 kg/ha. This average yield was 160 kg/ha less than in 2014.

The Lupin cultivar Mandelup was not available so a bitter lupin mix was planted at Riversdale at 110 kg/ha. Lupin yields at Riversdale averaged 272 kg/ha.

The oats cultivar Saia and vetch was planted at Riversdale at 29 kg/ha and 42 kg/ha, respectively. No other input cost was incurred during the season except the herbicide cost to kill the cover crop following the information day.

The economic data for 2013, 2014 and 2015 have been captured and will be discussed in this report. A summation of the gross margins of each of the six systems tested at the site over the 3 combined 3-year period has been completed.

6.10 DEVELOPING A NEMATODE BIOLOGICAL CONTROL AGENT FOR MOLLUSCS ASSOCIATED CANOLA (SLUGS AND SNAILS) IN SOUTH AFRICA; A Pieterse, JL Ross, AP Malan, University of Stellenbosch

Invasive European molluscs (slugs and snails) have become significant economic pests in South Africa, especially in the Western Cape where the climate is favourable. One crop that is particularly targeted is Canola (*Brassica napus*) which is a winter-arable crop that is commercially produced for animal feed protein. Canola is sown between March and May in the Western Cape, with the seedlings being most susceptible to mollusc damage during the first four weeks after planting. The three mollusc species that are particularly pestiferous in Canola are *Milax gagates*, *Deroceras panormitanum* and *Deroceras reticulatum*. All three species of slugs (as opposed to snails) are European exotic invaders. Current methods for controlling the invasive European slugs rely on the use of chemical molluscicide pellets containing metaldehyde and carbaryl, although these are often ineffective and toxic to non-target organisms making it crucial that a method of biological control be identified. The most effective commercial method

for the biological control of molluscs in Europe entails the use of the mollusc-parasitic nematode *Phasmarhabditis hermaphrodita*. The product, which is available in Europe from BASF, is sold under the trade name Nemaslug®. The product provides protection against many terrestrial mollusc families, including Agriolimacidae, Arionidae, Limacidae, Milacidae, and Vagnulidae. To date, Nemaslug® cannot be sold in South Africa due to the legislation (amended Act 18 of 1989, in terms of the Agricultural Pest Act 36 of 1947) that is currently in place, thus an indigenous method of biological control requires development. The project in question aims to identify local indigenous nematode isolates that have the potential to be developed as a biological control agent for molluscs in South Africa.

Several nematode species have been identified through annual surveys conducted in the Western Cape. Of the isolates identified to date using molecular and morphological data, the following species have been identified: *Angiostoma margaretae*; *Angiostoma* sp.; *Caenorhabditis elegans*; *mermithid* sp.; and *Phasmarhabditis* spp. Several different nematode species that have shown promise for the control of slugs have been the subject of numerous pathogenicity studies. Currently, the pathogenicity of local isolates is being compared with that of the commercial Nemaslug® product. New species are being named and described for South Africa. *Phasmarhabditis* sp. is in the process of being cultured *in vitro* for purposes of mass production. In addition, surveying, aimed at identifying further isolates, is continuous in the province. In conclusion, the project described here is aimed at developing an indigenous biological molluscicide, which should have a significant impact on the agricultural industries in South Africa.

6.11 DEVELOPMENT OF PROTEIN AND PHOSPHOROUS FEED INGREDIENTS FOR THE ANIMAL FEED INDUSTRY FROM FISH PROCESSING WASTE; N Goosen, University of Stellenbosch

The aim of this research is to develop the technology required to produce high quality protein and phosphorous animal feed ingredients using low value fish processing waste from capture fisheries and aquaculture as feedstock. By establishing suitable technologies to produce higher value animal feed ingredients from waste products, economic incentive can be created to encourage utilisation of these waste materials, simultaneously improving the utilisation of scarce natural resources. The overall

investigation will be achieved by way of three separate postgraduate (Masters) projects, each of which forms the basis of a Master's study.

The first two Masters studies have completed the laboratory phase of investigations and reporting (via Masters Theses) is under way. The third project was initiated in 2016 and planning and preparation for the trial is under way. It is anticipated that a growth- and bio-availability study will commence in September 2016.

The first two projects focused on development of technology to recover high-value products from fish processing waste, and the two products specifically targeted were enzymatically hydrolysed proteins and bone minerals (with emphasis on phosphates). The hydrolysed protein recovery process has been optimized at laboratory scale and reaction conditions have been optimized for two industrial enzymes, Alcalase and bromelain. In the phosphate project the bone mineral extraction and phosphate recovery has been optimized at laboratory scale. Additional to the original project aims, gelatin extraction was also investigated and processing of these data is being finalised. For both these projects, it is anticipated that thesis examination will be completed during 2016, and external examiners have already been appointed.

Good progress is being made with the final phase of the investigation which commenced in 2016. During this phase, the hydrolysed protein and bone mineral ingredients will be evaluated for bioavailability in aquaculture feed trials. All diets have been formulated and experimental feed ingredient preparation has commenced. Feed preparation will commence soon, and experimental animals have been ordered to initiate the trials in September 2016. It is anticipated that the trial will run to the end of November 2016, with all experimental and data analysis being completed in 2017. As the project stands currently, it is on track to deliver the required results within the time required.

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

In the surveys conducted in South Africa in cultivar trials and farmers' fields, 71 fungal

and oomycete species were obtained from soybean crowns, hypocotyls, cotyledons and roots. Of the 71 fungal and oomycete species, *Fusarium (F. begoniae, F. graminearum, F. oxysporum, F.solani)* were among the root rot causing species, while *Pythium* spp. and *R. solani (P. aphanidermatum, P. heterothallicum, P. irregulare, P. ultimum, R. solani* AG-2-2 IIIB and *R. solani* AG-4 HG-III) caused root rot and/or damping-off. However, *Sclerotium rolfsii* is reported to cause southern blight and *Diaporthe/Phomopsis* spp. complex are causal agents of stem blight in South Africa. These soilborne diseases of soybean are reported to cause yield losses of up to 70% and in some cases plant losses and yield reductions of 100% have been reported in highly susceptible soybean cultivars. In other countries it is clear that integrated management strategies that include at least seed treatment, resistance/tolerance and proper crop rotation are essential to sustainably manage soilborne diseases of soybean in South Africa. Although management strategies have been tested in other countries they have not been properly tested and applied in South Africa. For this purpose, three management strategies were evaluated last year under glasshouse conditions. Among the fungicides evaluated, potential fungicides suitable and effective as seed treatment on soybean were identified. Of the screened cultivars those with tolerance/resistance against the most important pathogens of soybean were also identified. Pre-crops (rotation crops) that are either non-hosts or have some degree of tolerance to the soybean pathogens were also identified, which will render them suitable as rotation crops. However, the results of this study need to be verified to be considered reliable. Therefore the aims of the current study were to repeat the glasshouse bioassays to control pre- and/or post-emergence damping off, root rot, southern blight and stem blight of soybean by investigating

a) fungicide seed treatments,
b) screening commercially available South African soybean cultivars for tolerance/resistance and
c) screening pre-crops as rotation crops to reduce disease pressure.

Apron XL (a.i. mefenoxam), Celest XL (a. i. fludioxonil + mefenoxam), DynastyCST (a. i. azoxystrobin + fludioxonil + mefenoxam), Maxim Quatro (a. i. thiabendazole + azoxystrobin + fludioxonil + mefenoxam), EverGol Energy (a. i. penflufen + prothioconazole + metalaxyl) and mixture of Apron XL (a. i. mefenoxam) + Celest XL

