PROTEIN RESEARCH FOUNDATION

2012/2013 RESEARCH REPORT

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Vision

The PRF strives to make a significant contribution to the promotion of local production of protein on a sustainable basis, in order to satisfy the growing need for protein for animal production purposes which will lead to an increase in the standard of living of all people in the RSA.

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 protein as well as the optimal utilization in the RSA for animal nutrition.

The PRF ascribes to...

- A balanced, objective approach.
- A critical awareness of the latest developments regarding the protein supply and utilisation.
- The promotion of cost-effective research.
- The dynamic promotion of the implementation of research results.
- The effective sustained utilisation of natural agricultural resources.

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1. INTRODUCTION

The Protein Research Foundation (PRF) was founded 23 years ago and during that time we have experienced many highs and lows, but 2012/2013 will be remembered by Board members, staff and contractors alike, as the year we hosted the 9th World Soybean Research Conference (WSRC IX 2013).

With that conference behind us, the remainder of the year reverted to the normal highs and lows, but it included many challenges as well as the satisfaction of successful achievements. As in the past, this report describes the various PRF activities and presents the most important achievements resulting from PRF funding.

2. GENERAL OVERVIEW

The International Soybean Research Conference is hosted once every four years by one of the respective countries involved. During the 2009 Conference in Beijing, South Africa was appointed the 2013 host, although the PRF indicated at the time that it was not in a position to host such a conference. The successful presentation for South Africa to host this event was made by other parties, but when after two years those proposals showed no sign of progress, the PRF received a request to assist. The Conference was successfully hosted in Durban by the PRF in co-operation with the Oil and Protein Seeds Development Trust/Oilseeds Advisory Committee (OPDT/OAC) on 17-22 February 2013. This project literally overshadowed all other activities in the 2012/2013 research year.

In spite of this distraction, the PRF feels very satisfied with the progress made in its main activities due to outstanding research results and progress with other projects discussed in this report, with technology transfer and with an exceptional generic marketing campaign that covered a wide variety of aspects relating to both soybeans and canola.

International co-operation continues at a rapid rate. Several Board members, staff and contractors visited PRF partners and business associates in other countries, discussed common matters, attended conferences and forged new ties. Similarly, various international researchers visited South Africa to follow up on co-operation agreements, or upon invitation to discuss important subjects identified by the PRF. Various Board committees and work groups continue to identify needs relating to these aspects, after which they will submit proposals for final Board resolutions.

The Elite soya trials, conducted in co-operation with institutions in Argentina, Brazil and China, are considered to have been very successful and the first positive results are expected as early as 2013/2014.

Aimed at advertising the WSRC IX 2013 Congress in Durban, the PRF staff manned an exhibition stall at the Soya Congress (Congresso Brasileiro de Soja) in Cuiaba, Brazil. It was a first attempt at this type of activity for the PRF.

As in the past, PRF representatives attended various international and local conferences, information days, etc. either as delegates or speakers. This is an essential facet, to keep the PRF up to date with the latest developments and information of interest to the Foundation. However, it remains part of the technology transfer programme that the PRF considers of immense value. Each Trustee is expected to attend the relevant subject-specific conferences and annual general meetings. Various members serve as members of other executives and committees. It is important to mention Prof R Gous, recently elected as Honorary President of the South African Poultry Association (SAPA) and Vice-president on the World Poultry Science Association (WPSA).

During the recent past, the PRF hosted various successful information days at Hatfield, the University of Pretoria research farm. The number of attendees, and the interest shown in the event, has increased each year. Unfortunately, WSRC IX 2013 intervened in February 2013 making it impossible to host the scheduled “Hatfield Information Day” this year.

Stalls and exhibitions at strategic events such as NAMPO are manned sustainably. At these events the PRF makes available pamphlets, journal articles and news bulletins to all interested parties. During the past year more than 80 articles relating to soya and 20 about canola were published in various journals and magazines. These are available for perusal on the PRF web page (www.proteinresearch.net). The PRF also publishes and makes available income and cost estimates that are adjusted annually. The information is made available as part of normal distribution channels as well as on the PRF web page.

The PRF convenes annual think tanks for the Executive Committee and the Technology Committee. This year was no exception. The normal quarterly reports about local and international aspects relating to biofuel, or reports aimed at possible sources of protein that may result from such production, are also available on the PRF web page.

Dr Munro Griessel resigned from all committees during the past year and the PRF accepted his resignation with empathy. Dr Griessel is one of the 1990 PRF founding members and served as chairman of the Technology Committee for 18 years. As such he was also a member of the Executive. Dr Griessel indicated that he intended to retire from the PRF Board in 2014. The PRF honours him for his invaluable contribution over the years he has served the Foundation. There is no doubt that we will sorely miss his expertise. We wish him a blessed retirement. Dr Griessel will be

replaced by Dr Jos De Kock, both as chairman of the Technology Committee and as member of the Executive. The Board wishes Dr De Kock all the best in this new role.

There are few researchers in South Africa that are in a position to assist the PRF in the promotion of soybeans and canola, but even fewer are replaced after retirement. This is particularly true at institutes such as the ARC. Dr Geoff Tribe is another retiree this year who did pioneering work as an entomologist in the canola industry. We wish him all the very best and feel grateful that he will remain available as a consultant to the industry.

3. POLICY RESOLUTIONS

One of the most important policy resolutions implemented during the year was the decision to host the WSRC IX 2013 in Durban from 17-22 February 2013. The Board also resolved to allow Mr GJH Scholtemeijer to accept the position as chairman of the Organizing Committee. In addition, the Board resolved to allow Dr Joseph De Kock to accept his nomination as chairman of the Technical Committee. Both were assisted, with Board approval, by members of the Board, especially the Technical Committee and very importantly, PRF members of staff. The pressure on all was so much worse after the Organizing Committee suffered greatly after being left in the lurch by two so-called internationally recognised companies responsible for arranging conferences. The PRF has high praise for all who helped in any way to ensure the success of WSRC IX 2013. The PRF, the soya community and South Africa are proud of the outcomes of this international conference opened by Minister Derek Hanekom. Those South Africans who attended found it highly informative, and it provided an opportunity to forge good friendships within the international soya community. Two South Africans, Mr GJH Scholtemeijer of the PRF and Mr Willem Engelbrecht of K_2 Agri were elected to serve as members of the WSRC Continuation Committee. The next conference will be held in 2017 in Savana, Georgia (USA).

Aimed at active involvement in WSRC IX 2013, the Board accepted an invitation for the PRF to become the first non-American member of the World Soya Foundation (WSF). As this organisation has only just been created there is little to report about it.

The WSRC IX 2013 event emphasised that it is essential to establish an official South African soybean association. Until now, the role and activities of such an association have been fulfilled, *ipso facto,* by the PRF. In addition, a decision was taken to create a similar association in South African for canola. Significant progress has been made in this respect.

Based on the success and impact of the study to determine the potential of soybean production in South Africa, the PRF decided to request a similar study relating to

canola. The decision led to an agreement with Dr Mark Hardy, well-known researcher previously involved with the Department of Agriculture in the Western Cape (DAWC). The work is expected to be completed early in 2013. There is significant interest in and anticipation of the results of this study.

The above-mentioned decisions relating to canola resulted in a Board resolution to work with dedication and effort to uplift canola from its current relatively stagnant position. The first positive results have become apparent during the past two years and these are discussed later in the report. In this regard the Board also resolved to acknowledge the DAWC for its significant contribution to the establishment and promotion of the canola industry. The PRF accordingly acknowledged DAWC with a special award made to Institutions that contributes substantially to our Vision and Mission. The DAWC is only the second institution to be honoured in this way by the PRF.

The renewed action relating to the canola industry led to a Board decision to maintain the canola planning task team.

Co-operation between the PRF and the OPDT has been maintained for several years. However, during the past year an official co-operation agreement between the two parties was drawn up. The PRF acknowledges the work done by OPDT as its partner in terms of WSRC, its co-operation in terms of soybeans and now, during this year, for its co-operation in terms of the canola industry.

In the spirit of co-operation, the PRF decided to incorporate the Soybean and Sunflower Forum Meeting of the Oilseeds Industry into the PRF Soybean Working Group. This incorporation is for a trial period of one year and will be renewed if results warrant this.

Establishing canola in the summer rainfall region of South Africa has been discussed for a number of years. No action in this regard took place whilst clarity was awaited on the position of canola in the Western Cape. Based on the successes described above, the Board has established official contact with institutions and producers currently involved in canola in the summer rainfall region. Progress in this regard will be reported in the next research report.

To ensure continuity on the Board, additional Board appointments were approved during the year. Mr Gerhard Keun, PRF Chief Executive Officer for the past 10 years, was elected as a member of the Board. At the same time, Prof Ferdinand Meyer, Director of the Bureau for Food and Agricultural Policy (BFAP), another institution that has co-operated with the PRF for several years, was co-opted as a Board member, initially for a period of one year according to the PRF policy relating to the appointment of Board members.

4. SOURCES OF PROTEIN

4.1 International

4.1.1 General

During the year under review the production and supply of oil- and protein-rich seeds was subject to unstable climatic conditions, logistical problems and political interference in the market.

The international closing stock comprising the seven most important oilseeds for the 2011/2012 season was 66,1 million tonnes, 22,6 million tonnes less than the closing stock for the previous season (2010/2011). Soybeans were the main cause of the lower tonnage because the closing stock declined by 21,1 million tonnes to only 54,1 million tonnes for the 2011/2012 season.

The closing stock for the 2012/2013 season was 75,3 million tonnes, resulting from an increase in production of the seven oilseeds from 434,6 to 459 million tonnes for the 2012/2013 season. The biggest increase was in the production of soybeans, showing an increase of 27 million tonnes. Cotton seed, sunflower and canola did not show major deviations.

4.1.2 Soybeans

At the beginning of the year under review the South American soybean harvest was expected to remain at 14 million tonnes less, in spite of the late rains reported in Argentina. It was estimated that world soya production would decline by 20 million tonnes compared to the previous year (2010/2011). In fact the total world soya production for 2011/2012 (October/September) was 26 million tonnes lower than in the corresponding period in 2010/2011. This resulted in a materially lower world soya stock by the end of August 2012. The total soya production for the 2011-2012 season (October/September) was 238,9 million tonnes compared to 264,9 million tonnes recorded in the preceding season. This resulted in a strengthening of futures prices at the beginning of the year under review. A reduction in international rapeseed and canola production also contributed to the soya price increase. During the year under review, soya also experienced strong surface competition with other crops, not only in the USA, but also in other producing countries. China reported that government policy dictated that it would plant more maize at the expense of soya, because the country wished to be more self-sufficient in terms of grain crops.

Soya has stood firm in the fight for land based on the favourable soya/maize price ratio on the Chicago Board of Trade (CBOT) futures market. The price ratio was 2,3:1 on 8 March 2012 (November soya:December maize). This was a huge improvement compared to the 2,1:1 ratio at the beginning of February 2012.

In terms of the 2012/2013 (October/September) season futures soya prices were supported by the harvest risks in South America and the huge demand in China. Planting of grains and oilseeds was delayed due to unfavourable climatic conditions. In Argentina, 13 to 16 million hectares of agricultural land were flooded or were too wet for planting. Brazil experienced problems of the opposite nature. There, producers battled with a low soil moisture content on almost half the area earmarked for soya.

During the last week in February 2013, the futures prices of soya and soya oilcake strengthened, mainly due to the delays in exports from South America. Soya oilcake achieved the highest prices in the soya complex, while soya oil achieved the poorest prices in the complex.

The Argentinean government placed significant pressure on producers to market more actively. The government wants to accelerate the export of old stock as the government needs urgently to earn income from export tax. The producers' reluctance to sell old stock arises from the unfavourable exchange rate determined by the government and the high inflation rate of at least 30%. Producers are waiting for devaluation and a new exchange rate that will correspond closer to the actual value of the currency. Brazil's harvest expectation for the 2012/2013 season will not be as significant as estimated initially, but it will still be a record harvest. Harvest estimates initially varied between 80,1 to 81,2 million tonnes. These estimates are significantly higher than the 66,4 million tonnes for the previous season.

Brazil's biggest problems remain infrastructure bottlenecks and a shortage of transport vehicles. These factors caused a dramatic increase in transport costs to the respective harbours and resulted in declining farm gate prices for producers. Prices declined further due to the lower quality of beans delivered because of high moisture content. Transport costs from central Mato Grosso to the Paranagua harbour increased by 60 to 80% compared to prices a year earlier. Reasons mentioned for the dramatic increase in transport costs include the poor road conditions, new legislation that requires truck drivers to adhere to longer rest periods, higher diesel prices and a truck shortage. Transport profit margins are too low and trucks moved to southern Brazil where transport profit margins are higher.

Soya oilcake prices benefitted from the lower soya harvest estimates in South America in the 2010/2011 season. The decline in ethanol production in the USA contributed to this, because it resulted in a lower supply of distillers dried grain with solubles (DDGS).

4.1.3 Canola

Rapeseed and canola prices also strengthened compared with those at the beginning of the year under review. Canada benefited from the lower harvests in other countries because the demand for Canadian canola increased. Naturally this resulted in lower stock levels in Canada by the end of the Canadian season. According to expectations this situation will change during the 2012/2013 season largely because Canadian and Australian producers indicated that they will plant more.

Canola remains the second most important oilseed in the world. It maintains a relatively constant international tonnage.

Total production over the past three years was -

2010/2011	61,8 million tonnes
2011/2012	61,4 million tonnes
2012/2013	63,9 million tonnes

However, closing stocks trended downward -

2010/2011	7,1 million tonnes
2012/2013	5,3 million tonnes

The largest three producing countries were -

EU	19,65 million tonnes
Canada	14 million tonnes
China	12,5 million tonnes

4.1.4 Other

International sunflower production fluctuated significantly over the past three years, mainly due to climatic factors.

2010/2011	2011/2012	2012/2013
33.6 million tonnes	39.56 million tonnes	35.6 million tonnes

The three most important producing areas achieved as follows -

	2010/2011	2011/2012	2012/2013
EU	7.0 tonnes	8.3 tonnes	7.0 tonnes
Russia	5.8 tonnes	9.5 tonnes	8.0 tonnes
Ukraine	8.0 tonnes	9.5 tonnes	8.4 tonnes

The global fishmeal production for the first six months of 2013 is up to 10% lower compared to 2012. Global stocks are low but prices are declining due to lower demand, mainly from China's aquaculture industry that was affected by recent poor weather conditions. In addition, alternatives to fishmeal, such as soya concentrates, are being used in aquaculture. Global fishmeal production for the period October 2010 to September 2011 was 5,01 million tonnes. The comparative 2011/2012 production was 4,98 million tonnes and Oil World estimates the 2012/2013 production to be only 4,3 million tonnes.

Between April and June 2013 the fishmeal production in Peru declined to a 10-year low. On 24 July 2013 prices were US$1 450 (R14 500) for FAQ standard meal and US$1 600 (R16 000) for Super Prime.

Peru has changed its fishing regulations. Only anchovy landings for non-human consumption may be used for fishmeal. Landings from small vessels within the 10 mile zone are dedicated for direct human consumption. Up to 40% of the latter is being processed as unrecorded landings and could comprise between 100 000 and 200 000 tonnes.

4.2 Local

4.2.1 General

The demand for oilcake and fishmeal comprised 1 865 360 and 45 000 tonnes respectively for the marketing year (1 April 2011 to 31 March 2012). No imported fishmeal is used, but 1 089 433 tonnes (59%) oilcake was imported. The comparative consumption for the previous period (1 April 2010 to 31 March 2011) was 1 857 490 tonnes oilcake and 37 000 tonnes fishmeal. In 2011/2012 there was an increase of 21,6% in the consumption of fishmeal, but a marginal decline of 0,1% in the consumption of oilcake. AFMA's 2012 Annual Report estimates the oilcake consumption in the 2012/2013 marketing year to be 2 200 000 tonnes. In the opinion of the PRF the estimate is too high and it was reduced to 1 900 000 tonnes.