(a. i. fludioxonil + mefenoxam) fungicides were evaluated as seed treatments for their effects on survival, growth and root rot of seedlings in soil infested with *Fusarium* spp. *(F. begoniae, F. graminearum, F. negundis, F. oxysporum, F. solani), Pythium* spp. *(P. aphanidermatum, P. heterothallicum, P. irregulare, P. ultimum),* and *Rhizoctonia solani* (AG-2-2 IIIB and AG-4 HG-III). Results of the effect of fungicide seed treatment on survival of soybean seedlings grown in soil infested with important soilborne pathogens showed that pre- and post-emergence damping-off of soybean caused by important soilborne pathogens of soybean can be effectively controlled by Evergol, DynastyCST, Maxim Quatro and a mixture of ApronXL and CelestXL. However, Evergol and Maxim Quatro are more effective against *Fusarium* spp. Although seed treatment with Apron XL (a.i. mefenoxam) was effective in reducing damage caused by *Pythium* species, it was not effective against other soilborne diseases of soybean causing species. However, Celest XL was effective in reducing damage caused by *R. solani* AG-2-2IIIB and AG-4 HGIII, and although, it reduced damping-off of soybeans caused by *Pythium* species, in most cases it was not as effective as the mixture of Apron XL and Celest XL. It was surprising that DynastyCST and Maxim Quatro were not performing as effective as the mixture of Apron XL and Celest XL, since the active ingredients also contained fludioxil and mefenoxam. However, during the visit to the Argentinian seed treatment facility, Dr M. Scandiani pointed out that the active ingredient azoxystrobin found in both DynastyCST and Maxim Quatro affect seed germination negatively. Therefore, in Argentina they are using a product called Maxim Evolution which contains the same three active ingredients included in Maxim Quatro, but without the azoxystrobin, and reported Maxim Evolution to be much more effective than Maxim Quatro. Our effort to import a sample of Maxim Evolution from Argentina for research purposes was unfortunately not successful. *Twenty-seven soybean cultivars were evaluated against important soilborne disease of soybean causing pathogens (*Diaporthe phaseolorum *var*. meridionale, Phomopsis longicolla, F. begoniae, F. graminearum, F. negundis, F. oxysporum, F. solani, F. virguliforme, P. *aphanidermatum, P. heterothallicum, P. irregulare, P. ultimum), R. solani* AG-2-2 IIIB and *R. solani* AG-4 HG-III, *Sclerotinia sclerotiorum* and *Sclerotium rolfsii)* under glasshouse conditions in order to determine resistance/tolerance in South African commercially available cultivars. From the results obtained in the cultivar screening bioassay, it was clear that there are differences in cultivar tolerance/resistance against the soilborne pathogens of soybean included in this study. Cultivar soy8 was one of the most susceptible cultivars to *F. solani, S. rolfsii* and

all species of *Pythium* and *Rhizoctonia.* In addition, cultivars differ in their reaction against different species. For instance, cultivar soy13 had the highest resistance against all *Fusarium* spp., most of *Pythium* spp. and *R. solani* AG-2-2IIIB, but was highly susceptible to *R. solani* AG-4 HGIII and moderately susceptible to *Sclerotium rolfsii.* In the cultivar screening bioassay conducted with *P. longicolla* and *D. phaseolorum* var. *meridionale*, it was found that there are different degrees of tolerance/resistance in the cultivars. All of the cultivars evaluated appears to be susceptible to *Fusarium virguliforme, M. phaseolina* and *S. sclerotiorum.* Therefore, selecting a cultivar, with tolerance/resistance against soilborne diseases to plant in a field with a known soilborne disease problem, knowledge of the most important pathogen/s is essential. This is necessary, since most of the cultivars tend to have different reactions to different species of soilborne disease causing pathogens.

In order to investigate whether soilborne pathogens of soybean (F. *begoniae, F. graminearum, F. negundis, F. oxysporum, F. solani, P. aphanidermatum, P. heterothallicum, P. irregulare, P. ultimum), R. solani* AG-2-2 IIIB and *R. solani* AG-4 HG-III) can affect the pre-soybean (rotation) crops that are used as rotation crops with soybean, six crops were identified and evaluated under glasshouse bioassays. The result of this study revealed that dry bean is affected by only two *Pythium* spp. *(P. aphanidermatum* and *P. heterothallicum)* and two *R. solani* AGs (AG- 2-2IIIB and AG-4 HGIII). In addition, sunflower, sorghum, and wheat are also affected by *Pythium* and *R. solani.* The pathogens caused significant damping-off and root rot on these crops. An interesting observation was that most of the pathogens included in the study induced significant damping-off on yellow maize. However, survival of white maize was not affected by the presence of these pathogens in the soil except by *R. solani* AG-2-2IIIB. Therefore, in the absence of other management strategies it is important to rotate soybean crops with white maize in order to reduce the inoculum pressure for the following soybean crop without significantly compromising the production of the pre-season crop.

Three management strategies were evaluated. In the two years' study, among the fungicides evaluated, potential fungicides suitable and effective as seed treatment on soybean were identified. Cultivars with tolerance/resistance against important soilborne pathogens of soybean were also identified, as well as pre-crops (rotation crops) that are

either non-host or have some degree of tolerance/resistance to the soybean pathogens evaluated. The ideal practice in combating the soilborne diseases of soybean is to combine the best of the three strategies. This will ensure the sustainability of the management practice with considerably lower input cost. However, the results of this study need to be verified under field condition to be considered reliable. For this purpose, commercially available fungicides that were evaluated under glasshouse conditions will be used to test their ability to control soilborne diseases of soybean under field conditions. Three representative sites, one each in cool, moderate and warm soybean production area, will be selected. In each site seeds of three soybean cultivars will be treated with four fungicides, which will have three replicates.

6.13 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

Across the globe, the world population is rising at a drastic rate, higher income opportunities in urban areas attract more people to cities, and coupled therewith is the higher income that these people have at their disposal. Higher income streams increase the demand for protein-rich and high-value foods. Furthermore, humans are faced with the huge challenge of producing the same amount of food that was produced in the last 8 000 years, but only in the next 40 years.

South Africa is currently experiencing the same challenges and there is an important drive to supply the human demand for animal-source protein and to reach self-sufficiency in protein supply. Critical linkages exist between the human demand for animal-source protein, the number of animals to be slaughtered to supply this demand, and the animal feeds required to feed the animals. South Africa requires a decision support tool to aid decision making, to provide accurate and relevant results, and to measure self-sufficiency in protein supply.

In this study, dynamic data generated by the BFAP model is integrated into the APR model. Thereafter, the APR_OPT model is able to determine least-cost animal feeds to satisfy the nutrient requirements of all animal categories. This study aims to quantify,

manage, and forecast the linkages between these industries. The specific objectives are to replicate and update the APR model, to generate and forecast baseline results for the period 2015 to 2024 with integrated BFAP data, and to determine self-sufficiency of protein for animal feed in the future.

Table: Percentage growth of local production to satisfy growth in oilcake demand

Percentage growth required for local protein production to reach certain targets by 2024			
Projected total protein consumption 2024	**Required annual growth rate for local production from 1 190 917 tonnes**	**Oilcake quantity**	**Percentage of projected consumption**
Tonnes	**%**	**Tonnes**	**%**
2 805 516	0.67%	1 262 482	45%
2 805 516	4.59%	1 683 310	60%
2 805 516	8.52%	2 104 137	75%
2 805 516	12.45%	2 524 964	90%
2 805 516	15.06%	2 805 516	100%
Local growth at forecasted total protein growth			
2 805 516	9.57%	2 216 358	79%

Animal feed consumption is expected to increase by an average of 2.54% annually to 14.6 million tonnes by 2024 (Table). Total protein usage for animal feeds is expected to increase from 1.98 million tonnes in 2015 to 2.81 million tonnes by 2024, with a 4.63% average increase per year. South Africa's self-sufficiency in protein supply for animal feeds is expected to increase from 60% in 2015 to 79% by 2024.

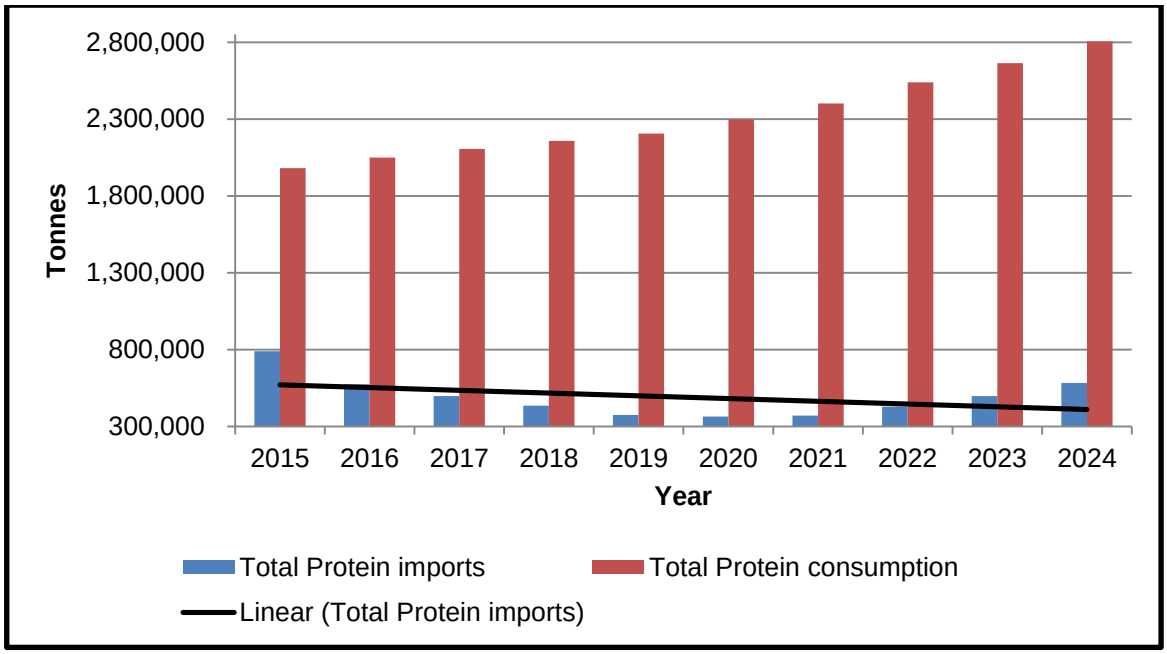


Figure: Total protein versus imported protein

6.14 INCOME AND COST ESTIMATES OF SOYBEANS AND CANOLA AND A FEW COMPETITIVE CROPS; SG Ferreira, Protein Research Foundation and Agriconcept

The main objectives of the Protein Research Foundation (PRF) are to replace imported protein for animal consumption with locally produced protein; and the improved utilisation protein. These objectives are promoted by funding research and technology transfer.

The PRF currently concentrates on two crops, soybeans and canola. It is very important to achieve relative profitability for these and competitive crops.

Income/cost estimates are very useful as they are important information and management tools. It is also possible to use the estimates for strategic planning and policy purposes.

Previously crop income/cost estimates were obtainable easily from the Departments of Agriculture and certain agri businesses. Most government departments no longer conduct the studies regularly and the information they have is mostly dated.

As a result, the PRF requested Agriconcept (Edms.) Bpk. to calculate income/cost estimates for selected grain crops in the summer rain fall areas on a continuous basis.

FIELD OF STUDY AND SOURCE OF INFORMATION

Regions and sources of information are shown in the table below:

Table 1 Regions and sources of information

Area	Irrigation	Dry land	Source
North West Province			
MGK area	X		MGK
NWK area		X	NWK
Mpumalanga Province			
Trichardt		X	Group discussion
Piet Retief		X	Group discussion
Loskop irrigation scheme	X		MGK
KwaZulu-Natal			
Bergville/Winterton	X		Group discussion
Bloedrivier		X	Group discussion
Free State			
Reitz area		X	VKB
Northern Cape Province			
GWK area	X		GWK

Method

At the moment the PRF enjoys the co-operation of agri businesses within the summer rain fall area. MGK, NWK, GWK and VKB prepare annual income/cost budgets for various crops produced within their service areas. The objective of the budgets is to serve planning instrument and assist with credit applications. They also provide, annually at about August, income/cost crop estimates for the purposes of this study. Agriconcept evaluates the information, does the necessary adjustments where necessary and repackages the information to present the information on a comparable basis. To present the income/cost estimates in a standard format, in a comparable way, every attempt is made to obtain detailed information from agribusinesses. The information is presented in summarised format without making available any detailed information. The PRF tries to reflect a typical medium to long-term situation. As such seasonal variations are not taken into consideration.

Table Regions and sources of information

Area	Irrigation	Dry land	Source
North West Province			
MGK area	X		MGK
NWK area		X	NWK
Mpumalanga Province			
Trichardt		X	Group discussion
Piet Retief		X	Group discussion
Loskop irrigation scheme	X		MGK
KwaZulu-Natal			
Bergville/Winterton	X		Group discussion
Bloedrivier		X	Group discussion
Free State			
Reitz area		X	VKB
Northern Cape Province			
GWK area	X		GWK

Agri businesses in some areas do not offer agricultural economical services. The PRF obtains information in those areas by conducting group discussions. A small group of farmers are involved to obtain the information. The information obtained is processed to produce income/cost estimates. The information is adjusted annually, according to the latest prices or by using price indices. Every attempt is made to conduct group sessions every three years, because of possible structural changes within the industry.

Budget format

The budget is prepared as follows:

- **Gross income**

  The expected yield per crop, as well as the gross price, is used as the basis for calculating gross income. SAFEX listed prices are used to calculate the gross income for soybeans, maize, wheat and sunflower. SOILL estimates are used for

canola prices to calculate budgets. GWK prepared a groundnut price. Gross prices on 06.11.2014 for futures contracts were as follows:

Crop	Source	Futures contract for delivery during	Futures contract price R/tonne
Soybeans	SAFEX	May 2016	5 380
Maize	SAFEX	July 2016	2 946
Wheat	SAFEX	December 2016	4 650
Sunflower	SAFEX	July 2016	5 880

Canola and groundnut prices were as follows:

Crop	Source	Delivery during	Estimated price R/tonne
Groundnuts	GWK	April/May 2016	10 930
Canola	SOILL	November/December 2016	4,550

- **Net price at farm gate**

The net price per tonne at the farm gate represents the gross price less marketing costs.
Marketing costs include the following items:

Transport differential (obtained from SAFEX)
Grade discount for wheat (SAFEX formula)
Handling fee
Broking fee or marketing commission
Hedging costs
Drying costs
Statutory wheat levy

Transport costs from farm to silo were estimated by Agriconcept, taking into account distance between farm and silo.

It was assumed that products are delivered immediately after harvest, allowing no estimate for storage costs.

- **Costs prior to harvest and harvesting costs**

  Costs prior to harvest are set out in the attached budgets and do not require much explanation. Harvesting costs include only fuel and repair costs. Where producers use contractors' services, the costs were used as cost.

  Depreciation is not included as a cost item. Mechanisation costs include only fuel and repair costs.

- **Comparable yields**

  A comparison between yields for various regions is shown in Table 6.2 and Table 6.3.

Tabel 6.2 Vergelyking graanopbrengste vir die verskillende streke, besproeiing

Streek	Soja-bone	Mielies	Koring	Grond-bone	Canola	Sojabone as persentasie van mielies
	Ton per ha					%
Noordwes Provinsie						
MGK gebied (Brits)	4.00	12.00	5.50	-	-	33%
Mpumalanga Provinsie						
Loskop Besproeiingskema	4.00	12.00	5.50	-	-	33%
KwaZulu-Natal						
Bergville	4.00	12.00	6.00	-	-	33%
Noordkaap Provinsie						
GWK gebied	4.00	13.50	7.50	3.00	3.50	30%

Tabel 6.3 Vergelyking graanopbrengste vir die verskillende streke, droëland produksie

Gebied/Produk	Sojabone	Mielies	Sonneblom	Koring	Sojabone as persentasie v mielies
	Ton per ha				%
Noordwes Provinsie					
NWK gebied					
Koster (Streek 1)	2.00	3.50	2.00	-	57%
Lichtenburg (Streek 2)	1.50	3.50	1.50	-	43%
Mpumalanga Provinsie					
Trichardt (Presisie)	2.50	8.90	-	-	28%
Piet Retief	2.50	6.50	-	-	38%
KwaZulu-Natal					
Bloedrivier	2.00	4.50	-	-	44%
Vrystaat					
Reitz gebied	2.00	5.00	2.25	2.50	40%

The assumption obtained in tables 6.2 and 6.3, indicates a relatively constant ratio, with the exception of Koster and Kinross, between soybean and maize yields for the respective regions.

6.15 PRF WEBSITE; GJH Scholtemeijer, M du Preez and Y Papadimitropoulos, Protein Research Foundation

The Marketing Committee has paid significant attention to the website over the past few years. The POEMS software system ("PRF/OPDT Electronic Management System") deserves special attention. POEMS enables the administration to use a single programme to control finalised projects, handle project and bursary applications, administer approved bursaries and projects, as well as managing the funding and the central list of contacts. POEMS also offers a search function that allows users to search for general information and news items on the PRF website and on the POEMS project database. Certain information is not available on the public domain and may be

accessed only via the PRF database. The Board is grateful to Mrs Du Preez and the staff involved in maintaining the website.

One of the measures to determine the value of the website to users is the number of visitors and time spent on the site, including the number of pages read. The statistics below indicate the number of visitors per reporting year, since the inception of the website.

Reporting year	**Unique visitors** *Raw values **	**Unique visitors** *Google values*		
		Visitors	*Pages*	*Pages per visit*
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

* *Raw values indicate total interactions measured by the web server, while Google values only measure the visitors that link to the web site using a web browser. Visitors that link to the web site again, using the same browser are not counted again.*

7. STUDY GRANTS AND BURSARIES

Bursaries for Masters studies are awarded for a period of two years, and for three years in the case of Doctoral studies.