During preparation of this report, the actual consumption figures for six months by AFMA members for the 2012/2013 marketing year were known. If those figures were

to be translated to figures for 12 months, they comprise consumption of 1 313 286 tonnes oilcake by AFMA members and 54 710 tonnes fishmeal consumed by AFMA members. At this stage the fishmeal consumption by AFMA members already exceeds the total fishmeal consumption (45 000 tonnes) reported for the previous marketing year. This may be ascribed to good fishing figures for the first part of 2012 and the relatively low fishmeal prices (R6 500 – R7 500 per tonne). Comparative soya oilcake prices were relatively high, as mentioned in 4.1.1 of the report.

According to the SA Fishmeal Marketing Company, fishing figures for the period January to April 2013 were very poor. During the corresponding period of the previous year 130 000 tonnes more fish were harvested. Currently the inland price of fishmeal is R12 000 to R13 000 per tonne. The results of these figures will probably be reflected in the 2013/2014 marketing year figures. There was good progress with soya production locally, comprising 560 950 tonnes in the 2010/2011 marketing year (311 450 ha), 710 000 tonnes in the 2011/2012 marketing year (418 000 ha), 650 000 tonnes in the 2012/2013 marketing year (472 000 ha) and 851 000 tonnes estimated for the 2013/2014 marketing year (estimated at 516 000 ha).

This reduces the pressure on imported oilcake and the expected oilcake imports for 2012/2013 will be 981 820 tonnes compared to more than one million tonnes in the previous two years.

The up-scaled oilcake consumption by AFMA members for 2012/2013 (1 313 286 tonnes) indicates a slight decrease compared to the actual consumption of 1 329 126 tonnes in the previous year. The decline is mostly due to reduced use of full fat soya and soya oilcake. Factors that played a role may be the more favourable fishmeal/soya oilcake price ratio as well as the lower increase in local poultry production. Poultry is the largest consumer of oilcake. Soya oilcake remains the most important source of protein for AFMA members and comprised 75,9% of the total oilcake consumption during the 2011/2012 marketing year. The estimated consumption for the 2012/2013 marketing year is 70,7%. This figure includes full fat soya, translated into a soya oilcake equivalent.

4.2.2 Local Protein Production

4.2.2.1 Soybeans

The effects of the market situation on soya and soya product prices were mentioned above. However, soya oilcake was the price leader in this regard. CBOT prices recorded from mid-January until May 2012 increased by 44% to US $435 per short tonne. The effect on the landed price of 47% protein oilcake at Durban is also clearly apparent. As an example, on 5 March 2012 the landed price of soybean oilcake (47% protein) in Durban was R3 641 at an exchange rate of R7,55/US$. Two months later

(2 May) the price was R4 451 at an exchange rate of R7,72/US$. On 24 July the price was R6 000 per tonne, further strengthened by an even weaker exchange rate.

Prices of imported soya oilcake declined slightly after that period, but it remained significantly higher than at the beginning of the year under review. In October 2012 the landed price in Durban was R5 860 per tonne and at the beginning of 2013 it was about R5 500 per tonne.

For the first harvest estimate of March 2012 the area planted under soybeans was 472 000 ha. At an expected yield of 755 950 tonnes it represented the largest harvest ever. According to the Harvest Estimate Committee the increase comprises 45 950 tonnes or about 6,5% more than the estimate of 710 000 tonnes for the previous season.

According to figures for February 2013 only 650 000 tonnes were produced. Due to largely negative agricultural conditions the average yield for 2012 (1,39 t/ha) is 18,2% lower than the average yield of 1,7 t/ha for the previous season, 0,34 t/ha lower than the previous five-year average of 1,73 t/ha and 0,33 t/ha lower than the previous 10-year average of 1,72 t/ha.

The average yields in the most important provinces for 2011 and 2012 were -

	2011 t/ha	2012 t/ha
KwaZulu-Natal	2.71	2.40
Limpopo	2.50	2.30
North West	2.50	1.50
Mpumalanga	1.55	1.30
Free State	1.41	1.15

These figures reflect the immense effect of seasonal rainfall and heat during critical phases of soybean production between January and March. According to the February 2013 harvest estimate, 515 000 ha was planted under soybeans in the 2012/2013 season, representing an increase of 9,1% compared to the 2012 season.

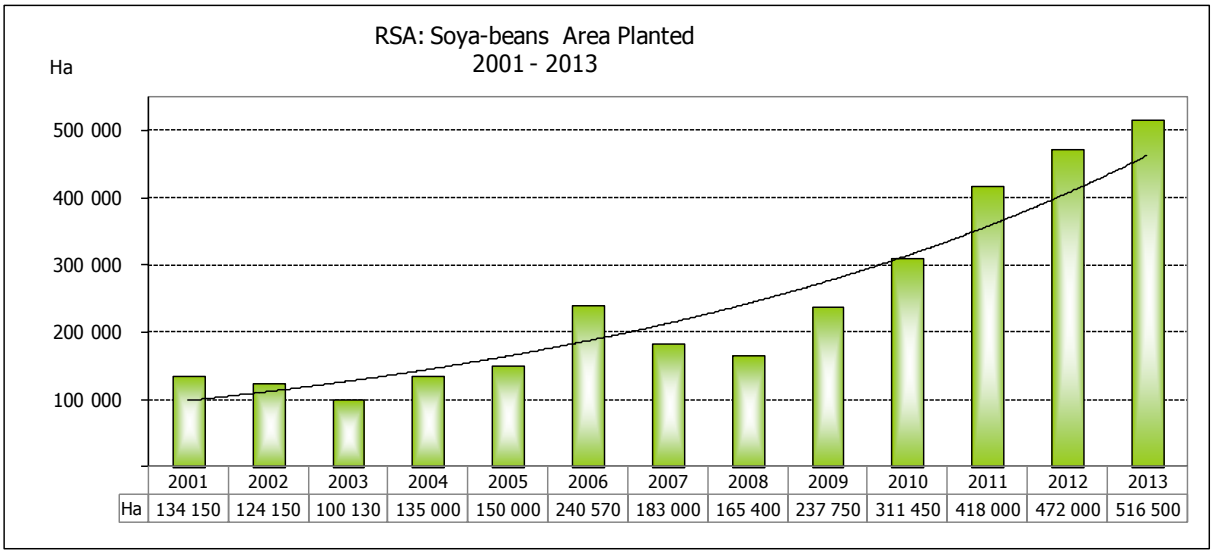
According to the Crop Estimate Committee the number of hectares planted to soybeans, per province, compared to the previous year was -

	2012	2011	Change
Northern Cape	500	500	0
Free State	175 000	135 000	+40 000
Eastern Cape	500	1 000	-500
KwaZulu-Natal	34 000	34 000	0
Mpumalanga	200 000	190 000	+10 000
Limpopo	22 000	23 500	-1 500
Gauteng	19 000	14 000	+5 000
North West	21 000	20 000	+1 000
TOTAL	**472 000**	**418 000**	**+54 000**

A few years ago the PRF set a goal of one million tonnes on 500 000 ha for soybeans in 2015. This goal, considered against the current momentum within the local soya industry, could have been achieved during the 2013 planting season.

The PRF also set a target of 33:67 for soya : maize as a rotation ratio. This represents a soya planting area of about one million hectares, which has been set as a new target for 2020.

Additional estimates included reference to 750 000 hectares of soya, or a yield of one million tonnes soya that will be required by 2015 if the expected increase in crushing capacity were to be realised. By February 2013 a crushing capacity of 600 000 tonnes was available, with significant additional expansions being built.



Source: National Crop Estimate Committee

The graph prepared by the Crop Estimate Committee, showing the area planted under soybeans since 2001, provides perspective. The PRF is particularly proud of the annual increase since 2008, as well as the constantly increasing trend. The increased awareness of producers in terms of conservation farming, and the importance of soybeans as a rotation crop in such a system, combined with good prices, has obviously made the soybean industry the strongest growing industry in the agricultural sector over the past six years. This process is supported by new cultivars that are being made available in South Africa, new seed companies that have entered the market and, especially, new entrants in the oil crushing industry that will have available the most modern equipment to produce the same quality soybean meal as that currently being imported, mainly from Argentina. The Elite soybean trials, initiated by the PRF, that are playing such an important role in the sustained vitality of the soya industry are also discussed elsewhere in this report.

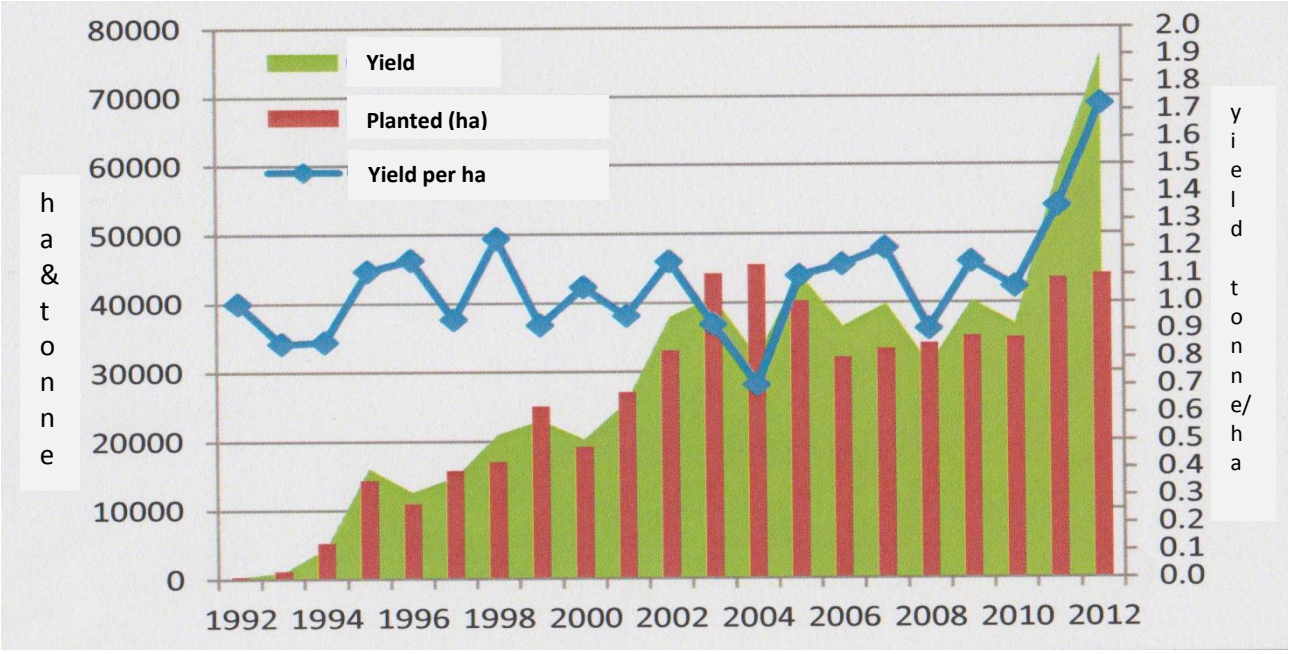
During the past year the meetings of the soya working group that coincided with the Soybean and Sunflower Forum, were generally well attended. This contributed positively to the promotion of the soybean industry. Several speakers provided useful input and these presentations were followed by lively discussions of the topics.

There was good media coverage of the soybean industry during the year, with much input and encouragement from the PRF. We should continue to distribute information in this way, particularly to the western parts of South Africa where there is a growing interest in soybeans.

4.2.2.2 Canola

During the past two years the canola industry succeeded in escaping from a stagnant position. The PRF is grateful that its renewed efforts to stimulate the industry seem to have been successful.

The 2012 year was marked by various highlights. The most important was that 79 650 tonnes was produced, at the highest average yield per hectare ever achieved, namely 1,79 tonnes per hectare.



It was quite clear that this achievement was not merely due to the favourable climatic conditions, which included above-average and well-distributed rainfall, but was also due in large part to the PRF's investment in the evaluation and establishment of the best available cultivars. These were the first fruits of a concerted effort by the PRF to promote canola production in the country. The achievement finally lays to rest the perception that South African farmers plant unsuitable cultivars.

The target of 75 000 tonnes on 50 000 ha by 2015 has been exceeded. As more producers accept canola as a cash crop in its own right the growth will remain sustainable.

Prof André Agenbag's role in technology transfer and his expertise must not be underestimated. It is very clear during visits to farms that he has been instrumental in improving the growing practices which has led to better yields.

The visit by Phil Thomas, Mr Canola of Canada, was one of the most informative, interesting and uplifting foreign visits to the Western Cape yet. Both producers and advisers/experts in the canola industry participated and shared in the transfer of knowledge. We will reap the results in future. Mr Thomas's presentation at the SKOG day at Langgewens on 6 September 2012 elicited widespread interest.

An investigation by Mr SG Ferreira, a PRF contractor, assisted by Messrs JSG Joubert and A Theron, both PRF Board members, entitled Relative Profitability of Basic Rotation Systems: Swartland ("*Relatiewe Winsgewendheid van Basiese Wisselboustelsels: Swartland*"), confirms the potential of canola not only as a rotation crop but as a profitable competitive commodity in its own right. This

investigation focussed on the Swartland only, as the PRF canola task team feels that this area has the biggest short-term potential for expansion. Canola offers a very cost effective and profitable alternative to the wheat monoculture system.

Various other rotation systems applied in this area were also identified and investigated. Gross margins were calculated separately for alternative systems. The system that allows canola growing on 25% of the farm area each year, achieved the best results. Producers and role players in the area showed a positive response to the report and it is now used as a marketing aid. (Other research projects that support the canola industry are discussed in more detail below).

The PRF action to promote canola in the Western Cape is supported largely by researchers in the Department of Agriculture in the Western Cape (DAWC). The PRF canola working group, attended by researchers from the ARC, DAWC, agricultural companies, co-operatives, seed companies and others, remains the backbone that provides direction for the canola industry. This working group is supported particularly well, and discussions at the meetings definitely stimulate more interest in expanding the industry. Canola Focus is an informative publication sponsored by the PRF and it is a privilege for the PRF to acknowledge its editorial team comprising Messrs P Lombard, J Bruwer and Prof G A Agenbag.

Other actions to promote the canola industry to a wider audience take place regularly.

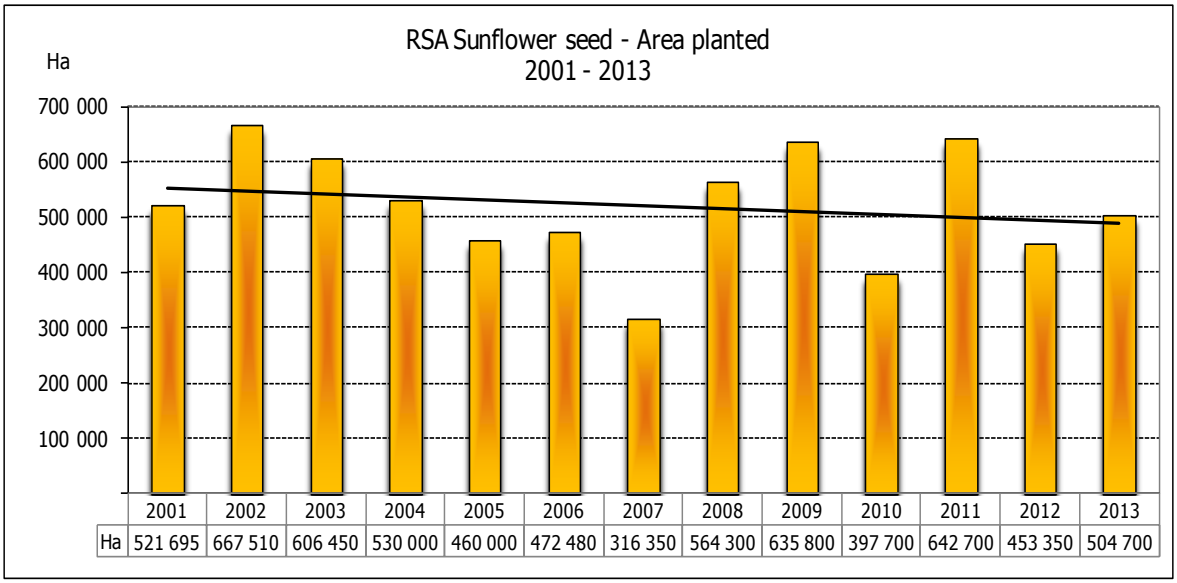
A canola planning work session was held on 2 and 3 February 2012. All relevant Agribusiness representatives in the Western Cape were invited to attend the planning discussions to determine the road ahead within each area of expertise. Included in the discussions were the identification of the roles each person or group, including the PRF, could play in the process and the definition of any assistance or aids that might be required.