Bursaries awarded by the Bursary Committee (a subcommittee of the Marketing Committee) during this year, were:

7.1 MSc Studies

7.1.1 Ms T Khahlu (Second application); “Drought tolerance markers in soybean”, University of Pretoria.

7.1.2 **Mr MN Engelbrecht** (Second application); “Afronding van beeste op aangeplante weidings met byvoeging van volvet kanola en/of ander hoë kwaliteit proteïenbron”, University of Stellenbosch.

7.1.3 **Mr W de Jager** (First application); “An integrated model to project animal protein consumption in South Africa”, University of the Free State.

7.1.4 **Ms KZ Neethling** (First application); “Die effek van verskillende kombinasies van proteïen- en energiebronne op veselvertering van ruvoere”, University of Stellenbosch.

7.1.5 **Ms JA Engelbrecht** (First application); “The evaluation of alternative protein sources (lupins, canola and canola oilcake) in ostrich nutrition”, University of Stellenbosch.

7.1.6 **Mr A Coetzee** (First application); “Stikstof bo-bemesting op canola: Tyd en toedieningstempo’s”, University of Stellenbosch.

7.2 PhD Studies

7.2.1 **Ms M du Plessis** (Second application); “Molecular markers for drought tolerance in soybean”, University of Pretoria.

7.2.2 **Ms E Jordaan** (Second application); “Epidemiology and population structure of *Macrophomina phaseolina* (Charcoal rot) on sunflower and soybean”, University of Pretoria.

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

7.3 Completed theses received

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

7.3.1 **Ms GC Buitendach**, “Effect of long-term exposure to different dietary fatty acids on production and egg quality of layers”, MSc, University of the Free State.

7.3.2 **Mr MN Engelbrecht**, “The effect of supplements containing different protein and energy sources and essential oils on the performance of pasture finished heifers”, MSc, University of Stellenbosch.

7.3.3 **Mr HCvdW Leicester**, “Effects of yeast based direct fed microbial supplementation on the performance of high producing dairy cows”, MSc, University of Pretoria.

8. ACHIEVEMENT AWARDS TO PROMOTE THE PRF VISION AND MISSION

The PRF annually awards individuals and organisations for special contributions to support the PRF vision and mission, as well as attaining its objectives.

The awards fall within these categories:

- Best Doctoral thesis
- Best Master’s thesis
- Best article in a scientific journal
- A person that has made an exceptional contribution in promoting the PRF vision and mission;
- A PRF Board Member that has played a meaningful role in promoting the PRF activities; and
- An organisation or individual that has played a significant role in assisting the PRF to achieve its objectives.

During the year under review an award was made in only one category, namely,

A person that has made an exceptional contribution in promoting the PRF vision and mission:

- Mr R and Mrs M Thomas, Tigme.com

The awards were handed to the recipients at a Board meeting in the Cape during the year under review.

9. CONCLUSION

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

We are blessed to have so many co-workers and supporters that are willing to work hard in attaining the PRF objectives. We think of all the researchers, research institutes, universities and other tertiary institutions, the government, especially the Department of Agriculture, Fisheries and Forestry (DAFF), specifically the Crop Estimates Committee, provincial departments and other supporting services such as the press and all agents that assist us with the transfer of technology. These include producer bodies such as Agri SA, Grain South Africa, SAGIS, SA Grain Laboratory, the Commodities Trusts, especially the Oil and Protein Seeds Development Trust, co-operatives and agricultural companies, seed, chemical and equipment companies and distributors, our auditors, lawyers, web master Tigme.com, Contemporary Events, the fund managers FOORD and Old Mutual and all that are not mentioned by name but are always available to help.

Our loyal and very dedicated staff make a huge contribution and it is difficult to find appropriate words to thank them for all their input during the past year and the years before.

It has always been the policy of the PRF to appoint board members with specific knowledge required by the PRF to further its activities. All the board members who serve on the PRF have made huge contributions in the past year to the success that we look back upon today. We express our sincere gratitude.

An unqualified word of thanks to everybody.

GERHARD JH SCHOLTEMEIJER
CHAIRPERSON

ANNEXURES

I LIST OF APPROVED PROJECTS IN 2015/16

1.	Evaluation of PRF soybean elite lines under South African conditions GP De Beer and WF van Wyk	Protein Research Foundation
2.	National soybean cultivar trials AS de Beer , L Bronkhorst, HSJ Vermeulen, NN Mogapi, TC Ramatlotlo and S Seutlwadi	ARC Grain Crop Institute
3.	Etiology and population structure of *Macrophomina phaseolina* (charcoal rot) in sunflower and soybeans in South Africa E Jordaan and JE van der Waals	University of Pretoria
4.	Determining root-knot nematode resistance in soybean genotypes in South Africa H Fourie	North West University
5.	Studies on *Lecnicillium muscarium* as a microparasite of the soybean rust fungus, *Phakopsora pachyrhizi* and its use as a biocontrol agent against soybean rust KS Yobo	University of KwaZulu-Natal
6.	Cultivar evaluation of oil and protein seeds in the winter rainfall area PJA Lombard, L Smorenburg and JA Strauss	Department of Agriculture: Western Cape

7.	Chemical manipulation of vegetative growth, reproductive development and grain yield in canola GA Agenbag	University of Stellenbosch
8.	Nitrogen topdressings in canola: time of application and rates GA Agenbag	University of Stellenbosch
9.	An evaluation of continuous cash crop production (including small grains, canola and other alternative broadleaf crops) under conservation agriculture principles on high potential soils of the Riversdale flats JA Strauss	Department of Agriculture: Western Cape
10.	Developing a nematode biological control agent for *molluscs* associated canola (slugs and snails) in South Africa A Pieterse, JL Ross and AP Malan	University of Stellenbosch
11.	Development of protein and phosphorous feed ingredients from fish processing waste for the animal feed industry N Goosen	Department of Agriculture: Western Cape
12.	Management strategies for soilborne soybean diseases in South Africa YT Tewoldemedhin and SC Lamprecht	ARC Research Institute for Plant Protection

13.	Projected protein requirements for animal consumption in South Africa D Strydom, W de Jager and E Briedenhann	University of the Free State and Protein Research Foundation
14.	Income and cost estimates for soybeans and canola and a few competitive crops SG Ferreira	Protein Research Foundation and Agriconcept
15.	PRF Web Site GJH Scholtemeijer, M du Preez and Y Papadimitropoulos	Protein Research Foundation

II LIST OF PROJECTS FINALISED DURING 2014/2015

1.	Sulphur (S) and Nitrogen (N) canola fertilisation GA Agenbag and E Kempen	University of Stellenbosch
2.	Boron needs of canola GA Agenbag and E Kempen	University of Stellenbosch
3.	Promotion of canola as rotation crop within a conservation farming system in the dry land sowing area of the Swartland by means of a producer competition IF Slabbert	Department of Agriculture: Western Cape
4.	Promotion of canola as rotation crop- within a conservation farming system in the dry land sowing area of the southern Cape by means of a producer competition JG Loubser	Department of Agriculture: Western Cape

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

(Updated January 2015)

TABLE 1: FISH MEAL AND OIL CAKE BALANCE SHEET (2012/2013 - 2014/2015) (APRIL - MARCH)

	FISH MEAL (TON)			OIL CAKE (TON)		
Year	2012/2013	2013/2014	2014/2015	2012/2013	2013/2014	2014/2015
Requirements/Sales	45 000	25 000	45 000	1 877 671	1 979 065	2 067 331
Available/Produced	85 000	65 000	90 000	760 321	969 100	1 173 905
Shortage/Imports	*-40 000*	*-40 000*	*-45 000*	*1 117 350*	*1 009 965*	*893 426*

2014/2015 - Estimate
Source: Fishing industry; AFMA Chairman's Report 2013/2014

TABLE 2: FISH MEAL AND OIL CAKE USAGE (2012/2013 - 2014/2015) (APRIL - MARCH)

	FISH MEAL (TON)			OIL CAKE (TON)		
Year	2012/2013	2013/2014	2014/2015	2012/2013	2013/2014	2014/2015
AFMA Members	41 875	19 770	37 425	1 254 487	1 272 823	1 329 603
Non-AFMA Members	3 125	5 230	7 575	623 184	706 242	737 728
Total	*45 000*	*25 000*	*45 000*	*1 877 671*	*1 979 065*	*2 067 331*