The session established a more positive attitude toward the canola industry. Objectives and focus areas for expanding the industry were identified. Follow-up discussions to evaluate outcomes will take place in the new season.

4.2.2.3 Sunflowers

Sunflowers remain an important source of protein to supply the South African demand. Until two years ago, when soybean production surpassed sunflower production for the first time, sunflowers were the main local source of protein for animal consumption.

The graph below shows that sunflower production is following a declining trend, but it is still supplemented by imports.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ha	521 695	667 510	606 450	530 000	460 000	472 480	316 350	564 300	635 800	397 700	642 700	453 350	504 700

Source: Crop Estimate Committee

Sunflower oilcake imports were as follows for the past two years -

2010/2011	57 159 tonnes imported
2012/2013	165 000 tonnes imported

It is undeniable that the sunflower industry will require a significant push in the near future to allow it to regain its previous status.

4.2.2.4 Other

The consumption of fishmeal is determined by the fishmeal price and prices of competitive products. Fishmeal as a source of protein is being replaced to an increasing extent by high quality soybean oilcake. During the previous two years only about 30 000 tonnes of fishmeal was consumed each year, but the figure increased to 48 875 tonnes in 2012/2013.

Local and Imported Fishmeal – 2010 to 2013			
	2010/2011	**2011/2012**	**2012/2013**
Local production: RSA*	72 000	90 000	70 000
Namibia*	10 000	5 000	5 000
Sub-total	**82 000**	**95 000**	**75 000**
Imports**	0	0	0
Russian trawlers ***	12 000	10 000	10 000
TOTAL FISHMEAL AVAILABLE	**94 000**	**105 000**	**85 000**
			Exports
South African product	35 000	45 000	35 000
Namibian product	10 000	5 000	5 000
Russian trawler product	12 000	10 000	10 000
TOTAL AVAILABLE IN SA and NAMIBIA	**37 000**	**45 000**	**35 000**

* Estimate by Fishmeal Marketing Company, Oceana Afriproducts (Pty) Ltd, UFE and NAMSOV
** Customs and Excise
*** All the Russian trawler meal and some local fishmeal has been exported

Source: AFMA Chairman's Report – 2012/2013

The local fishmeal production for January to June 2013 was 24 000 tonnes, significantly lower than in recent years.

The South African fishing industry experienced major problems with the Department of Agriculture, Forestry and Fisheries (DAFF). No vessels were available due to poor maintenance. An industry vessel had to be chartered to conduct the surveys to determine the Total Allowable Catch (TAC) and quotas. In 2013, fishing started late due to poor fish availability. The water temperature was too high for shoals to enter the allocated fishing zones.

4.2.3 Processing of Legume Crop Products

4.2.3.1 Full Fat Producers

According to the AFMA Chairman's Report for 2012/2013, the inclusion of full-fat soya in animal feeds fluctuated between 1 and 3%. The highest consumption in 2011/2012 was 165 000 tonnes.

According to the SAGIS figures, full-fat soya was used as follows during the past three calendar years -

2010	160 300 tonnes
2011	111 500 tonnes
2012	114 600 tonnes

These figures are expected to increase dramatically in the near future.

4.2.3.2 Oil Crushing Industry

According to information obtained from SAGIS and the Crop Estimate Committee at DAFF, an average of 111 300 tonnes soybeans was crushed annually in the past 10 years.

The development of the soya industry changed the situation and a significant upward trend is clear.

According to SAGIS, the average tonnes of soybeans crushed for oil over the past three years were -

2010	145 300 tonnes
2011	192 400 tonnes
2012	296 000 tonnes

The growth in the soybean meal processing industry has gone from strength to strength. The constraint on expansion of production put forward by the soybean producers of production capacity has been addressed and eliminated until an estimated 2020.

The processing of soybeans for human consumption remains relatively constant, servicing a small but important niche market sector of the industry. Usage of soybeans for human consumption was 27 000 tons in 2012, down from the 30 000 tons in the previous year. The unavailability of non GMO soybeans in South Africa has become a problem for some smaller niche market processors. This industry has potential for steady growth.

Full fat soya processing declined during 2012 due to decreased competitiveness against a high protein soybean meal. This decline was however marginal and the processed volume in 2012 of 145 000 tons, appears to be steady off take. Significant additional full fat soya processing capacity exists if required but price ratios of full fat soya to high pro soymeal and soya oil determine usage.

Soybean meal resulting from mechanical oil extraction of soybeans has grown establishing a niche market that competes with full fat soya. The balance between protein and energy makes it suitable for a range of diets as a soybean meal replacement. New plants have been established in South Africa, the advantage of these plants is that they are not capital intensive, the disadvantage is that their efficiencies are very low relative to solvent extracted plants. They could remain and play a role in the industry but this sector is not expected to grow significantly.

The largest sector for soybean consumption is that of solvent extracted soybean meal. This sector has increased dramatically. The crushing capacity for high protein soybean meal was 600 000 tons in 2012 will increase to 2 100 000 tons in 2014, an increase of 250%. Between 2012 and 2014 three new plants have been completed and the elaborate expansion of two further plants has taken place. Capacity that has been created is in the main of high standard with the ultimate objective of replacing Argentine soybean meal imports. To achieve this soybean meal will need to be properly de-hulled, of high protein content and achieve a level of consistency.

Quality of soybean meal is extremely important to the industry in order for it to fulfil the requirement of replacing imported Argentine soybean meal. The quality begins with the nutrient content and management of variation in the soybean, the effective de-hulling of the soybeans to reduce fibre levels and the correct heat application to destroy the maximum anti nutritive factors but not damaging protein quality. Near infra-red technology is being applied to establish a routine test to determine if over-processing has taken place. The technology of measuring optimum heat treatment using a rapid assay is still required.

It is an exciting time in the soybean processing industry and it is unlikely that we will ever again see the industry expand the way it has in such a short period of time. We look forward to a significant portion of imported soybean meal being replaced by domestic high protein meal within a short period of time.

4.2.3.3 Other Sources of Protein

As mentioned earlier, sunflowers remained the main source of protein for animal consumption for many years. According to the AFMA Chairman's Report for 2012/2013, AFMA members used a total of 290 000 tonnes sunflower oilcake in 2012/2013 and the total quantity available in the market was 400 000 tonnes.

4.2.4 Consumers of Protein

4.2.4.1 Animal Feed Manufacturers

A total of 1,877 million tonnes oilcake was available to the animal feed industry during the past year. Of the total, only 760 321 tonnes were produced locally, requiring imports of 1,117 350 tonnes. The importation of more than 728 000 tonnes soya oilcake is of particular interest in terms of the PRF campaign to promote soybeans. More information about this is available under various headings in this report.

The economic difficulties experienced by the developed world affected the less developed economies during 2012/13. The South African economy held up relatively well initially but the adverse global effects spilled over from developed and developing countries which had a direct impact on the South African livestock and animal feed industries.

South Africa in 2012 was ranked the 22 largest feed industry in the world at 11 million tons.

High feed raw material costs remained a challenge. The South African maize price remained stable between April 2012 and April 2013, decreasing only marginally from R2235 to R2155/ton while soybean meal prices increased significantly from R4200 to R5200/ton over the same time-period, after having peaked at R6200/ton in September 2012.

Soya oilcake (including full fat soya) usage for AFMA members decreased from 1 008 760 tons in 2011/12 to 892 480 tons in 2012/13 a decline of 14.45%. This change was due mainly to a movement to fishmeal and other oilcakes. The feed industry utilized 728 150 tons of imported soybean oilcake over this period.

AFMA feed sales increased by only 0.5% between 2011/12 and 2012/13 to 6 176 151 tons mainly assisted by higher sales of pig feeds which typically move from home mixing to the formal feed industry during times of high raw material prices. In the poultry sector a drop of 1.6% and 4% in broilers and breeder feed reflects the current challenges faced by the poultry industry in the form of increased imported chicken meat and rising raw material cost.

National Feed sales for 2012/13 were calculated at 11,146 million tons which is an increase of 0.54% from the previous year. AFMA made up 59.77% of the national feed sales during this period.

Liaison with the registrar on changes in regulations under Act 36 of 1947 that will affect the feed industry received constant attention and is of paramount importance. The South African feed industry was well represented by AFMA in the International

Feed Industry Federation (IFIF), enhanced by the hosting of the 4th Global Feed and Food Conference at Sun City.

The trading environment in which the feed industry finds itself remain extremely challenging.

4.2.4.2 Human Consumption

According to SAGIS the 10-year average use of soybeans for human consumption is only 19 080 tonnes.

During the past three calendar years, the following quantities of soybeans were processed for human consumption (per calendar year) -

2010	22 200
2011	21 700
2012	21 100

4.2.4.3 Other Consumers

In the year under review both the pork and poultry Industries in South Africa continued the battle against high input costs and imports of relatively inexpensive products. Despite the fact that both industries are major employers in the farming sector, the government seems unwilling to intervene to alleviate the dire conditions that have developed.

The South African poultry industry, in 2012, experienced one of the most difficult years in its history. Frozen chicken products from Brazil and the EU, high feed prices due to the cost of maize and soybeans, the increases in fuel prices and labour costs caused a major crisis in the South African poultry industry. A dramatic oversupply in the local market resulting from the importation of chickens meant that many companies could not recover their production costs and a number of producers had to close their farms.

In 2012 feed usage was 4 097 000 tonnes at an average feed price increase of 30%. The broiler feed price averaged R 4 355 per tonne. The broiler industry consumed approximately 3,57 million tonnes of feed, while the broiler chick producers consumed 521 000 tonnes of feed. In 2012 imports comprised 404 163 tonnes of poultry meat, representing an increase of 15,4% compared to 2011. Of the imports, 56,16% were from Brazil, while 34% were from the EU.

The broiler industry is presently negotiating with government authorities to increase poultry import tariffs.

The number of broilers slaughtered per week in 2012 was 18.79 million, 0,7% higher than in 2011. In 2012 per capita poultry meat consumption was 36,2 kg, 9,61 kg, beef 16,45 kg and pork 4,61 kg. Imported poultry meat represented 21,4% of the poultry consumed. The per capita consumption of eggs increased from 150 in 2011 to 156 in 2012 or 9.61kg.

The pork industry suffered drastic retail price reductions, even as much as R4/kg, resulting in production costs that were between R1 and R1,50/kg higher than the pork price. The relatively low costs of imported chicken had a major impact on the pork industry because chicken is largely replacing pork in processed foods. The net effect is that many farmers are being forced out of the industry. Those that remain committed to the industry have recently been spending capital on mechanisation as a means of improving productivity and reducing labour costs, but these measures will have a high impact on future unemployment numbers.

Research in the pork industry was boosted over the past six years because research funds were made available through the statutory levy paid by pig producers. Six years ago there was virtually no research on pig farming in the country, but now the funds allocated for research are fully committed each year. The number of student bursaries and research projects increases continuously. Current research is creative and of great value to the pork industry. It is heartening to see how the interest in research into pig production has blossomed, merely because there are funds available to conduct research.

The situation in the poultry industry has not been as positive. In fact, the long anticipated source of research funding from SAPA's statutory levy is about to disappear before it had any impact on the research environment in South Africa. Apart from the establishment of a Chair in Poultry Health and Production at the University of Pretoria, the upgrading of facilities at that university for the Poultry Disease Management Agency (PDMA) and the relatively small amounts spent on capital items at some of the other universities in the country, there were no attempts to encourage research, boost postgraduate numbers or inspire undergraduate students to study poultry science. All such aspects would have been of great value to the poultry industry. Unfortunately it is highly unlikely that the industry will re-impose the statutory levy this year and that means that no new initiatives will be possible in future.

The poultry industry can ill afford to lose any initiative in this regard. The dire shortage of academics, researchers and postgraduate students interested in poultry science will have a severe impact on the industry in the years to come.

4.2.5 Projections 2015, 2020 and 2025

The main focus of the PRF is to produce more plant protein locally to replace imported oilcake as far as possible. Replacing imported oilcake with locally produced oilcake will lead to foreign exchange savings, promote employment opportunities, reduce risks for the animal feed industry and as a result, will improve food security. In its efforts to manage its research actions, the PRF must know the future demand for plant protein, specifically oilcake. This means that it is essential to prepare regular projections of the future demand for oilcake for animal consumption.

During the year under review projections were prepared to show the oilcake needs within the framework of four scenarios. These included high income growth, lower income growth, with import tariffs on livestock products held in place or with these tariffs phased out. Projections of the most probable scenario, a relatively higher income growth with tariffs being maintained were assumed. Given this scenario, the projections for oilcake demand in 2015 was 2 116 377 tonnes, 2 355 727 tonnes in 2020 and 2 632 604 tonnes in 2025. It is important to note that locally produced oilcake as a percentage of total consumption was an average of 37,3% for the four seasons from 2008/2009 to 2011/2012. It is an enormous deficit to fill.

There is progress with the production of local oilcake. The local production of oilcake in 2010/2011 was 624 912 tonnes and 766 927 tonnes in 2011/2012. According to expectations it will be 918 180 tonnes in 2012/2013. This increase in locally produced oilcake may be ascribed mainly to the growth in the soybean industry. Hectares planted under soya increased from 237 750 ha in 2008/2009 to 516 500 ha in 2012/2013, while yield increased from 516 000 to an expected 851 000 tonnes for the same period. The PRF has set a target, in terms of soya of one million tonnes to be produced by 2015 (500 000 ha at two tonnes/ha) and 2,5 million tonnes by 2020 (one million ha at 2,5 tonnes per ha). It seems as if the 2015 targeted yield will be reached earlier than expected. The target of 500 000 hectares has already been exceeded.

Local soya oilcake, as a proportion of the total oilcake consumption in South Africa, has increased over time. Currently it comprises 69% of total oilcake consumption. If it is assumed that this will increase to 75% of oilcake consumption in 2015, it implies a demand for 1 587 282 tonnes soya oilcake in 2015. The demand for soya oilcake in 2020 and 2025 respectively will be 1 766 795 and 1 974 453 tonnes. Translated into whole soybeans, it means a demand for 1 984 103 tonnes in 2015, with a corresponding demand for 2 208 494 and 2 468 066 tonnes soya in 2020 and 2025 respectively. These figures do not include soybeans for human consumption and exports.

5. PROJECTS FINANCED 2012/13

During 2012/2013, the Protein Research Foundation funded 19 research projects (See Annexure I), one (1) more than the previous year. Seven (7) of the 19 projects were new, while 12 were continuations of existing projects. A total of 23 funding applications were received. Four (4) were declined.

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 2013/2014, the PRF received 23 applications. Three (3) of those were new applications. These applications will be described in the next research report.

6. PROJECTS FINALISED SUCCESSFULLY OR THAT SHOWED PROGRESS (Annexures I and II)

6.1 EVALUATION OF PRF-SOYBEAN ELITE LINES UNDER SOUTH AFRICAN CONDITIONS: Messrs GP De Beer and WF van Wyk, Contracter, Protein Research Foundation

- **Trial 1: (INTA)**

Three replications of fifteen (15) genotypes, which included maturity groups 4 to 7, were planted in four 45 cm rows, 5 m in length, on 10/12/2012. Six (6) local cultivars from Pannar and Link Seed were included as controls for each maturity group.

- **Trial 2: (EMBRAPA)**

Three replications of nine (9) genotypes, which included maturity groups 4 to 8, were planted in four 45 cm rows 5 m in length on 12/11/2012. Six (6) local cultivars from Pannar and Link Seed were included as controls.

- **Trial 3: (VIÇOSA)**

Three replications of ten (10) genotypes, which included maturity groups 4 to 7, were planted in four 45 cm rows 5 m in length on 12/11/2012. Six (6) local cultivars from Pannar and Link Seed were included as controls.

- **Trial 4: (EEAOC)**

Three replications of 16 genotypes, which included maturity groups 4 to 7, were planted in four 45 cm rows 5 m in length on 2/11/2011. Six (6) local cultivars from Pannar and Link Seed were included as controls.

- **Trial 4 extra: (EEAOC)**

Three replications of fifteen (15) genotypes, which included maturity groups 4 to 8, were planted in four 45 cm rows 5 m in length on 3/11/2011. Six (6) local cultivars from Pannar and Link Seed were included as controls.

- **Trial 5: (CHINA)**

Three replications of twelve (12) genotypes, which included maturity groups 4 to 8, were planted in four 45 cm rows 5 m in length on 13/12/2011. Four (4) local cultivars from Pannar and Link Seed were included as controls.

Eighteen (18) different data sets were taken of each of these genotypes before threshing and five (5) after threshing.

The best yields achieved in the different trials were 4307 kg/ha for J102515 in trial1, 4935 kg/ha for LS 6146 R in trial 2, 4325 kg/ha for CDX 10-105 in trial 3, 4010 kg/ha for MDAT-640-5I in trial 4, 4323 kg/ha for 580-5I in trial 4 (UP-Only) and 4168 kg/ha for PAN 1664 R in trial 5. Notice that in two of the six trials our local cultivars had the best yields.

6.2 NATIONAL SOYBEAN CULTIVAR TRIALS: Messrs JL Erasmus, NN Mogapi, HSJ Vermeulen and TC Ramatlotlo; ARC-Institute for Grain Crops

A total of 36 cultivars were evaluated (2007/08 to 2011/12 season) in 146 field trials distributed over the production area representing the cool-, moderate- and warm areas. Conventional as well GM cultivars were included in the trials which were executed in a conventional manner (i.e. no Roundup application). 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 measured and the yield reliability of cultivars calculated. Yield reliabilities serve as guidelines for cultivar selection. The mean number of days from planting to 50% flowering of cultivars for the cool-, moderate and warm areas was respectively 75, 62 and 53 days.

The overall mean yield was 2 302 kg ha^{-1} for the cooler areas, 2 392 kg ha^{-1} for the moderate and 3 195 kg ha^{-1} for the warm areas. Cultivars with a high stability are

important in the selection of cultivars by producers due to the reliability of the expected future yield. Cultivars which had high stabilities over the reporting period were PAN 535 R, PAN 737 R and Dundee for the cooler areas, A5409 RG, Heron and LS 6161 R for the moderate areas and, PAN 737 R and LS 6150 R for the warmer areas. Cultivars with an above average reliability at yield targets from 1000 to 4 000 kg ha^{-1} for three seasons or more can be considered the long-term high performers and deserve special mentioning. These cultivars were PAN 1583 R for the cooler areas, PAN 1666 R, PAN 1454 R, PAN 1583 R , PAN 1664 R and LS 6150 R for the moderate areas as well as LS 6150 R, LS 6161 R, PAN 737 R, PAN 1664 R and Heron for the warmer areas.

6.3 INCREASING SOYBEAN PRODUCTION ON THE HIGHVELD: Mr WF van Wyk, Contractor, Protein Research Foundation

- **Cultivation methods with different rotation systems**
  Bold printed treatment is the treatment for the prevailing season.
  Treatments: Plough (soya, soya, soya, **soya**) **-** (soya, maize, soya, **maize**) - (maize, soya, maize, **soya**), No-till (soya, soya, soya, **soya**) - (soya, maize, soya, **maize**) - (maize, soya, maize, **soya**), and disc (soya, soya, soya, **soya)** - (soya, maize, soya, **maize**) - (maize, soya, maize, **soya**). In 2009/10 a maize monoculture treatment was added to all three cultivation methods.

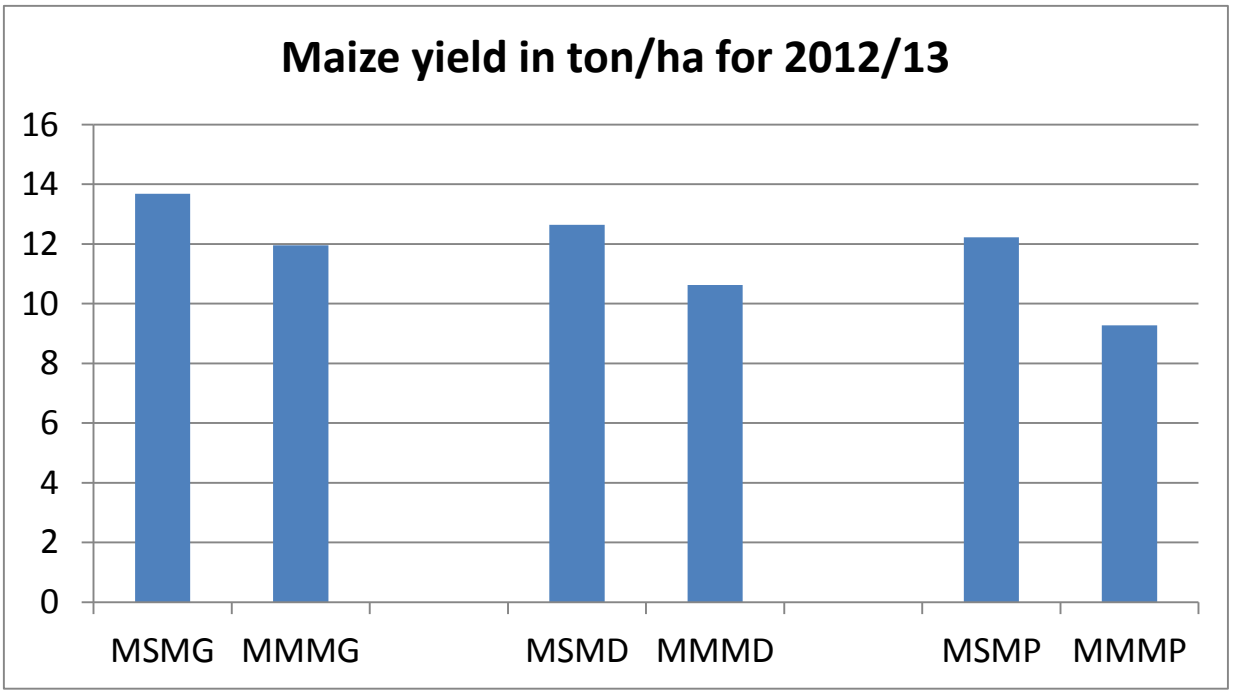


FIG. 1. Maize yield (ton/ha) for the different cultivation and rotation systems in 2012/13

According to Fig.1 above-average yields were achieved with maize in the 2012/13 season. The highest average yield was achieved where maize followed soybeans uisng no-till (13.7 ton/ha) and the lowest yield where maize followed maize using plough cultivation (9.2 ton/ha).

The soybean yields are shown in Figure 2.

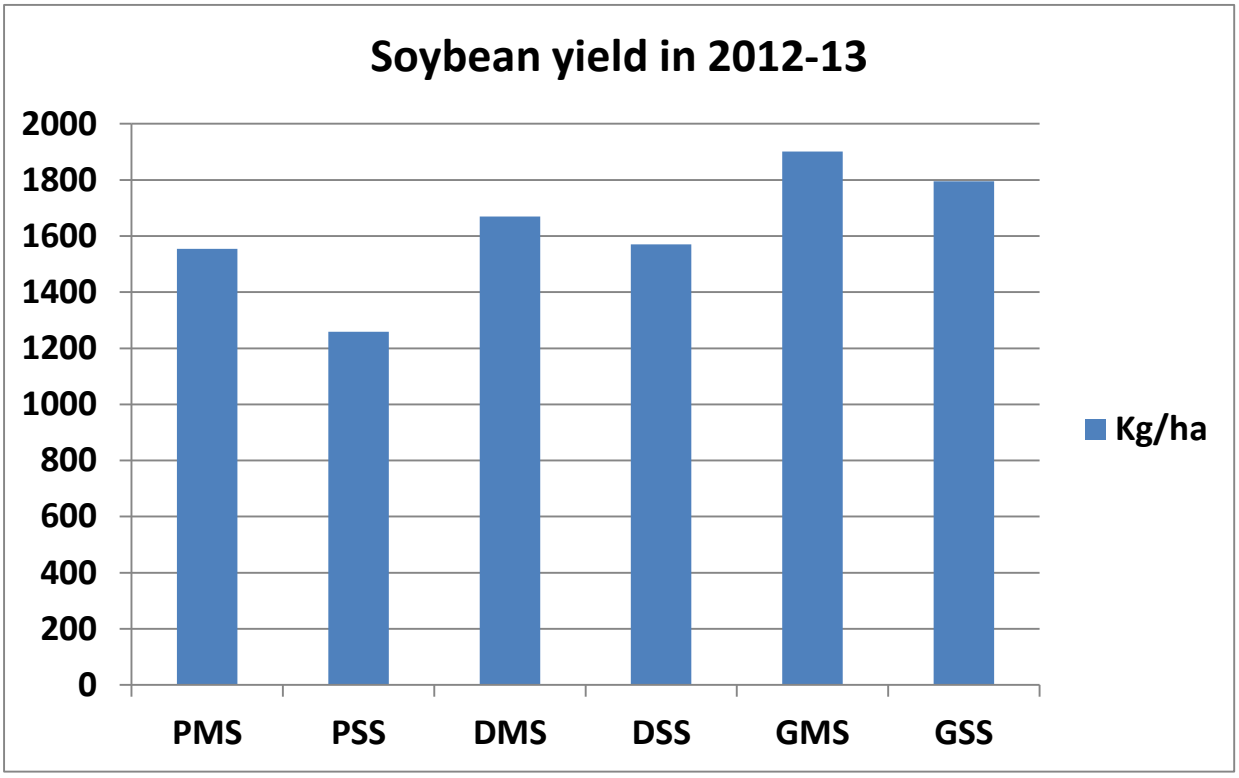


FIG. 2. Soybean yield (kg/ha) for the different cultivation and rotation systems in 2012/13

It is clear from the graph that the yield of soybeans followed by soybeans was lower than when soybeans after maize for all three cultivation methods. With no-till, both soybeans followed by soybeans and maize followed by soybeans had the best yields. Yields were low because this trial is planted under dryland conditions and the rainfall in February was low.

Maximum yield (irrigation)

This trial was not planted this year due to a problem with the irrigation system but will continue in the 2013/14 season.

Planting date trial:

Fourteen different cultivars that varied between MG-IV to MG-VII were planted on seven different planting dates in 45 cm rows. The planting dates were respectively 25/9/2012, 5/10/2012, 25/10/2012, 5/11/2012, 20/11/2012 and 30/11/2012.

In Figure 3 the number of days from planting to harvest is shown for the different cultivars for the different planting dates. It is evident that the MG-IV cultivars at all planting dates were ready for harvest in a time frame of between 130 and 148 days while the longer season cultivars were harvested between 136 to 204 days. The

variation of the longer season cultivars in terms of harvest readiness is therefore much bigger than with the short season cultivars at different planting dates.

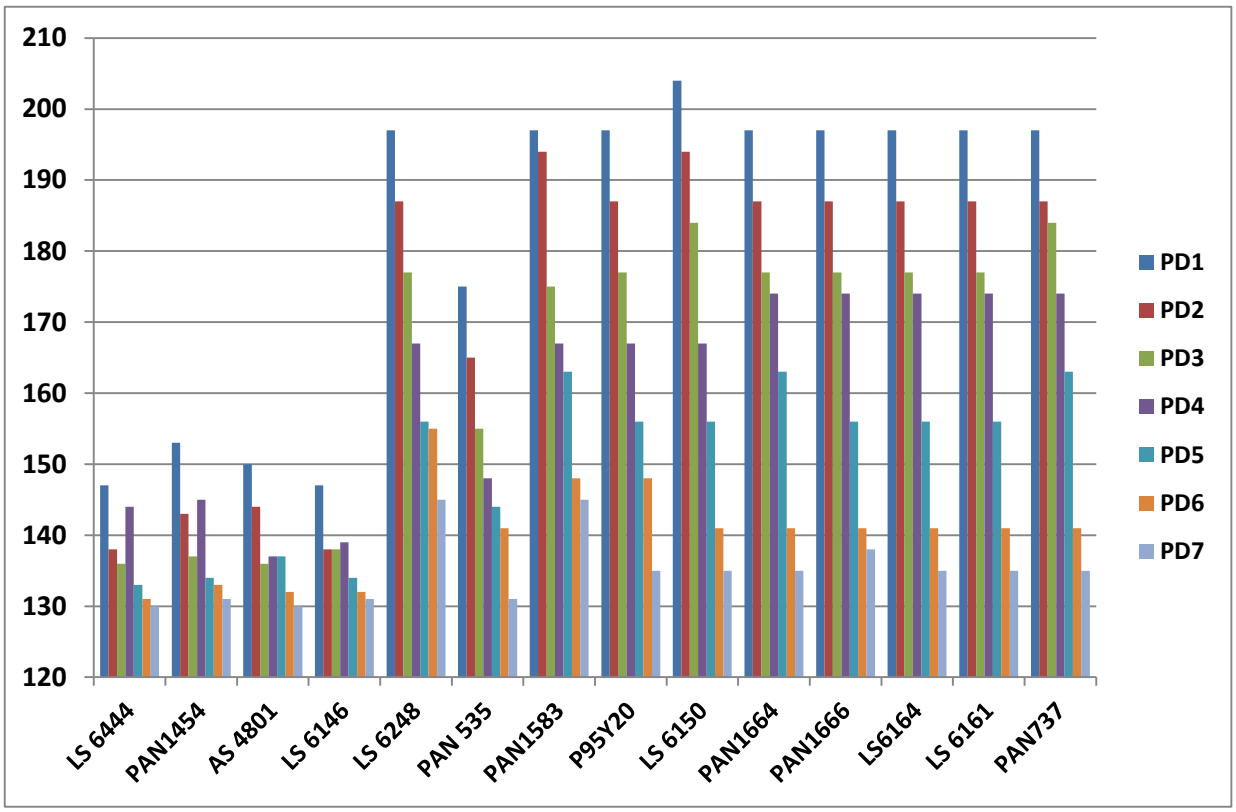


FIG. 3. The number of days from planting to harvest of 14 cultivars for 7 planting dates (PD)

The yields of the 14 cultivars at 7 different planting dates are given in Figure 4

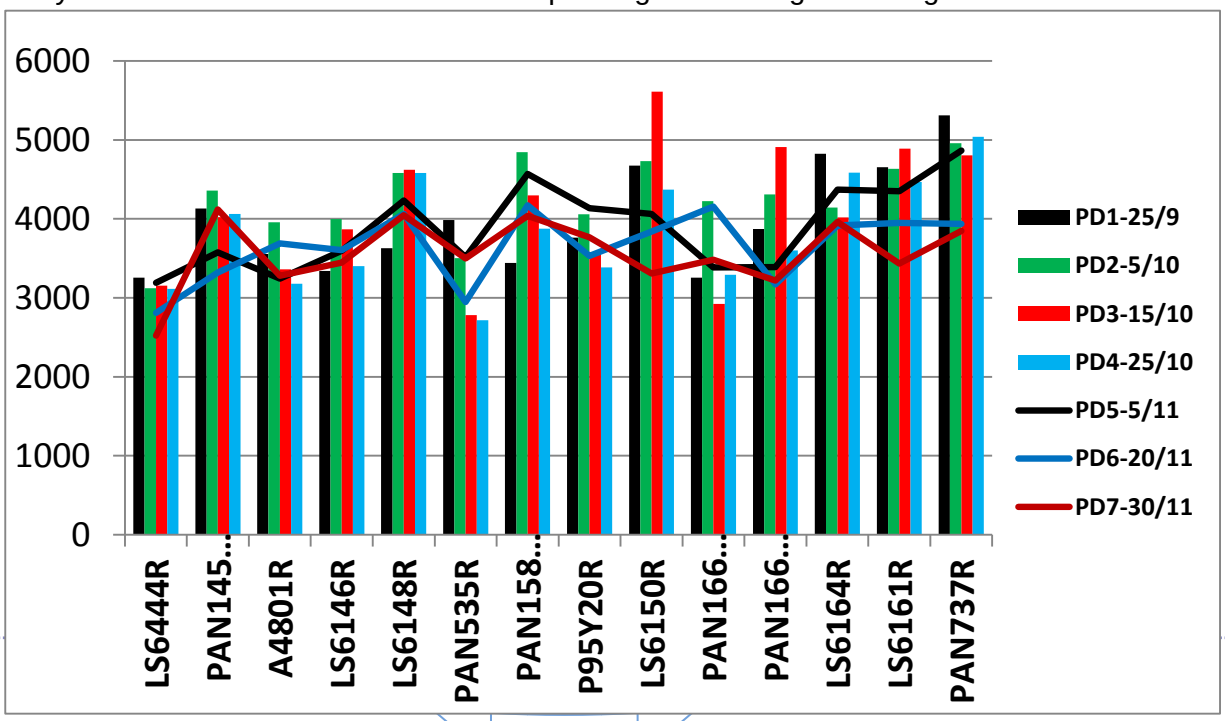


FIG. 4. Yield (kg/ha) of 14 cultivars for 7 planting dates (PD)

The early planting dates produced better yields in general than the later plantings except for certain determinate growers (PAN 1664R and PAN 535R) where yields were the same or better.