Source: AFMA websit www.afma.co.za
2014/2015 - Estimate
* Non-AFMA Members figures can also include unused stocks

TABLE 3: THE MAIN RAW MATERIAL USAGE BY AFMA-MEMBERS (APRIL - MAY) (2012/2013 - 2014/2015)

RAW MATERIALS	TOTAL (TON) (2012/2013)	INCLUSION RATE (%)	TOTAL (TON) (2013/2014)	INCLUSION RATE (%)	TOTAL (TON) (2014/2015)	INCLUSION RATE (%)
Sunflower oilcake	290 032	4,70	294 583	4,58	308 706	4,80
Groundnut oilcake	1759	0,03	1917	0,03	1554	0,02
Soya oilcake	814 604	13,19	821 670	12,78	856 413	13,32
Full fat soya	77 876	1,26	75 267	1,17	91 413	1,42
Cottonseed oilcake	17 539	0,28	20 892	0,32	12 843	0,20
Full fat cottonseed	9 436	0,15	10 340	0,16	7 539	0,12
Canola oilcake	14 847	0,24	23 555	0,37	27 750	0,43
Full fat canola	0	0,00	0	0,00	0	0,00
Copra and Palm kernel	27 969	0,45	23 231	0,36	22 750	0,35
Maize germ oilcake	425	0,00	1 368	0,02	303	0,00
Total oilcake	*1 254 487*	*21,52*	*1 272 823*	*19,79*	*1 329 603*	*20,68*
Total maize products	*3 199 641*	*51,80*	*3 324 316*	*51,69*	*3 474 249*	*54,04*
Total fish meal	*41 875*	*0,68*	*19 770*	*0,31*	*37 425*	*0,58*
Feed	*6176151*		*6397563*		*6428694*	

Source: AFMA Chairmans website www.afma.co.za
AFMA rawmaterial usage April 2014-March 2015 estimate
[1]Note: Total oilcake in Table 3 include all oilcake and not only specific oilcake items listed in table 3

TABLE 4: FISH MEAL: LOCAL PRODUCTION & IMPORTS (2011/2012 - 2014/2015) (APRIL - MARCH)

	LOCAL (RSA + NAMIBIA) FISH MEAL PRODUCTION (TON)				IMPORTED FISH MEAL (TON)		
Year	2011/2012	2012/2013	2013/2014	2014/2015 PROJ	2011/2012	2012/2013	2013/2014
RSA	90 000	70 000	65 000	65 000			
Namibia(i)	15 000	14 000	13 000	13 000			
Total	*105 000*	*84 000*	*78 000*	*80 000*	*-40 000*	*-40 000*	*-45 000*

Source: AFMA; SA Fishmeal Marketing Company
2014/2015-Estimate.
(i) Includes Russian trawlers operating in Namibian waters

TABLE 5: OIL CAKE: LOCAL PRODUCTION AND IMPORTS (2011/2012 - 2014/2015)

	LOCAL OIL CAKE PRODUCTION (TON)			IMPORTED OIL CAKE (TON)		
Year	2012/2013	2013/2014	2014/2015	2012/2013	2013/2014	2014/2015
			PROJECT			PROJECT
OIL CAKE:						
Groundnuts oilcake	1	0	0	235	588	..
Sunflower oilcake	233 268	278 297	327 600	57 159	166 273	61 434
Soya Cake	364 240	449 272	624 000	922 499	728 150	610 022
- Full fat	105 120	155 654	120 000			
Beans				1 083	468	3 256
Cotton Cake				68 333	127 604	121 082
- Full fat	11 562	5 602	6 000	11 763	37 232	
Other						
Canola	31 130	66 275	82 305	0	0	0
Lupins	15 000	14 000	14 000	0	0	0
Copra & Palm Kernel				28 361	57 035	.
Total	*760 321*	*969 100*	*1 173 905*	*1 089 433*	*1 117 350*	*1 110 123*

Source: AFMA website www.afma.co.za
Estimate - 2014/15 .The projected local production figures for soja and cotton reflect fullfat and oilcake
South African Supply and Demand Estimate Report NAMC 29 August 2014

TABLE 6: OIL SEED AND GRAIN PRODUCTION IN THE RSA (TON)
(2010/2011 - 2014/2015 - MARKETING SEASON)

CROP	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
White maize	7 822 400	6 052 000	6 740 000	5 545 000	7 697 350
Yellow maize	5 220 600	4 308 000	5 090 000	6 145 000	6 609 700
Sorghum	220 093	155 000	135 500	147 200	268 920
Groundnuts	87 880	64 250	59 000	41 500	78 090
Sunflower	516 265	860 000	522 000	557 000	853 325
Soya beans	560 950	710 000	650 000	784 500	944 340
Cotton seed(i)	14 793	31 373	22 326	10 641	17 115
Wheat	1 430 000	2 005 000	1 870 000	1 870 000	1 790 909
Canola	36 900	58 800	79 000	112 041	147 250

Source: National Crop Estimates Committee ; Final production estimate for winter crops and Fith crop estimate for summer crops for the 2014/15 marketing year (19 December 2014);
(i) Cotton South Africa .

TABLE 7: ESTIMATED OIL SEED AND GRAIN SUPPLY IN THE RSA (TON)
(2014/2015 MARKETING SEASON)

CROP	Opening stock	Imports to RSA	Production	Exports	Total supply
White maize	274 318	0	7 697 350	655 000	7 316 668
Yellow maize	314 710	0	6 609 700	1 505 000	5 419 410
Sorghum	50 069	8 725	268 920	27 900	299 814
Groundnuts	13 300	0	78 090	16 000	75 390
Sunflower	47 116	32 000	853 325	50	932 391
Soya beans	61 806	110 000	944 340	500	1 115 646
Wheat	485 665	1 800 000	1 760 684	278 000	3 768 349
Canola	12 500	0	147 250	0	159 750

Source: Opening stock, import , and export figures obtained from South African Supply and Demand Estimates Report, National Agricultural Marketing Council, 28 November 2014

TABLE 8: AREA PLANTED TO OIL SEED AND GRAIN CROPS IN THE RSA
(2008/2009-2014/2015 PRODUCTION SEASON)

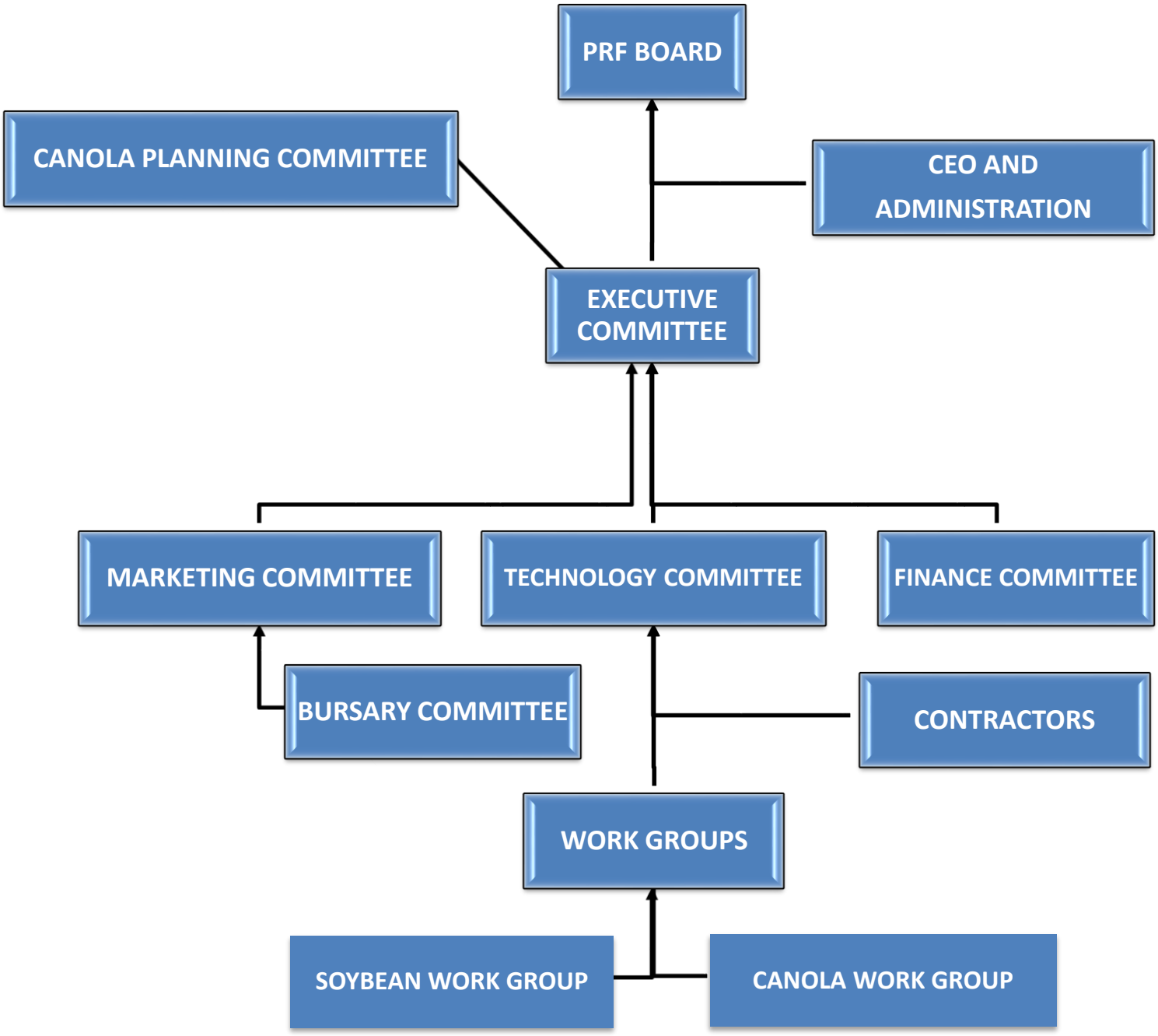
CROP	Ha planted .2009/10	Ha planted .2010/11	Ha planted .2011/12	Ha planted .2012/13	Ha planted .2013/14	Ha planted .2014/15
White maize	1 719 700	1 418 300	1 636 200	1 617 200	1 551 200	1 401 450
Yellow maize	1 022 700	954 000	1 063 000	1 164 000	1 137 000	1 198 550
Sorghum	86 675	69 200	48 550	62 620	78 850	80 500
Groundnuts	57 450	55 150	45 450	46 900	52 125	58 200
Sunflower	397 700	642 700	453 350	504 700	598 950	633 600
Soya beans	311 450	418 000	472 000	516 500	502 900	618 000
Wheat	642 500	558 100	604 700	511 200	505 500	476 570
Canola	35 060	34 820	43 510	44 100	72 165	95 000
Total	4 273 235	4 150 270	4 366 760	4 467 220	4 498 690	4 561 870