TRIALS CONDUCTED BY FARMERS:

SCLEROTINIA TRIAL AT KINROSS (VOSSTOFFEL BOERDERY)

Six companies entered different products for the control of sclerotinia this past season and are as follows:

- Philagro: Sumisclex, Sumisclex + BreakThru, Sumisclex + BreakThru as corrective treatment.
- Plant Health Products: Eco-T on seed followed by Eco-77 spray applications, Eco-T spray applications and Eco-T + Agrisil(K) spray applications and Eco 77 on seed followed by one and two spray applications with Procymidone 250 SC + BreakThru during flowering and 10 days later. .
- Stimuplant: B-Rus on seed followed by spray application during flowering (R1).
- Green Bio: Chitosan on seed followed by spray application during flowering (R1).
- Helga Dagitat: Armenius, Sparticus and T-Gro on seed.
- BASF: Bellis at respectively 600g and 1200g/ha with first flower (R1)

Controls were included between all treatments in such a way that each treatment was bordered by a control at least on one side. A short growth type (LS 6444 R) was included in the trial to “avoid” sclerotinia while a longer growth type (LS 6161 R) was used where the different biological and chemical treatments were tested.
The trial was planted on 20/11/2012 and the different treatments were applied as plants developed. There was no sclerotinia infection this season but the trial was damaged by hail on 11 May and was therefore not harvested.

PLANTING DATE AND PLANT DENSITY TRIAL AT STOFFBERG (PIET PRINSLOO AND JOHAN SCHEEPERS)

18 Cultivars were planted at three different plant densities on the 24/10/2012 and 14/11/2012 respectively at Piet Prinsloo (first planting) and Johan Scheepers (second

planting) Flowering and harvesting dates were taken as well as pod heights. The trials were harvested, threshed and all post-harvest data were taken.

In spite of a very dry season, good results were achieved, especially with respect to plant densities. The results demonstrated that some cultivars prefer higher plant densities whilst others do not. These trials were planted under no-till conditions.

It is clear that upright cultivars like LS 6444 R and LS 6146 perform better at a high plant population (520 000) than at a low plant population (400 000). It is also evident that the MG-IV and V cultivars out-yielded the long season growers and this was caused by the drought in February.

The second planting was 65 – 75% damaged by hail 10 days after emergence but some of the long season cultivars (especially the indeterminate growers) recovered well and therefore out-yielded the early cultivars.

The yields of the second planting date were considerably lower than of the first planting date but when considering the hail damage that occurred, some of the longer growers had reasonable yields.

Mr Marius van Rensburg of the Department of Agriculture at Nooitgedacht, Ermelo (Mpumalanga) was the responsible officer for the trial and he helped with the collection of flowering and harvesting data.

6.4 ESTABLISHMENT OF AN EARLY WARNING SYSTEM FOR SOYBEAN RUST: Mr GP de Beer; Contractor, Protein Research Foundation

During the 2012/13 season an early warning system was attempted for soybean rust based on trap crop trials, also referred to as indicator trials. Ten localities were identified that represented the major soybean production areas. The PRF and other co-workers such as PANNAR, the KZN Department of Agriculture and a number of soybean producers attempted to create this early warning system. The localities were Kestell (Free State), Cedara, Greytown, Normandien, Vryheid (KwaZulu Natal), Dirkiesdorp, Morgenzon and Kinross (Mpumalanga), Greylingstad (Gauteng) and Potchefstroom (North West).

As in the past the trap crop trials were planted approximately two weeks before the general soybean planting date in each region. Two round up- ready soybean varieties (PAN 1454 R, a MG 4 cultivar and PAN 737 R, a MG 7 cultivar) were planted on an area of 200 m² per site. The producers on whose properties these trials were located were responsible for planting and maintaining the trials, which were visited from the 9 January 2013 on a weekly basis. Strict sanitary protocols

were followed in the screening process in order to limit transmission of spores between trials.

Once rust was detected the relevant producer in the affected area was immediately advised to spray the trial with specific fungicides in order to ensure that the trial did not serve as a a source of infection of commercial material in the area. Rust was first found at Cedara (8 February 2013), Vryheid (9 February 2013), Dirkiesdorp and Normandien (4 March 2013). No rust was found at any of the other localities.

6.5 INVESTIGATING THE ETIOLOGY AND INCIDENCE OF SOILBORNE DISEASES OF SOYBEAN IN SOUTH AFRICA: Drs YT Tewoldemedhin and SC Lamprecht: ARC-Plant Protection Research Institute

Soybean seedlings and plants are susceptible to a wide range of soilborne pathogens, which complicates research on the etiology and diagnosis of soilborne diseases of the crop. Research in other countries showed that soilborne diseases of soybean can cause significant economic losses in most soybean growing areas of the world. Yield losses of up to 70% and in some cases plant losses and yield reduction of 100% in very susceptible soybean cultivars have been reported. In South Africa, the etiology of soybean soilborne diseases was not studied and documented prior to the study that was conducted over the past two years. It, therefore, is the first extensive survey that has investigated soilborne disease of soybean in South Africa. The study was done in thirteen national cultivar trial sites situated in soybean production localities in six provinces representing three climatic regions. The results of this study indicate that important soilborne pathogens reported in other countries were found to be associated with diseased soybean crowns and roots in soybean production areas of South Africa. The incidences of genera and species recovered were affected by area sampled, time of sampling and climate of the area sampled.

In the previous study it was concluded that the importance of all the species found in soybean production regions of South Africa should be determined on soybean as soilborne pathogens. Furthermore, the previous survey was conducted on national cultivar trial sites and concluded that the incidence and severity of soilborne diseases of soybean should be determined on commercial farmers' fields irrespective of the cultivar planted in order to determine the extent and importance of soilborne diseases in the major soybean production areas of the country. Therefore, the main objectives of the study during 2012/13 were to determine the incidence and severity of soilborne diseases of soybean in commercial farmers' fields irrespective of the cultivar planted in the major soybean production areas of the country; and to investigate the potential of all the fungal species, recovered from the previous study, as soilborne pathogens of soybean by employing pathogenicity tests on soybean seedlings under glasshouse conditions.

The identity of fungi and oomycetes associated with diseased cotyledons, crowns and roots of soybean plants were assessed in a survey conducted during the 2012/13 growing season. Soybean plants and rhizosphere soil were collected from all commercial farms that were surveyed. Plants were sampled at three growth stages (two weeks after planting, flowering and physiological maturity or seed pod filling) from twelve soybean commercial farms that represent three climatic regions (cool, moderate and warm) in five provinces of South Africa. Diseased cotyledons, hypocotyls/crowns and roots were rated for disease severity and analysed for associated mycoflora using morphological description and sequence analyses of DNA exracted from representative isolates. Soil samples collected from each area were used for glasshouse assays to determine the existence and biological nature of soilborne diseases by pasteurizing half of the soil at 83ºC and planted with soybean seeds. In addition, pathogenicity trials of all the representative species of fungi and oomycete were conducted under glasshouse condition. Pathogenicity and relative virulence of each isolate was determined by assessing the percentage survival of soybean seedlings, plant length and crown and root rot severity three weeks after planting.

From the survey conducted the highest crown and root rot ratings were recorded at Brits, Bothaville and Clocolan, while Brits, Clocolan and Vryheid had the highest cotyledon rot severity. The highest crown rot severities were recorded at the third sampling time. Root rot severity was high at Clocolan throughout the season (all the three sampling times).

A total of 6860 fungal isolates was recovered from cotyledons, crowns and roots. The fungal isolates were from 29 fungal genera. The most frequently isolated fungal genera and species included *Alternaria* spp*., F. equiseti, F. oxysporum, F. solani, Gliocladium* spp*., Macrophomina* spp*., Phoma* spp*., Phomopsis* spp*., Pythium* spp*., Rhizoctonia spp., Trichoderma* spp*.* and *Sclerotium* spp*.* In addition, *Sclerotinia* isolates were recovered from diseased soybean stems and crowns. The incidences of genera and species isolated were affected by area sampled, time of sampling and climate of the area sampled.

In this study, close to 60% of all isolates obtained belonged to the genus *Fusarium* of which *Fusarium oxysporum* was the dominant species with more than 40% of the isolates recovered belonged to this species. The second most dominant species within the genus *Fusarium* was *F. solani*. *Fusarium equiseti* was also amongst the frequently isolated species within the genus. *Fusarium solani* isolates recovered in this study do not have 100% sequence similarity with the sudden death syndrome causing species (*Fusarium virguliforme* formally known as *F. solani* f. sp. g*lycines*, *F. tucumaniae, F. brasiliense* and *F. crassistipitatum*). However, some *Fusarium* isolates obtained from a farm in Lydenburg (Mpumalanga), with typical sudden death symptoms on the plants, had 99% similarity with *Fusarium virguliforme* based on one

gene area. Further study is being under way to confirm whether these isolates are one of the sudden death causing species.

Glasshouse assays revealed that the survival of soybean seedlings grown in pasteurized field soils collected from all the farms sampled significantly improved, though with varying degrees at each sampling time. The surveys conducted during the 2012/2013 growing season confirmed that the fungi reported as soilborne disease causing organisms in other countries are found associated with diseased cotyledons, crowns and roots of soybean in South Africa, but some fungi were also reported on soybean for the first time.

Pathogenicity assays using 46 *Rhizoctonia* isolates, representing the eight anastomosis groups (AGs) and the unidentified multinucleate *Rhizoctonia*, showed that the multinucleates AG-2-2 IIIB, AG-4 HG-III, AG-4 and one unidentified multinucleate *Rhizoctonia* were pathogenic, since they reduced survival of soybean seedlings and caused significantly more hypocotyl and root rot. Even though *R. zeae* and a few isolates of AG-Ba did not cause pre-emergence damping-off, they caused significant hypocotyl and root rot compared to the control. This study showed that pathogenic *Rhizoctonia* species and AGs occur on soybean in all production areas in South Africa. Other pathogenicity trials are being under way and the results will be reported shortly.

This is the first extensive survey on commercial soybean farms to have investigated soilborne diseases and associated pathogens of soybean in South Africa. The survey conducted on commercial farmers' fields during the 2012/2013 season should be repeated during 2013/2014 to confirm results and to ensure that all the fungi and oomycetes associated with diseased cotyledons, crowns and roots of soybean are identified for further studies. This will also determine the focus of future research to develop management strategies against the most important soilborne diseases of soybean in South Africa.

6.6 INSECT BIODIVERSITY AND ABUNDANCE IN SOYBEANS (*GLYCINE MAX*): Ms JM Truter, ARC- Grain Crop Institute, Potchefstroom

The importance of soybeans has increased over the past few growing seasons in South Africa, due to its suitability as a rotation crop with maize. As a result of this production increase it is important to assess arthropod biodiversity in soybean and to determine base line data for future use in assessments of the possible effects of genetically modified soybean or changes in crop production practices on arthropod communities. A better understanding of the species that occur on soybeans may also assist in the development of integrated pest management strategies.

Several arthropod biodiversity studies have been conducted internationally related to biodiversity in soybeans, but a lack of similar information exists in South Africa. Rawat and Kapoor (1968) reported 273 insect species to attack soybeans. In Nigeria 24 insect pest species were recorded (FMARD, 2002), in the tropics 84 insect species caused damage (Jackai *et al*., 1990) and in India 20 pest species were recorded (Singh & Singh, 1990). From these studies it can be concluded that the complex of insects that inhabit soybeans is large and diverse. It must be accepted that any crop expansion is usually accompanied by increased levels of pests, thus necessitating increased awareness for potential future threats (Van Wyk & Smit, 2010).

The aims of the study were to compile a list of arthropods which occur on soybean plants and to compare the diversity and abundance of arthropods on herbicide-tolerant and conventional soybeans. Future pests and possible economically important arthropods were identified from the list through an environmental risk assessment model approach.

In Brits four herbicide-tolerant soybean fields and in Potchefstroom one herbicide-tolerant as well as one conventional soybean field was sampled. Conventional fields were not available in the Brits area and therefore no comparative study could be made between the two sites in Potchefstroom and those in Brits. Two methods of collection were used, i.e. pitfall traps and a D-Vac for suction sampling. Both above-ground and ground-dwelling arthropods were sampled. Thirty pitfall traps were placed randomly in each field to sample ground-dwelling arthropods, which was left in the field for one week before collection. The D-Vac method (Kruger *et al*., 2008) was used to collect the above-ground arthropods. Five replications of 5 m rows were sampled in each field. The D-Vac bags and its contents were placed into a plastic bag and kept for 2 days in a refrigerator. Collection of samples was done once a week for a period of a month (February-March). Growth stage of the soybean was between R5-R6. Species were sorted to morpho-species and identified to at least order and family level. The morpho-species were also grouped into the following functional groups: detritivores, herbivores, predators and parasitoïds. The herbivores and predators were further divided on the basis of feeding strategy into sucking herbivores/predators (piercing-sucking mouthparts) and chewing herbivores/predators (chewing mouthparts). Statistical analyses were done with the total arthropod diversity and for the different functional groups. The Shannon and Margalef indices, the total number of species as well as the total number of individuals were compared between soybean varieties (herbicide-tolerant vs. conventional). The Shannon diversity index (H^1) describes diversity (species richness and evenness), whereas the Margalef richness index (d) describes species richness. The statistical analysis was only done for the Potchefstroom site as no conventional fields were available for the Brits area.

The diversity of arthropods collected during this study was high. A total of 6,175 arthropod individuals, comprising 169 morpho-species were collected during this study. In Brits a total of 4,543 arthropod individuals consisting of 118 morpho-species and in Potchefstroom a total of 1,632 arthropod individuals consisting of 129 morpho-species were collected. The 169 morpho-species consisted of 13 orders. Only 44.3% of these species occurred in both localities. The most abundant arthropods and species found on soybeans and which should be considered in a risk assessment are listed in Table 1.

The diversity indices indicated no differences between herbicide-tolerant and conventional soybeans for total arthropod diversity in Potchefstroom. There was also no significant difference between number of species, but there was, however, a significant difference for the number of individuals between herbicide-tolerant and conventional soybeans ($p=0.01$) in the Potchefstroom area.

Initial results indicate that herbicide-tolerant soybeans do not have an effect on arthropod diversity or on the different functional groups. Additional research over various seasons is, however required to confirm this observation. This study provides a baseline in biodiversity of arthropods on soybeans in South Africa and generates a basic checklist of these species that can be used in an integrated pest management system.

Knowledge and understanding of the entire soybean system, not the pests alone, and of the influence of herbicide-tolerant cropping systems on the occurrence, density and behaviour of pest and beneficial arthropods in soybeans must increase if integrated pest management systems for soybeans are to be developed and implemented (Jackai *et al*., 1990; Jackson & Pitre, 2004).

Table 1. Functional groups and abundance of arthropods that should be considered in an environmental risk assessment of soybeans.

		Most abundant species per functional group			
Functional group	**Species per group**	**Order**	**Family**	**Genus/ Morpho spp.**	**Total individuals**
Detritivores	18	Diptera	-	Diptera sp. 6	167
Sucking herbivores	34	Hemiptera	Cicadellidae	Cicadellidae sp. 2	111
Chewing herbivores	38	Coleoptera	Chrysomelidae	Chrysomelidae sp.1	66
Sucking predators	15	Hemiptera	Miridae	*Deraeocoris* sp. 1	45

Chewing predators	54	Hymenoptera	Formicidae	Formicidae sp. 1	3 386
Parasitoïds	13	Hymenoptera	-	Hymenoptera sp. 2	49

6.7 INVESTIGATING ENZYME ACTIVITY AS A NEW TOOL TO FACILITATE RAPID IDENTIFICATION OF ROOT-KNOT NEMATODE RESISTANCE IN SOYBEAN GENOTYPES: Prof H Fourie, Ms C Venter and Mr J Berner, School for Biological Sciences, North-West University, Potchefstroom

Root-knot nematode resistance levels of local soybean cultivars that continuously enter the market must be available to producers. The use of host plant resistance is currently one of the few cost-effective and environmentally-friendly management strategies to minimize yield losses since no nematicides (synthetic and/or biological) are currently registered locally for use on the crop. Classical assays to determine the host suitability of soybean cultivars to *Meloidogyne* spp. are elaborate, laborious, time-consuming and strongly influenced by environmental conditions and nematode genetic variability. This project thus focusses on the use of biochemical markers, which include the most recent deoxyribonucleic acid (DNA) technology, to enable identification of root-knot nematode resistance in soybean. These include phenotypic markers based on proteins and/or enzymes associated with the resistance status or response to nematode infection, *viz*. catalase (CAT), lipoxygenase (LOX) and peroxidase (POD). Results obtained as a result of screening trials that were conducted with *M. incognita* showed that substantial variation existed among the 24 cultivars with regard to their host status to this root-knot nematode species. Gall rating indices obtained 30 days after inoculation (DAI) indicated that the resistant standard LS5995 as well as cultivar PHB95Y20 had similar and significantly lower index values compared to the other 22 cultivars screened. Although significant differences were evident among the latter 22 cultivars they all exhibited high gall rating indices with PAN1666R having the highest, followed by Sonop and A5409RG. Furthermore, all nematode parameters that were determined indicated that cultivar LS5995 was the poorest host to *M. incognita* with an Rf value of <1, indicating resistance. In contrast cultivar LS6248R was the most susceptible, followed by Dundee and LS6164R. For the traditional screening techniques used, results obtained thus far indicate that gall ratings do not correspond with egg and second-stage juvenile (J2) counts/root system and per g of root and also not with Rf values that were determined. The traditional method of using gall ratings at an early growth stage of soybean plants therefore is not an option to use in order to accurately identify poor hosts of *M. incognita*. In terms of enzyme activity measured, CAT results were highly variable and do not warrant further discussion. Initial results with LOD and POD on the other hand showed a 40% and 20% increase in activity for the respective enzymes for *M. incognita*-infected LS5995 plants compared to uninfected plants.

6.8 CULTIVAR EVALUATION OF OIL AND PROTEIN SEEDS IN THE WINTER RAINFALL AREA: Mr PJA Lombard, Western Cape Department of Agriculture

The Western Cape Department of Agriculture conducted a range of cultivar trials during the 2012 season in the Western and Southern Cape (Rûens). In the Southern Cape eight trials were planted and the data sets of five trials were used. Three trials were lost due to bird damage (wildemakoue), fall over because of blackleg and too wet conditions at Tygerhoek. In the Swartland seven trials were planted at six locations and six sets of data were used (wildemakou damage at Grasrug).

The past season was characterized by very good moisture conditions in both the Swartland and Rûens. At both areas, above average rainfall occurred during the spring which caused an extended growing season (by a few days). The exception was Pools in the Swartland with below average rainfall.

In the Swartland, the average yield was significantly higher in 2012 (2300 kg ha^{-1}) than in 2010 and 2011 (1840 kg ha^{-1} and 1923 kg ha^{-1}). The trial result from Pools differed significantly. The TT cultivars had a very low yield while four cultivars yielded over 2000 kg ha^{-1}. The trial average (despite the low TT yields) was 1344 kg ha^{-1}.

The mean trial yields varied between 1344 kg ha^{-1} (Pools) and 3124 kg ha^{-1} (Langgewens 1st planting on the 9th of May). The yield of 1st planting at Langgewens was 4% higher than the 2nd planting (23 May). The small difference can be attributed to favourable climatic conditions during seed fill stage.

Hyola 50 (2948 kg ha^{-1}) was on average the best conventional cultivar and Hyola 575 CL (2850 kg ha^{-1}) the best CL cultivar. The CL cultivar, 46Y83 (2755 kg ha^{-1}) has the 3rd highest seed yield, however significantly lower than Hyola 50. The seed yield of Agamax, Hyola 571CL and 45Y86 returns were significantly lower than those of Hyola 575 CL.

In the TT group, the two hybrids Hyola 555 TT (2392 kg ha^{-1}) and Tumby HT (2177 kg ha^{-1}) gave the highest yield (all the trials). The seed yield of Hyola 555 TT was significantly better than the other cultivars in the TT group. The yield of the TT cultivars (1969 kg ha^{-1}) was on average 25.6% lower than the conventional cultivars (2647 kg ha^{-1}) (24.6 in 2011 and 25.26% in 2010). The average yields of the CL cultivars were 7.1% lower than that of the conventional cultivars.

In the Rûens the average yield per trial ranged from 3062 kg ha^{-1} at Klipdale to 1855 kg ha^{-1} at Tygerhoek 1. The data from the Tygerhoek trial (early planting) are included; the yield was less than expected due to very wet conditions. The average yield of TT cultivars was 17.5% (22.1% in 2010 and 11% in 2011) lower than the

average of the conventional cultivars. The seed yield of the CI group was only 0.2% better than the conventional group (10% in 2011).

The CL cultivar 46Y83 (3194 kg ha^{-1}) and the conventional cultivar Hyola 50 (3.193 kg ha^{-1}) had the highest average yield in Rûens. In the TT group, the two hybrids Hyola 555 TT (2553 kg ha^{-1}) and CB Jardee HT (2518 kg ha $^{-1}$) gave the highest seed yield.

6.9 BORON REQUIREMENTS OF CANOLA: Prof GA Agenbag and Mr E Kempen, University of Stellenbosch

Boron is one of the eight essential micronutrients required for normal growth and development of most plants. Deficiency of boron can cause reductions in crop yield, impair crop quality or have both effects, due to its role in various metabolic processes and pollination. Boron deficiencies may result in sterility or low germination of pollen. Like all its relatives in the Brassica family, canola has a very high boron requirement and needs more boron through all growth stages (vegetative and reproductive) than most other crops. However, high levels of boron may be toxic to plants, and crops differ with regard to sensitivity. Little research has been done previously in the Western Cape on boron requirements of canola and although some canola producers do apply boron, recommendations are based on research done on cereal and vegetable crops and have not been verified for canola.

Field trials were conducted during 2012 at Altona and Langgewens Research Farm in the Swartland and Roodebloem in the Southern Cape on soil with deficient (< 0.30 mg kg^{-1}) or low (0.30-0.50 mg kg^{-1}) boron contents. Boron, at rates of 0, 0.5, 1.0 and 1.5 kg Solubor ha^{-1} were applied 40 days after planting (DAP), 60 DAP or 40 and 60 DAP. Due to a long rainy season and generally cool climatic conditions during the grain filing stages, high grain yields of more than 2000 kg ha^{-1} were obtained at Altona and Roodebloem. Smaller grain kernels (lower thousand grain weight) at Langgewens indicated less favourable conditions during grain filling which resulted in lower grain yields and lower oil and protein contents. Solubor (boron) applications resulted in significantly higher grain yields in all localities. Optimum application rates differed between localities and seem to correlate with boron content of the soil, while application rates of 2-3 kg Solubor ha^{-1} showed reduced yields (toxic effects) at all localities. No significant differences were obtained between Solubor applications at 40 or 60 days after planting in 2012. It was however clear that splitting the application between 40 and 60 days after planting did not result in higher grain yields. Solubor (boron) applications had very little effect on oil or protein content of the grain.

6.10 PLANT DENSITY OF CANOLA: IMPACT ON THE SUPPRESSION OF WEED AND YIELD OF CANOLA IN THE SWARTLAND: Dr PJ Pieterse, University of Stellenbosch

The aims of the study are 1) to study the effect of plant density on the suppression of weeds (biomass) by different canola cultivars in the Swartland and Southern Cape and 2) to study the effect of plant density on the development (flowering date, physiological ripening date), growth (biomass of reproductive versus vegetative components), plant length, yield and quality of different canola cultivars in the Swartland and Southern Cape canola production areas. Field trials were planted on the Roodebloem experimental farm (Southern Cape) and the Langgewens experimental farm (Swartland) respectively. In one set of experiments at each locality the recommended weed control programs were followed to create a weed-free environment. In the second set of experiments no weed control (except for non-selective herbicides before planting) were carried out to determine the weed suppressive effects of the different canola cultivars. The treatments were as follows: a) 4 cultivars (1 open pollinated and 1 hybrid cultivars each of the TT en Clearfield types) (CB Jardee, Bravo, 43c80 en 45y82) were planted and b) sowing densities were manipulated with the aim of achieving 4 plant densities (30, 60, 90 en 120 plants m^{-2}). Plant samples (canola and weeds) were taken about 60 and 90 days after establishment and the dry mass was determined. Yield and physiological ripening date of the canola seed were determined as well as crude protein and crude fat content. Preliminary results showed, as expected, that the weed infested trials had a much lower plant density as well as biomass production of canola plants. There are however, no clear trends in terms of the effect of cultivar or plant density on weed suppression or yield. There are however still results that need to be statistically analyzed and these results may clarify the picture. The research will be continued in 2013 and 2014.

6.11 CHEMICAL OPTIONS FOR WEED CONTROL IN GM-CANOLA: Dr PJ Pieterse, University of Stellenbosch

The aims of the project are: 1) to determine the effect of applying different doses of glufosinate ammonium (Basta®) to ryegrass and wild radish (ramenas) seedlings at different growth stages in order to investigate the possible use of more economic but effective dosage rates and 2) to determine the efficacy of glyphosate, glufosinate ammonium, atrazine and imazamox (Cysure®) and mixtures of these herbicides with the pre-emergence herbicide propyzamide (Kerb®) that can be applied after establishment of canola in terms of immediate as well as residual weed control. The four herbicides were selected because canola cultivars resistant to atrazine and imazamox are already available in South Africa and it is expected that GM canola cultivars resistant to glyphosate (Roundup Ready® cultivars) and glufosinate ammonium (Liberty Link® cultivars) will be released in South Africa in the not too

distant future. Glasshouse trials on ryegrass (a commercial pasture cultivar as well as a weedy accession from the field) showed that satisfactory control (>90%) could be obtained with 2.5 L ha^{-1} of glufosinate ammonium on plants ranging in age (size) from 2 weeks to 10 weeks. Therefore the statement from literature that weed size plays an important role in glufosinate ammonium efficiency could not be confirmed for ryegrass. Likewise the need to apply 5 to 7.5 L ha^{-1} of glufosinate ammonium (the registered dose in South Africa) to control ryegrass was also not confirmed. However it must be taken into consideration that these trials were carried out under favorable conditions in a greenhouse and should be tested in the field. Field trials showed that the best results in terms of weed control were obtained by applying glyphosate at 1.5 L ha^{-1}, followed by atrazine at 2.5 L ha^{-1} , glufosinate ammonium at 7.5 L ha^{-1} and imazamox at 1.2 L ha^{-1}. Addition of propyzamide did not have any effect on the efficiency of the herbicides. The trials will be repeated in 2013 and 2014.

6.12 EVALUATION OF SHORTENED CANOLA PRODUCTION PERIODS AND THE USE OF ALTERNATIVE CROPS ON THE SUSTAINABILITY OF WINTER GRAIN PRODUCTION UNDER CONSERVATION AGRICULTURAL PRACTICES IN THE RIVERSDALE FLATS: Dr JA Strauss and Mr W Langenhoven: Directorate: Plant Science, Western Cape Department of Agriculture

2012 was the first 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.
All trial areas were planted and managed according to the planned protocols (including appropriate weed, disease and insect control measures).

Riversdale received adequate rainfall during the season, which resulted in above average canola yields. No other cash crop was harvested due to a management decision to kill off the growth of wheat, barley and lupin in mid September to control a possible serious weed issue.

Canola production - Canola (AGAMax) was planted at Riversdale at 2.7 kg/ha.

A total of 58 kg N/ha was applied to each plot (20kg N/ha at planting and 38kg N/ha top-dressings). Canola yields at Riversdale averaged 1804 kg/ha with all plots showing oil yield above 40%.

Economics - Crop production data from the Riversdale site has not been captured at the writing of this report. Since the decision to kill the other cash crops was a drastic measure to ensure a weed-free trial site (a decision no farmer will do on his whole farm), an economist will be advising us how to handle the economics for each cash crop to be able to compare the systems with each other.

6.13 SULPHUR (S) AND NITROGEN (N) REQUIREMENTS OF CANOLA: Prof GA Agenbag and Mr E Kempen, University of Stellenbosch

It is generally known that in comparison to wheat, canola needs approximately double the amount of nitrogen (N), phosphorus and potassium and more than three times the amount of sulphur (S) to produce a tonne of grain. For this reason the application of sulphur fertiliser to canola is very important to ensure high yielding crops. Research started during 2012 at three localities in the Western Cape aiming at the establishment of optimum nitrogen and sulphur application rates, optimum application times and the evaluation of different sources of nitrogen and sulphur.

Due to the growth conditions in 2012 which favoured high yielding crops, grain yields increased significantly due to increased nitrogen application rates (0, 40, 80, 120 and 160 kg N ha^{-1}, applied as LAN) at all localities. Yield responses to nitrogen were however increased when sulphur (0, 30 and 60 kg S ha^{-1}, applied as gypsum) was applied as well. For this reason, highest yields of 2573 kg ha^{-1} at Altona, 2173 kg ha^{-1} at Roodebloem and 1938 kg ha^{-1} at Langgewens were obtained with rates of 120-160 kg N and 30-60 kg S ha^{-1}. In general, yields obtained with 30 and 60 kg S ha^{-1} did not differ significantly.

In a second trial, three S rates (0, 30 and 60 kg S ha^{-1}, applied at planting or divided between planting, 30 and 60 days after planting) were evaluated in combination with three N rates (0, 80 and 160 kg N ha^{-1}). In contrast to Langgewens, grain yields at Altona and Roodebloem were generally increased by splitting the sulphur application between planting, 30 and 60 days after planting. According to literature, sulphur may yield good results when applied as a top dressing during the growing season of canola. Because Langgewens received less rain compared to the other localities, poor results at Langgewens may be due to the poor solubility and as a result slow reaction time of gypsum (which was used as a source of sulphur). This conclusion was however not supported by the results of an experiment where different sources of nitrogen and sulphur were compared, because no differences in yield with Urea-S compared to gypsum (plus LAN) as sources of sulphur were recorded at any locality during 2012.

To determine the effect of different growing seasons, the trials will be repeated during 2013.