Source: National Crops Estimates Committee: Intentions to plant Summer crops 2015 Production season 28 October 2014
Area estimate to plant Winter crops 2014 production season (19 December 2014)

Table 9: NOTE ON MARKETING SEASON
FOR SUMMER AND WINTER CROPS

Crops	Season
White maize	May - April
Yellow maize	May - April
Sorghum	April - March
Groundnuts	March - Feb
Sunflower	March - Feb
Soya beans	March - Feb
Wheat	Oct - Sept

IV PRF STRUCTURES



V LIST OF BURSARY APPLICATIONS: 1995 - 2015

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
	1995							
1	Ms E Upton **Promotor: Dr J Coetzee**	BSc (Agric), BSc (Agric) (Hons)	Stellenbosch University	Dierevoeding: Ontwikkeling van polimeerbedekte ureum	Development and evaluation of polymer coated urea as a potential slow-release urea supplement for ruminants.	**M.Sc**	Received 2000	H
2	Mr GE Schroeder	BSc (Agric), BSc (Agric) (Hons), MSc (Agric)	University of Pretoria	Melkbeesvoeding	Availability and partitioning of amino acids from various heat processed Protein sources to the Mammary gland of Lactating Dairy Cows.	**PhD**	Received 1998	H
	1996							
3	Mr HM Böhme **Promotor:** **Prof CW Cruywagen**	BSc (Agric), BSc (Agric) (Hons)	Stellenbosch University	Die evaluering van 'n stadige-vrystellende ureum produk.	Evaluering van die insluiting van 'n kommersiële stadig vrystellende ureum-melasseproduk (Ureïed) in lekke vir skape op laergraadse ruvoer.	**M.Sc**	Received 1998	H
4	Ms MB Young	BSc (Agric)	University of KwaZulu-Natal	Development of simulation model to determine the economic optimum amino acid supply for laying hens and broiler breeders.	An evaluation of effective energy in the formulation of diets for laying hens.	**M.Sc**	Received 2000	P
5	Mr AV Ferreira **Promotor:** **Prof JH van der Merwe**	BSc (Agric), BSc (Agric) (Hons), MSc (Agric)	University of the Free State	Die essensiële aminosuurbehoeftes van SA Vleismerinoramlammers.	The essential amino acid requirements of South African Mutton Msrino lambs.	**PhD**	Received 2000	H
6	Mr CA Loëst	BSc (Agric), BSc (Agric) (Hons), MSc (Agric)	University of the Free State	Amino acid utilization by beef cattle.	Amino acid profile of lamb carcass and duodenal digesta content	**PhD**	Received 2000	H
	1997							
7	Ms L McLouglin	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.	**M.Sc**	Received 2000	P
8	Mr PDR van Heerden **Promotor:** **Prof GHJ Kruger**	BSc, BSc (Hons), MSc	PU for CHE	Die evaluering van de novo proteïensintese, chlorofilfluoressensie-induksieparameters en ensiemaktiwiteite van oksidatiewe stresmetabolisme as indikatore van droogte toleransie in	Physiological and Biochemical basis of dark chilling and superimposed drought stress in Glycine max (L.) Msrrill.	**PhD**	Received 2000	S

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
	1998							
9	Ms A Booysen	BSc, BSc (Hons)	PU for CHE	Die evaluering van faktore wat stikstof-binding by sojabone beïnvloed asook die impak daarvan op saadproteïen-inhoud.	Factors affecting biological nitrogen fixation as assessed by the ureide technique in Glycine Max L. (Msrrit) and its implication on soybean production in South Africa	**M.Sc**	Received 2001	S
10	Ms GJM Coetzee **Promotor: Dr LC Hoffman**	BSc (Agric)	Stellenbosch University	Gebruik van canola-oliekoek vir visvoeding.	Effects of feeding omega-3 fatty acids and Vitamin E on the chemical composition and microbial population of Broiler meat.	**M.Sc**	Received 2000	VV
11	Mr CM Coetzer	BSc (Agric), BSc (Agric) (Hons), MSc (Agric)	Kansas State University	Manipulation of ruminal degradability characteristics of various protein sources.	Msthionine metabolism in growing cattle	**PhD**	Received 2001	H
	1999							
12	Mr J van E Nolte **Promotor: Dr AV Ferreira**	BSc (Agric)	Stellenbosch University	An evaluation of degradable intake protein and non-protein nitrogen on intake and digestion by Dohne Msrino sheep fed wheat straw.	An evaluation of degradable protein and non-protein Nitrogen on intake and digestion by Dohne Msrino sheep fed wheat straw.	**M.Sc**	Received 2001	H
13	Mr PGW Wessels **Dr PJ Pieterse**	BSc (Agric)	Stellenbosch University	Canola en lupien as wisselbougewasse.	Soil Nitrogen Dynamics and spring wheat (Triticum Aestivum)production in different cropping systems in the Swartland.	**M.Sc**	Received 2001	C
14	Mr WD Jonker **Promotor:** **Prof GHJ Kruger**	BSc	PU for CHE	Waterhuishouding van sojabone onder Suid-Afrikaanse toestande.	Invloed van vog- en ligstremming op die ontwikkeling en Bioproduktiwiteit van Glycine max (L.) merr. Genotipes van verskillende volwassenheidsgroeperings.	**M.Sc**	Received 2000	S
	2000							
15	Mr GDJ Scholtz **Promotor:** **Prof HJ van der Merwe**	BSc (Agric), BSc (Agric) (Hons)	University of the Free State	Lusern gradering stelsel.	Models for lucerne quality grading.	**M.Sc**	Received 2002	LU