6.14 ENHANCEMENT OF CANOLA AS A ROTATION CROP WITHIN A CONSERVATION SYSTEM IN THE DRY-LAND AREAS OF THE SWARTLAND USING A COMPETITION BETWEEN PRODUCERS: Mr IF Slabbert, Western Cape Department of Agriculture

Fourteen producers entered and all were evaluated. The entrants included four participants in the Malmesbury area, three in the Moorreesburg area, three in the Piketberg area, three in the Hermon area and one near Durbanville. It was an outstanding season. Rainfall distribution was very good. Initially very little rain fell, but as the plants grew, more rain fell in all areas. It remained relatively cool during the main flowering time in August.

No special group events were convened, but at the September SKOG day, demonstration and cultivar trials were viewed. Visits were arranged to various farms where canola had been planted, to provide advice to the farmers.

The average 2012 yield was 1,81 tonnes per hectare. In 2011 the average yield was 1,64 tonnes per hectare. This means that the average yield was 0,17 tonnes more than that of the previous year and was the highest yield recorded since inception of the competition in 2001.

The highest yield, of 2,46 tonnes per hectare, was achieved by Mr AJ Louw of Malmesbury. The second highest yield was recorded by Mr Boet Le Roux, at 2,247 tonnes per hectare. Mr AJ Louw also achieved the highest gross margin of R6 996 per hectare, while Mr Boet Le Roux achieved the second highest gross margin of R4 779 per hectare. Mr Isak Smit, farming in the Eendekuil area achieved the best yield of 9,19 kg/mm rainfall during the season.

6.15 ENHANCEMENT OF CANOLA AS A ROTATION CROP WITHIN A CONSERVATION SYSTEM IN THE DRY-LAND AREAS OF THE SOUTHERN CAPE USING A COMPETITION BETWEEN PRODUCERS: Mr JG Loubser, Contractor, Protein Research Foundation

Thirty producers entered the Southern Cape Canola competition in 2012. The information from all the entrants was processed and included in the report. The results were released and discussed on 26 February 2013 at the annual Overberg Agri Pre-planting Information Day held at Rietpoel near Caledon.

The results were individually discussed with each participant after the Information Day.
The rainfall distributions (mm) for five weather stations were discussed. The weather stations are Voorstekop (Heidelberg), Shildskloof (Rietpoel), Napky (Swellendam), Uitkyk (Riversdal) and Dunghye Park (Caledon).

The rainfall for March and April was above the long-term average. The rainfall was well distributed. The Canola seeds which were sown sprouted after 7 to 10 days.
For the month of May the rainfall was above the long-term average at Voorstekop but below average at the other four stations.The rainfall for June was above average for Voorstekop, Rietpoel and Uitkyk but below the average at Dunghye Park and Napky.
In July the rainfall changed and was above average in Rietpoel, Napky and Uitkyk and below the average in Voorstekop and Dunghye Park.

Only at Dunghye Park was the rainfall below average in August with all other stations recording above-average rainfall, and in September the above-average rainfall continued at all stations other than Voorstekop. Temperatures in August and September were relatively low which softened the effect of the low rainfall on seed forming.

The average canola producers' price was R4,392 per ton and the average yield was 2.17 ton per hectare. The average gross margin was R5 634 per hectare.

Agri Dwala (Pty) Ltd of the farm Jafters Krantz near Napier was the participant with the highest yield (3.345 tons/ha) and the best gross margin (R10,169 /ha).

Agri Dwala (Pty) Ltd of Napier was the participant who managed rainfall most effectively with a yield of 9,114 kg seed per millimetre of rain.

6.16 INCOME AND COST ESTIMATES FOR SOYBEANS, CANOLA AND CERTAIN COMPETITIVE CROPS, Messrs JSG Joubert and SG Ferreira

During the year under review income and cost estimates for selected crops and respective regions within the summer and winter rainfall areas were calculated as had been done in previous reporting years. Apart from the income and cost aspects, the information includes costs to produce a crop, but also the relative profitability of certain competitive crops in terms of gross margin (gross income less variable costs). The estimates are prepared to keep the PRF informed of the relative profitability of promoted crops to achieve the PRF vision and mission. The information is also available to producers for calculating comprehensive farm and cash flow planning. In addition, the information may be used to calculate credit requirements for the farming enterprise. Advisers and contractors/consultants may use the available information in the broader advisory environment and actions. The respective areas and crops included in the summer and winter rainfall calculations are shown in Tables 1 and 2.

TABLE 1: COST AND INCOME ESTIMATES WITHIN THE SUMMER RAINFALL AREA ACCORDING TO CROP AND REGION

Area	Irrigation/ Dry land	Maize	Soybeans	Wheat	Canola	Groundnuts	Sunflowers
GWK							
Central irrigation regions	Irrigation	X	X	X	X	X	
KwaZulu-Natal							
Bloedrivier	Dry land	X	X				
Winterton	Irrigation	X	X	X			
Magaliesberg Grain Co-operation							
Brits	Irrigation	X	X	X			
Mpumalanga							
Piet Retief	Dry land	X	X				
Middelburg	Dry land	X	X				
Loskop	Irrigation	X	X	X			
North West Co-operation							
Koster	Dry land	X	X				X
Lichtenburg	Dry land	X	X				X
Free State Co-operation							
Reitz	Dry land	X	X	X			X
Frankfort	Dry land	X	X				

TABLE 2: COST AND INCOME ESTIMATES WITHIN THE WINTER RAINFALL AREA ACCORDING TO CROP AND REGION

Area	Wheat	Barley	Canola
Cape Agri area			
Malmesbury	X		X
Porterville	X		X
Eendekuil	X		X
MKB Area			
Moorreesburg	X		X
Overberg Agri Area			
Caledon	X	X	X

Bredasdorp	X	X	X
Central South Co-operation Area			
Swellendam/Heidelberg	X	X	X

Information required to prepare income/cost estimates was obtained, where possible, from agribusinesses. Where information was not available for specific regions, group discussions were held with producers to obtain the information. Due to structural changes within the industry the group discussions are repeated at approximately three yearly intervals. For interim periods assumptions of cost/income estimates are adjusted according to the latest available prices.

Estimates are based on typical and/or recommended practices in the respective areas, or on study group information obtained. The sources of information are indicated by footnotes shown below estimates.

Sources of information are summarised in tables 3 and 4.

TABLE 3: SOURCES OF INFORMATION, SUMMER RAINFALL AREA

Area	Dry land / Irrigation	Source
Central irrigation regions	Irrigation	GWK estimates
Bloedrivier	Dry land	Group discussions
Winterton	Irrigation	Group discussions
Loskop Irrigation Scheme	Irrigation	MGK estimates
Brits	Irrigation	MGK estimates
Piet Retief	Dry land	Group discussions
Middelburg	Dry land	Group discussions
Koster	Dry land	NWK estimates
Lichtenburg	Dry land	NWK estimates
Reitz	Dry land	VKB estimates
Frankfort	Dry land	VKB estimates

TABLE 4: SOURCES OF INFORMATION, WINTER RAINFALL AREA

Area	Source
Malmesbury	Cape Agri estimates
Porterville	Cape Agri estimates
Eendekuil	Cape Agri estimates
Moorreesburg	MBK estimates
Caledon	Overberg estimates
Bredasdorp	Overberg estimates
Swellendam/Heidelberg	SSK estimates

6.17 THE EFFECTS OF DIETARY CRUDE PROTEIN ON THE FERTILITY OF BROILER BREEDER MALES: Dr NC Tyler, University of KwaZulu-Natal

The response of broiler breeder females to dietary crude protein (CP) for egg production has been studied in the past, but less literature is available on the response in male fertility. Since males are often given the same feed as the females, but do not have the same requirements for protein, it may be possible to save on the cost of protein in male rations, if it were worth feeding the sexes separately. To test this, broiler breeder males (either in natural mating pens, with all females on a commercial ration, or in individual cages) were provided with a fixed daily feed

allocation resulting in intakes of 10.4, 12.4, 14.2, 17.8, 19.3 and 20.1 g CP/bird d. Birds eating <14.2 g CP/d lost weight, while those eating above this gained weight. Hatch percentage was not affected by CP intake and was high across all treatments. Predictions of sperm fertility by counting the sperm trapped in the outer perivitelline membrane of oviposited eggs also did not differ between CP treatments. Diets were formulated to be iso-energetic, but subsequent analysis showed a range of 10 to 11.5 MJ ME/kg and it is possible that this could have caused the decrease in body weight on the low protein (and low energy) feeds, but this did not detract from the important finding that fertility was not compromised even at the lowest intake of protein. Recommendations from breeding companies range from about 14 g CP to over 16 g CP for male breeders, but the results here demonstrate that as little as 10.4 g CP could be fed without compromising fertility. As long as sufficient energy is supplied to prevent males from losing weight, there is an opportunity to reduce feed costs and save at least 4 g protein/bird d by providing males with a separately formulated diet, without compromising fertility.

6.18 PRF WEB PAGE, Mr JSG Joubert, Protein Research Foundation

The PRF web page remains a source of essential information and plays an important role in communicating such information to all interested parties. It is apparent when viewing the web page that the PRF is committed to making the web page as user friendly as possible, particularly to keep up with, and adapt to trends in this regard.
During the year under review, the photo gallery was introduced to allow visitors to view images of items described in the text.

The online function for income and cost estimates is now fully functional. Demonstrations of the function and applications were presented at various events during the year. Management summaries of projects, study reports (dissertation papers) and articles, not available previously, are now included as part of the web site. Links to other institutions remain important and a number of new links to agricultural or related local and international institutions have been set up.
Board members were introduced to the new web site formats, and the functions were demonstrated to the members to keep them informed of new developments and progress relating to the web site.
The statistics below show the number of visitors to the site per reporting year since the inception of the web site.

Reporting year	Number of visitors
2004	1691
2005	3285
2006	4552
2007	5402
2008	11104
2009	8484
2010	7313
2011	7830
2012	9252

During the year under review the number of visitors increased by 18,2%, compared to the previous year,. It is encouraging to note that the total number of pages viewed and the number of pages viewed per visit increases continuously.

6.19 PROJECTIONS OF OILCAKE DEMAND FOR ANIMAL CONSUMPTION IN 2015, 2020 AND 2025: Drs DB Strydom, E Briedenhann and Mr JSG Joubert

These projections are prepared annually and are based on the actual oilcake consumption shown in the AFMA Annual Report. The method of preparation remains unchanged, only the variables change. The AFMA Annual Reports do not show the oilcake consumption per animal species. This requires the use of an APR model and that model was used, as in the past, to show the division of oilcake consumption per animal species for each basis year. This calculation is an essential element for projections, as the future demand for oilcake required for animal consumption is derived from future demand for animal products such as meat, egg, dairy products etc. for a growing population. The Nieuwoudt/McGuigan model is used to determine the future demand for animal products and to prepare the projections for future oilcake demand.

Variables that are important for projections include estimates relating to population growth according to race. For these projections it is particularly important to distinguish between urban and rural areas in terms of the Black population.

Expected income growth is also considered according to race. Income growth is shown for low and high income scenarios. These estimates also require a differentiation relating to urban and rural Black populations to determine income growth. Another variable taken into account is the income elasticity for various animal

products consumed per population group. Protective rates that apply to the respective animal products are incorporated in the model.

When the project was initiated some time ago, projections were prepared for the 2010 year. Now it is possible to determine the accuracy of those projections. The actual oilcake consumption for 2010/2011, compared to the projected consumptions calculated in the past, showed no significant deviations. This confirms the reliability of the models. Results for the oilcake projections for 2015, 2020 and 2025 are discussed in section 4.2.5 of the Research Report.

7. STUDY GRANTS

Since the start of the study grant (bursary) scheme eighteen years ago (1995), the PRF has awarded 63 grants to deserving candidates. The grants are awarded specifically to those studying to attain a Masters or Doctoral degree. For the 2012 academic year the Grant Committee received nine applications. Of these applications seven were approved for the 2012 academic year.

In the case of a Masters degree, the prospective candidate's study field must fall within the broad guidelines of the PRF vision, mission and objectives. In the case of doctoral studies, grants are considered only if the study field falls within a category that is considered a high priority at the PRF. The PRF also does everything possible to ensure that the results of the theses and scripts will reach potential users of the information. Students and study leaders are encouraged to publish results in popular and/or scientific journals or magazines. Brief summaries of the theses and scripts are included on the PRF web page.

The applicants mentioned below received annual grants valued at R35 000. Bursaries for Masters studies are awarded for a period of two years, while doctoral bursaries are awarded for a period of three years. At the end of each year of approved study, the study leader must submit proof of satisfactory progress for the PRF to award the grant for the succeeding year of study.

<u>MSc Studies</u>

1. Mr PD Carstens (second application); "Animal feed and meat science" ("Dierevoeding and Vleiskunde)", University of Stellenbosch.

2. Mr FV Meyer (second application); "The response of weaned piglets to varying dietary levels of synthetic valine and leucine", University of Pretoria.

3. Miss M du Plessis (second application); “Soybean nodule development”; University of Pretoria.

4. Ms MP Genis (first application); “Ruminant Nutrition” (“Herkouervoeding”); University of Stellenbosch.

5. Ms L van Emmenes (first application); “Monogastric Nutrition” (“Monogastriese voeding”), University of Stellenbosch.

6. Mr R Steyn (first application); “Canola oil” (“Canola-olie”), University of the Free State.

7. Ms GA Tesselaar (first application); “Monogastric Nutrition” (“Monogastriese voeding”), University of Stellenbosch.

Completed Theses received

During the year under review, the following theses were received from graduating PRF grant recipients:

1. Mr SB Ruck, *The response of broiler breeder hens to dietary lysine: hatchability, embryo growth and subsequent offspring performance*; MSc, University of KwaZulu-Natal.

2. Ms AM Jooste, *The effect of supplementing slow release nitrogen (optigen II) and FME on the degradability of poor quality roughage in sheep*; MSc, University of Pretoria.

3. Mr WJ Kritzinger, *Allometric description of ostrich (Strubio camelus var. Dometricus) growth and development*; MSc, University of Stellenbosch.

4. Mr FV Meyer, *The response of weaned piglets to varying dietary levels of synthetic valine and leucine*; MSc, University of Pretoria

8. ACHIEVEMENT AWARDS TO PROMOTE THE PRF VISION AND MISSION

In an effort to support and enhance its vision and mission and to achieve its objectives, the PRF offers a number of achievement awards in the following categories:

- Best Doctoral thesis;
- Best Masters thesis;
- Best article published in a scientific journal;

- Person that has contributed in an extraordinary way to promote the PRF's vision and mission;
- Board member that played a meaningful role over time to promote the PRF's activities; and
- During the year under review, the PRF Board also resolved to add a sixth category. This award is aimed at honouring a national or international institution that worked dedicatedly to assist the PRF in attaining its objectives.

During the year under review, awards were announced in four of the categories. Recipients of the awards each received a certificate and a suitable gift.

1. Best Masters thesis: Mr FV Meyer
   Feed intake, growth and carcass composition of weaned piglets receiving varying levels of valine and leucine in their diets, University of Pretoria.

2. Best article published in a scientific journal: Mr GD Sparks
   An economic evaluation of soybean based biodiesel production on commercial farms in KwaZulu-Natal, South Africa.

3. Person that contributed in an extraordinary way to promote the PRF's vision and mission: Prof André Agenbag, University of Stellenbosch.

4. Recognition of their outstanding contributions during an uninterrupted period of 11 years as members of the Protein Research Foundation: from 2001 to 2012: Mr Gerhard Keun, Chief Executive Officer.

The four awards were handed to recipients at suitable events held during the course of the year.

9. CONCLUSION

The highlight of the 2012/2013 year under review was the WSRC IX 2013. Although it was an expensive project, arriving unplanned at the door of the PRF, it certainly created a unique and all-time highlight. The PRF will have access to the fruits of this event for many years to come and will look back on the conference with immense pride.

Apart from this, the sustained progress in the soya industry as well as the very visible rejuvenation and growth of the canola industry are proof that the approach used over the years by the PRF to promote local oilcake production has been successful.

As older members begin to retire and younger members take over, we can confirm that the foundation on which the PRF is based bears testimony to success irrespective of the challenges that lie ahead.