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
16	Mr S Tyiso	BSc, HDE, BSc (Hons), MSc	University of KwaZulu-Natal	Development and maturation-drying effects on the biochemistry (lipid, protein lipid hydroperoxides, antioxidants) of soybean seeds.	Lipid Peroxidation and the antioxidant system in soybean seed maturation and germination.	**PhD**	Received 2004	S
17	Mr JR Sara	BSc, BSc (Hons), MSc	University of KwaZulu-Natal	The formulation of a nutritional feed for prawn mariculture in KZN.	An investigation into the Protein Requirement of Marine Prawn Fenneropenaeus indicus (H. Milne Edwards)	**PhD**	Received May 2007	VV
18	Mr JD Thornton **Promotor: Dr AV Ferreira**	BSc (Agric)	Stellenbosch University	Comparison of different RDP and UDP ratio's on intake and milk production efficiency in Saanen goats fed a complete diet.	The effect of dietary protein degradability on the performance of Saanen Dairy Goats.	**M.Sc**	Received 2003	H
	2001							
19	Ms S Nel **Promotor: Dr J Albertyn**	BSc, BSc (Hons)	University of KwaZulu-Natal	The cloning expression and characterization of a xylanase to improve the feed conversion ratio in chickens.	Cloning of the xyna gene from thermomyces lanuginosus and expression in saccharomyces cerevisiae.	**M.Sc**	Received 2002	P
20	Mr SG de Jager **Promotor: Prof CC du Preez**	BSc (Agric), BSc (Agric) (Hons)	University of the Free State	Groei en ontwikkeling van sojaboon-kultivars by verskillende rywydtes.	Groei en ontwikkeling van sojaboon cultivars by verskillende rywydtes.	**M.Sc**	Received 2004	S
21	Mr M de Beer **Promotor: Prof LG Ekermans**	BSc (Agric)	Stellenbosch University	Animal Nutrition	The influence of processing of Soya-beans and Sunflower seed on their Energy and Amino Acid availability for poultry.	**M.Sc**	Received 2003	P
22	Ms L Brundyn **Promotor: Dr AV Ferreira**	BSc (Agric)	Stellenbosch University	Die voedingswaarde en benutting van canola- en koringstoppel deur skape.	The utilization and supplementation to stubble lands for South African mutton Msrino ewes.	**M.Sc**	Received 2003	H

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
	2002							
23	Ms H Fourie	BSc, HOD, BSc (Hons), 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). **B.** Identification and validation of genetic markers associated with this resistance trait (breeding and biotechnology).	In vivo evaluation of resistance to Msloidogyna incognita race 2 (Nematode: Tylenchida) and identification of genetic markers for this trait in soybean (Glycine max).	**PhD**	Received 2005	S
24	Ms MM Viljoen **Promotor:** **Prof GHJ Kruger**	BSc, BSc (Hons)	PU for CHE	The influence of dark chilling on the endogenous rhythms of photosynthesis and sucrose synthesis in Glycine max (L.) Msrr.	The influence of dark chilling on the endogenous rhythms of photosynthesis and sucrose synthesis in Glycine max(L.) Msrr.	**M.Sc**	Received 2004	S
	2003							
25	Ms LR Breytenbach **Promotor:** **Dr M Ciacciariello**	BSc (Agric) (Hons)	Stellenbosch University	The influence of processing of canola and lupins on the amino acid availability for broilers.	The influence of processing of lupins and canola on apparent metabolizable energy and broiler performance.	**M.Sc**	Received February 2006	P
26	Mr SG Payne	BSc (Agric) (Hons)	Stellenbosch University	Evaluasie van grondstowwe in pluimvee- en varkvoeding.	The Phosphorus availability of feed phosphates in broilers.	**M.Sc**	Received June 2005	P
27	Ms JB Griffiths **Promotor:** **Prof CW Cruywagen**	BSc (Agric) (Hons)	Stellenbosch University	Herkouer voeding	The effect of extrusion on the degradability parameters of various vegetable protein sources.	**M.Sc**	Jan-06	H
28	Mr D Backhouse	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.	**M.Sc**	Received 2005	P
	2004							
29	Ms ER Malleson **Promotor:** **Prof LJ Erasmus**	BSc (Agric) Veekunde	University of Pretoria	The effect of ruminal pH on the protein degradability of typical dairy and feedlot diets.	Fishmeal Supplementation to high producing jersey cows grazing ryegrass or kikuyu pasture.	**M.Sc**	Received March 2008	H
30	Ms Z Bester **Promotor:** **Prof LJ Erasmus**	BSc (Agric) Veekunde	University of Pretoria	Die effek van rumen-beskermde metionien (RPMst) op die produktiwiteit van Holstein-koeie gedurende vroeë laktasie.	Evaluation of a liquid rumen protected methionine source using different techniques	**M.Sc**	Received September 2011	H

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
31	Ms N Smith **Promotor: Prof TS Brand**	BSc (Agric) Veekunde	Stellenbosch University	Gebruik van canola en lupiene in die diëte vir braaikuikens, volstruise en varke.	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.	**M.Sc**	Received 2005	P
	2005							
32	Mr W Visagie	BSc (Agric) Veekunde	Stellenbosch University	Essential amino acid requirements of goats.	The digestibilty and degradability of feeds and protein sources in dohne - merino sheep and boer goats	**M.Sc**	Received January 2010	H
33	Mr J Fourie **Promotor:** **Dr M Ciacciariello**	BSc (Agric)	Stellenbosch University	Use of enzymes for vegetable protein sources in poultry.	The effects of a multiple-enzyme combination in maize-soya diets for broiler chickens.	**M.Sc**	Received August 2007	P
34	Ms M Kritzinger	BSc (Agric)	Stellenbosch University	The effects of probiotics in gut health and protein utilization in poultry.	Alternatives to replace antibiotics in broiler diets: Effects on protein utilization and production performance	**M.Sc**	Received November 2009	P
	2006							
35	Ms MR Modiba	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 Jatrpoha curcas seed press cake	**M.Sc**	Received November 2009	H
36	Mr SF Magoda	BSc (Agric)	University of KwaZulu-Natal	Poultry nutrition (alternative protein source for Laying Hens).	Poultry nutrition (alternative protein source for Laying Hens).	**M.Sc**	Received June 2010	P
37	Mr H Nienaber **Promotor:** **Prof LJ Erasmus**	BSc (Agric), BSc (Hons)	University of Pretoria	The effect of ruminal pH on protein degradability.	Effect of roughage to concentrate ratio on ruminal fermentation and protein degradability in dairy cows.	**M.Sc**	Received August 2008	H
	2007							
39	Ms M. Strydom	BSc (Agric)	Stellenbosch University	Diere voeding ten opsigte van die monogastriese dier (Enkelmaagdier).	The effect of different levels of supplementary feed on the production of finisher ostriches (Struthio camelus) grazing irrigated lucerne (Msdico stiva) pastures	**M.Sc**	Received April 2011	P

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
40	Ms BK Theeruth	BSc (Animal & Poultry Science) 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	**M.Sc**	Received April 2009	V
41	Mr DB Strydom	B.Com	University of the Free State	Die ekonomiese impak van hernubare brandstof produksie op die Suid-Afrikaanse veevoer bedryf.	The economic impact of maize-based ethanol production on the South African Animal Feed Industry	**M.Sc**	Received March 2009	P
	2008							
42	Mr TL Khetani	BScAgric	University of KwaZulu-Natal	An evaluation of the effects of feed restriction on protein intake and its consequences on egg composition and incubation success in broiler breeder hens.	The effects of maternal dietary lysine intake on broiler breeder offspring performance	**M.Sc**	Received June 2011	P
43	Ms PT Mabulwana **Promotor: Dr PW Mokwala**	BSc (Botany & Microbioloby), BSc Honour (Botany)	University of Limpopo	Determination of drought stress tolerance among soybean varieties by morphological and physiological charactistics.	Determination of drought stress tolerance among soybean varieties using morphological and physiological markers	**M.Sc**	Received July 2013	S
	2009							
44	Mr SB Ruck	BSc Honours (Animal Science)	University of KwaZulu-Natal	The effect of protein in the diet of broiler breeders on egg fertility and hatchability.	The response of broiler breeder hens to dietary lysine: hatchability, embryo growth and subsequent offspring performance	**M.Sc**	Received March 2012	P
45	Ms J Patel	BSc Honours (Animal & Poultry Science)	University of KwaZulu-Natal	The effect of dietary lysine, crude protein, energy and feed allocation on broiler breeder hen performance.	The effect of dietary lysine, crude protein, energy and feed allocation on broiler breeder hen performance.	**M.Sc**	Received January 2015	P
46	Mr TR Olivier **Promotor: Prof TS Brand**	BSc (Agric)	Stellenbosch University	Monogastriese voeding	Determination of the nutrient requirements of breeding ostriches	**M.Sc**	Received May 2010	P
47	Mr EJ van der Westhuizen	BSc (Agric)	Stellenbosch University	Veekunde (Vleiskunde)	The effect of slaughter age on the lamb characteristics of Marino, South African Mutton Marino and Dorper lambs	**M.Sc**	Received May 2010	H

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
	2010							
48	Ms MM Minnaar **Promotor:** **Prof GHJ Kruger**	Honneurs (Plantbeskerming) BSc (Omgewingswetenskappe)	Northwest University	Die invloed van verhoogde swaeldioksied (SO_2) word gekwantifiseer op canola plante	Constraints on photosynthesis and antioxidant metabolism in winter and summer crops induced by sulphur dioxide fumigation	**M.Sc**	Received June 2013	C
49	Ms AM Jooste **Promotor:** **Prof WA van Niekerk**	B.Sc (Agric)	University of Pretoria	The effect of supplementing slow release nitrogen (optigen II) and FME on the degradability of poor quality roughage in sheep	The effect of supplementing slow release nitrogen (optigen II) and FME on the degradability of poor quality roughage in sheep	**M.Sc**	Received September 2012	H
50	Ms S Greaves **Promotor:** **Dr C Jansen van Rensburg**	B.Sc (Agric)	University of Pretoria	The effect of specific amino acids-lysine, Tryptophan, Thyptophan, Theonine of the immune system of weaning piglets.	Growth and immunity of weaner piglets supplemented with dietary tryptophan, threonine and glutamine.	**M.Sc**	Received May 2015	V
51	Mr WJ Kritzinger	B.Sc (Agric)	Stellenbosch University	Volstruis (Groei en voeding)	Allometric description of ostrich (*Struthio camelus var. Dometricus*) growth and development	**M.Sc**	Received April 2012	P
	2011							
52	Mr PD Carstens **Promotor: Prof TS Brand**	B.Sc Agric	Universiteit van Stellenboch	Diere Voeding en Vleiskunde	Studies to develop a mathematical optimisation model to desribe the effect of nutrition on the growth of ostriches (*Struthio camelus* var. *domesticu* s	**M.Sc**	Received July 2014	P
53	Mr FV Meyer **Promotor: Prof RM Gous**	B.Sc (Agric) Animal Science	University of Pretoria	The response of weaned piglets to varing dietary levels of synthetic valine and leucine	The response of weaned piglets to varing dietary levels of synthetic valine and leucine	**M.Sc**	Received August 2012	V
54	Ms M du Plessis **Prof KJ Kunert**	B.Sc (Biotechnology) B.Sc (Hons) Plant biotechnology	University of Pretoria	Soybean nodule development	Cysteine proteases activity and gene expression studies in soybean nodules during development and drought stress	**M.Sc**	Received July 2013	S
55	Ms SL von Waltsleben **Promotor: Dr N Tyler**	B.Sc (Agric)	University of KwaZulu-Natal	Determine whether feed restriction through different levels of crude protein has any influence on the fertility in broiler breeder males	The effect of dietary crude protein on fertility of broiler breeder males	**M.Sc**	Received June 2013	P

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
	2012							
56	Ms MP Genis **Promotor: Prof LC Hoffman**	BSc Agric (Veekunde met Agronomie)	Stellenbosch University	Herkouer voeding	The effect of dietary energy content and the provision of a *Beta*-adrenergic agonist in the diet on the production and meat quality of South Africa mutton merino feedlot lambs	**M.Sc**	Received July 2014	H
57	Ms L van Emmenes BSc Agric (Veekunde) **Promotor: Dr E Pieterse**	BScAgric (Animal Science as a major) 2011	Stellenbosch University	MSc Monogastriese voeding	Evaluation of phytase enzymes on performance, bone mineralisation, carcass characteristics and small intestinal morphology of broilers fed maize soya bean diets.	**M.Sc**	Received February 2015	P
58	Mr R Steyn **Promotor: Dr D Strydom**	BScAgric (Veekunde / Landbou - ekonomie) Landbou ekonomie Honneurs	University of the Free State	Canola-olie	When does a market qualify as a niche market: A canola case study	**M.Sc**	Received December 2014	C
59	Ms GA Tesselaar **Promotor: Prof TS Brand**	BScAgric (Animal Science with Conservation Ecology) 2010	Stellenbosch University	MSc Monogastriese Voeding	Development of a methematical optimization model for breeding ostriches: Identification of possible factors affecting feed intake and production	**M.Sc**	Received February 2015	P
	2013							
60	Mr LL Eksteen **Promotor: Prof GA Agenbag**	BScAgric (2012)	Stellenbosch University	Die gebruik van groeireguleerders in canola	Reducing height and lodging in canola (*Brassica napus L.*) using plant growth regulators	**M.Sc**	Received November 2014	C
61	Ms TC Maluleke	BSc Genetics (2011) BSc Hons (2012)	University of Pretoria	Plant Cystatins and insect resistance: Inhibition of insect midgut cysteine proteases by plant cystatins and their role in plant insect resistance	Plant Cystatins and insect resistance: Inhibition of insect midgut cysteine proteases by plant cystatins and their role in plant insect resistance	**M.Sc**	studies not completed yet	D
61	Ms M Cilliers (*nee* Du Plessis) **Promotor: Dr BJ Vorster**	B.Sc (2009) B.Sc Hons (2010) M.Sc (2012)	University of Pretoria	Molecular markers for drought tolerance in soybean	Molecular markers for drought tolerance in soybean	**PhD**	studies not completed yet	S

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62	Ms GC Buitendach **Promotor: Mr FH de Witt**	B.Sc Animal Science (2009) 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	**M.Sc**	Received August 2015	P
	2014							
63	Mr MN Engelbrecht **Promotor: Prof CW Cruywagen**	BSc Landbou ekonomie (2013)	Stellenbosch University	Afronding van beeste op aangeplante weidings met byvoeding van volvet kanola en/of ander hoë kwaliteit proteïenbron	The effect of supplements containing different protein and energy sources and essential oils on the performance of pasture finished heifers	**M.Sc**	studies completed Dec 2015	H
64	Miss T Khahlu	BSc (Biotechnology) (2010-2012)	University of Pretoria	Drought tolerance markers in soybean	Drought tolerance markers in soybean	**M.Sc**	studies not completed yet	S
65	Mr HCvdW Leicester **Promotor: Prof LJ Erasmus**	BSc Animal Science (2011) BSc Honours (2012)	University of Pretoria	Animal nutrition examining the effect of a quality roughage as a determinant of nitrogen efficiency in dairy cows	Effects of yeast based direct fed microbial supplementation on the performance of high producting dairy cows.	**M.Sc**	Received September 2015	H
66	Ms E Jordaan **Promotor: Prof J van der Waals**	BSc (Agric Plant Pathology (2008) MSc (Agric) Plant Pathology (2014)	University of Pretoria	Epidemiology and population on structure of Macrophomina phaseolina (Charcoal rot) on sunflower and soybean in South Africa (TBC)	Epidemiology and population on structure of Macrophomina phaseolina (Charcoal rot) on sunflower and soybean in South Africa (TBC)	**PhD**	studies not completed yet	S
	2015							
67	Mr W de Jager **Promotor: Dr Dirk Strydom**	BSc Agric Animal Science and Agricultural Economics (2013)	University of the Free State	An integrated model to project animal protein consumption in South Africa	An integrated model to project animal protein consumption in South Africa	**M.Sc**	studies not completed yet	D
68	Ms L van Emmenes **Promotor: Dr E Pieterse**	BSc Agric (Animal Science (2011) MSc Agric (Animal Science) (2014)	Stellenbosch University	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	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	**PhD**	studies not completed yet	D
69	Ms KZ Neethling **Promotor: Prof CW Cruywagen**	BSc.agric (Veekunde) (2013)	Stellenbosch University	Die effek van verskillende kombinasies van proteien en energie bronne op veselvertering van ruvoere	The effect of interaction between different combinations of energy and protein sources on IN VITRO forage NDF digestibility	**M.Sc**	studies not completed yet	
70	Ms JA Engelbrecht **Promotor: Prof T Brand**	BSc (Animal Science) (2014)	Stellenbosch University	The evaluation of alternative protein sources (lupins, canola and canola oilcake in ostrich nutrition)	The evaluation of alternative protein sources (lupins, canola and canola oilcake in ostrich nutrition)	**M.Sc**	studies not completed yet	C

NO.	STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	THESIS RECEIVED	CROP CODE
71	Mr A Coetzee **Promotor:** **Prof GA Agenbag**	BSc Agric (2011-2014)	Stellenbosch University	Stikstof bo-bemesting op canola: Tyd en toedieningstempo's	Determining the optimal rate and time of nitrogen topdressing applications for canola (*Brassica napus*) in the Swartland and Southern Cape production areas	**M.Sc**	studies not completed yet	C

Compiled by Maria du Preez

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 - 2016 (Separate addendum)