The PRF's success is based on the hard work and dedication of Board members and staff, but definitely also on the work done by the wide circle of friends, co-workers and contractors who always support the PRF actions, and to whom we owe a debt of gratitude. We also express unqualified appreciation to local and international co-workers, researchers and institutions, the press, fund managers, auditors, lawyers and web masters. We trust that this co-operation will continue in the new year and over many years to come leading to far-reaching and even greater achievements.

GJH SCHOLTEMEIJER
CHAIRMAN

ANNEXURES

LIST OF APPROVED PROJECTS IN 2012/13

1.	Evaluation of PRF- Soybean Elite Lines under South African Conditions Messrs GP de Beer and WF van Wyk	Protein Research Foundation
2.	National Soybean Cultivar Trials Messrs JL Erasmus, NN Nogapi and TC Ramatlotlo	ARC Institute for Grain Crops
3.	Increasing soybean production on the Highveld Mr WF van Wyk	Protein Research Foundation
4.	Establishing of an early warning system for soybean rust Mr GP de Beer	Protein Research Foundation
5.	Investigating the etiology and incidence of soilborne diseases of soybean in South Africa Drs YT Tewoldemedhin and SC Lamprecht	ARC Research Institute for Plant Protection
6.	Insect biodiversity and abundance in soybeans (*glycine max*) Ms JM Truter	ARC- Grain Crop Institute, Potchefstroom
7.	Investigating enzyme activity as a new tool to facilitate rapid identification of root-knot nematode resistance in soybean genotypes: Prof H Fourie, Ms C Venter and Mr J Berner	School for Biological Sciences, North-West University, Potchefstroom
8.	Cultivar evaluation of oil and protein seeds in the winter rainfall area Mr PJA Lombard	Department of Agriculture, Western Cape
9.	Boron requirements of canola Prof GA Agenbag and Mr E Kempen	University of Stellenbosch
10.	Plant density of canola: Impact on the suppression of weed and yield of canola in the Swartland Dr PJ Pieterse	University of Stellenbosch

11.	Chemical options for weed control in GM-canola Dr PJ Pieterse	University of Stellenbosch
12.	Evaluation of shortened canola production periods and the use of alternative crops on the sustainability of winter grain production under conservation agricultural practices in the Riversdale Flats Dr JA Strauss and Mr W Langenhoven	Department of Agriculture, Western Cape
13.	Sulphur (S) and Nitrogen (N) requirements of canola Prof GA Agenbag and and Mr E Kemp	University of Stellenbosch
14.	Enhancement of canola as a rotation crop within a concervation system in the dry-land areas of the Swartland using a competition between producers Mr IF Slabbert	Department of Agriculture, Western Cape
15.	Enhancement of canola as a rotation crop within a conservation system in the dry-land areas of the Southern Cape using a competition between producers Mr JG Loubser	Protein Research Foundation
16.	Income and cost estimates of soybeans, canola and some competitive crops Messrs JSG Joubert and SG Ferreira	Protein Research Foundation
17.	The effects of dietary crude protein on the fertility of broiler breeder males Dr NC Tyler	University of KwaZulu Natal
18.	PRF web page Mr JSG Joubert	Protein Research Foundation
19.	Projections of oilcake demand for animal consumption in 2015, 2020 and 2025 Drs DB Strydom, E Briedenhann and Mr JSG Joubert	Protein Research Foundation

LIST OF COMPLETED PROJECTS IN 2011/12

TITLE AND RESEARCHER		INSTITUTION
1.	S-Fertilizer requirements of canola produced in the production areas of the Western Cape Prof GA Agenbag	University of Stellenbosch
2.	Management of herbicide resistance in the Western Cape Dr PJ Pieterse	University of Stellenbosch
3.	An investigation into the production dynamics of eight crop rotation systems, including wheat, canola, lupins and pasture species in the Swartland, Western Cape Dr JA Strauss and Mr SJA Laubscher	Institute for Plant Production, Western Cape Department of Agriculture
4.	Economic sustainability of short- and long-rotation crop/pasture production systems in the Southern Cape Dr JA Strauss and Mr W Langenhoven	Institute for Plant Production, Western Cape Department of Agriculture
5.	The identification of soil parameters as indicators of sustainable dry-land crop production systems for the shale derived soils of the Western Cape: tillage practice, crop rotation, soil quality and crop production Mr J Labuschagne	Institute for Plant Production, Department of Agriculture, Western Cape
6.	Insect and other pests of canola Dr G Tribe and Mr A Lubbe	ARC-Plant Protection Research Institute
7.	The economic contribution of canola as a rotational crop in various crop rotation systems on a typical farming unit in the Swartland and Southern Cape Dr WH Hoffman	University of Stellenbosch

SHORT- AND MEDIUM-TERM DEMAND FOR AND UTILISATION OF FISHMEAL AND OILCAKE

(Updated January 2013)

TABLE 1: FISH MEAL AND OIL CAKE BALANCE SHEET (2010/2011 - 2012/2013) (APRIL - MARCH)

	FISH MEAL (TON)			OIL CAKE (TON)		
Year	**2010/2011**	**2011/2012**	**2012/2013**	**2010/2011**	**2011/2012**	**2012/2013**
Requirements/Sales	37 000	45 000	55 000	1 857 490	1 856 360	2 200 000
Available/Produced	94 000	105 000	105 000	624 912	766 927	918 180
Shortage/Imports	***-57 000***	***-60 000***	***-50 000***	***1 232 578***	***1 089 433***	***1 281 820***

2012/2013 - Estimate

Source: Fishing industry; AFMA Chairman's Report 2011/2012

TABLE 2: FISH MEAL AND OIL CAKE USAGE (20010/2011 - 2012/2013) (APRIL - MARCH)

	FISH MEAL (TON)			OIL CAKE (TON)		
Year	**2010/2011**	**2011/2012**	**2012/2013**	**2010/2011**	**2011/2012**	**2012/2013**
AFMA Members	30 754	26 492	51 033	1 255 258	1 329 126	1 345 149
Non-AFMA Members	6 246	18 508	3 967	602 232	527 234	854 851
Total	***37 000***	***45 000***	***55 000***	***1 857 490***	***1 856 360***	***2 200 000***

Source: AFMA Chairmans Report 2011/2012

2012/2013 - Estimate

* Non-AFMA Members figures can also include unused stocks

TABLE 3: THE MAIN RAW MATERIAL USAGE BY AFMA-MEMBERS (APRIL - MARCH) (2010/2011 - 2012/2013)

RAW MATERIALS	TOTAL (TON) (2010/2011)	INCLUSION RATE (%)	TOTAL (TON) (2011/2012)	INCLUSION RATE (%)	TOTAL (TON) (2012/2013)	INCLUSION RATE (%)
Sunflower oilcake	256 841	4,64	279 309	4,68	325 821	5,33
Groundnut oilcake	138	0,00	2045	0,03	2262	0,04
Soya oilcake	815 958	14,75	885 988	14,84	853 941	13,97
Full fat soya	142 758	2,58	122 772	2,06	108 252	1,77
Cottonseed oilcake	17 142	0,31	14 291	0,24	15 663	0,26
Full fat cottonseed	5 704	0,10	7 611	0,13	8 739	0,14
Canola oilcake	5 974	0,11	9 071	0,15	10 848	0,18
Full fat canola	1 056	0,02	0	0,00	0	0,00
Copra and Palm kernel	7 425	0,13	8 011	0,13	19 626	0,32
Maize germ oilcake	2 261	0,04	29	0,00	0,00	0,00
Total oilcake	***1 255 258***	***22,69***	***1 329 126***	***22,26***	***1 345 149***	***22,00***
Total maize products	***3 034 924***	***54,87***	***3 237 558***	***54,21***	***3 238 734***	***52,97***
Total fish meal	***30 754***	***0,56***	***26 492***	***0,44***	***51 033***	***0,83***

Source: AFMA Chairmans Report 2011/2012

AFMA rawmaterial usage April 2012-March 2013 scaled up to a twelve month period

[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 (2010/2011 - 2012/2013) (APRIL - MARCH)

	LOCAL (RSA + NAMIBIA) FISH MEAL PRODUCTION (TON)			IMPORTED FISH MEAL (TON)		
Year	**2010/2011**	**2011/2012**	**2012/2013**	**2010/2011**	**2011/2012**	**2012/2013**
RSA	72 000	90 000	90 000			
Namibia(i)	22 000	15 000	15 000			
Total	***94 000***	***105 000***	***105 000***	***-57 000***	***-60 000***	***-50 000***

Source: AFMA; SA Fishmeal Marketing Company
2012/2013-Estimate.
(i) Includes Russian trawlers operating in Namibian waters

TABLE 5: OIL CAKE: LOCAL PRODUCTION AND IMPORTS (2010/2011 - 2012/2013)

	LOCAL OIL CAKE PRODUCTION (TON)			IMPORTED OIL CAKE (TON)		
Year	**2010/2011**	**2011/2012**	**2012/2013**	**2010/2011**	**2011/2012**	**2012/2013**
OIL CAKE:						
Groundnuts oilcake	3	1	0	1	235	
Sunflower oilcake	249 984	336 966	369 180	103 062	57 159	
Soya Cake	152 000	227 600	488 000	989 112	922 499	
- Full fat	149 600	120 160				
Beans				357	1 083	
Cotton Cake	7 500			87 354	68 333	
- Full fat	25 000	40 000	10 000	17 928	11 763	
Other						
Canola	22 825	24 200	33 000			
Lupins	18 000	18 000	18 000			
Copra & Palm Kernel				34 764	28 361	
Total	***624 912***	***766 927***	***918 180***	***1 232 578***	***1 089 433***	***1 281 820***

Source: AFMA Chairman's report 2011/2012 :
Estimate - 2012/13 .The projected local production figures for soja and cotton reflect fullfat and oilcake

TABLE 6: OIL SEED AND GRAIN PRODUCTION IN THE RSA (TON)
(2008/2009 - 2012/2013 - MARKETING SEASON)

CROP	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013
White maize	7 480 000	6 775 000	7 822 400	6 052 000	6 740 000
Yellow maize	5 220 000	5 275 000	5 220 600	4 308 000	5 090 000
Sorghum	255 000	276 500	220 093	155 000	135 500
Groundnuts	88 800	99 500	87 880	64 250	59 000
Sunflower	872 000	801 000	516 265	860 000	522 000
Soya beans	282 000	516 000	560 950	710 000	650 000
Cotton seed(i)	17 378	15 658	14 793	31 373	22 326
Wheat	2 130 000	1 958 000	1 430 000	2 005 000	1 895 410
Canola	30 800	40 350	36 900	58 800	84 275

Source: National Crop Estimates Committee ; Fifth production estimate for winter crops (20 December 2012) and final crop estimate for summer crops for the 2012/13 marketing year (29 November 2012);
(i) Cotton South Africa .

TABLE 7: ESTIMATED OIL SEED AND GRAIN SUPPLY IN THE RSA (TON)
(2012/2013 MARKETING SEASON)

CROP	Opening stock	Imports to RSA	Production	Exports	Total supply
White maize	518 000	13 000	6 740 000	1 148 000	6 123 000
Yellow maize	476 000	35 000	5 090 000	229 000	5 372 000
Sorghum	52 100	65 000	135 500	19 800	232 800
Groundnuts	13 400	19 900	59 000	15 900	76 400
Sunflower	232 700	11 700	522 000	0	766 400
Soya beans	306 100	300	650 000	158 000	798 400
Wheat	651 000	1 585 000	1 895 410	260 000	3 871 410
Canola	6 900	0	84 275	0	91 175

Source: Opening stock, import , production and export figures obtained from Grain South Africa

TABLE 8: AREA PLANTED TO OIL SEED AND GRAIN CROPS IN THE RSA
(2007/2008-2012/2013 PRODUCTION SEASON)

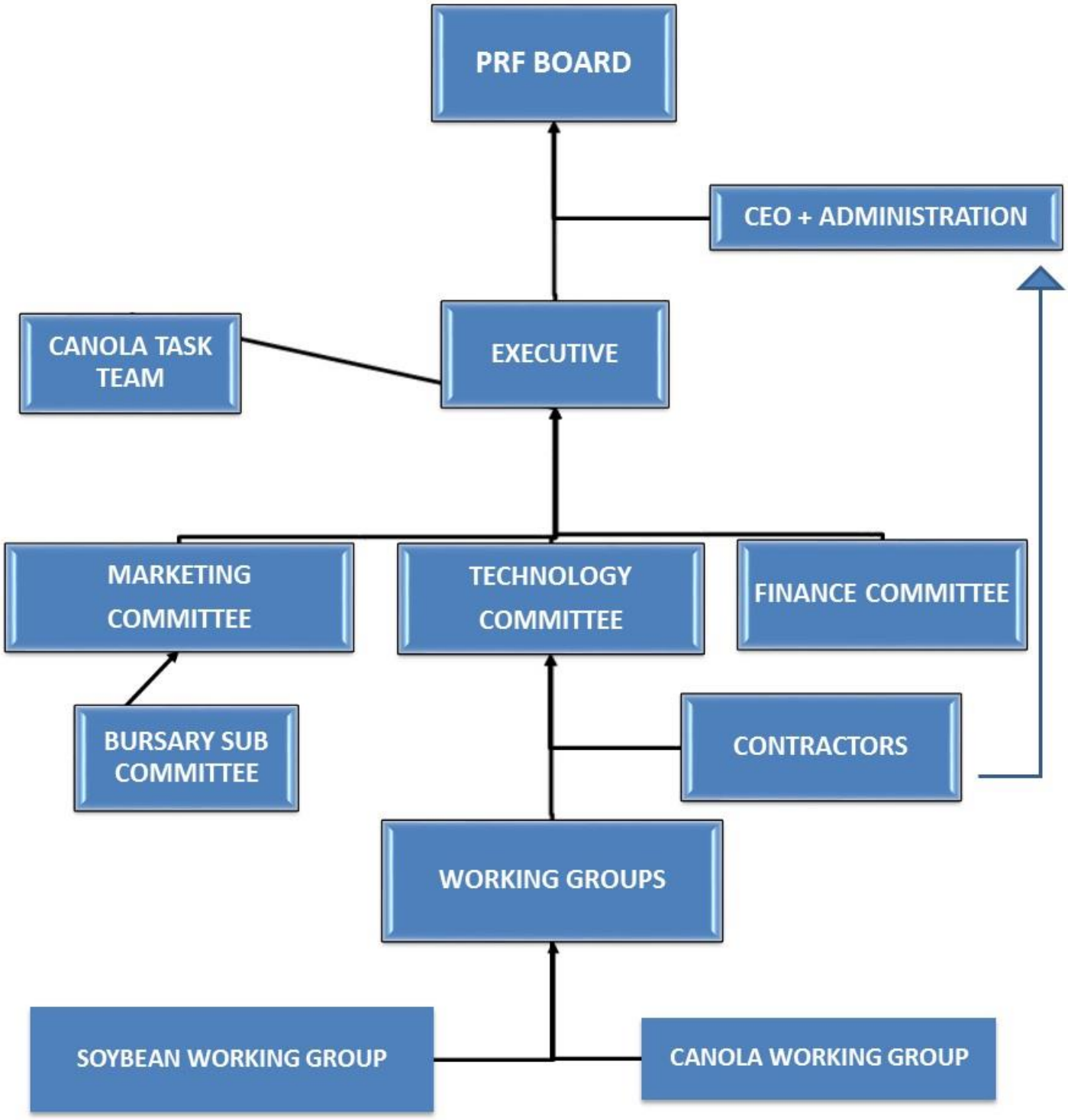
CROP	Ha planted .2007/08	Ha planted .2008/09	Ha planted .2009/10	Ha planted .2010/11	Ha planted .2011/12	Ha planted .2012/13
White maize	1 737 000	1 489 000	1 719 700	1 418 300	1 636 200	1 600 000
Yellow maize	1 062 000	938 500	1 022 700	954 000	1 063 000	1 135 000
Sorghum	86 800	85 500	86 675	69 200	48 550	64 650
Groundnuts	54 200	54 550	57 450	55 150	45 450	43 000
Sunflower	564 300	635 800	397 700	642 700	453 350	525 000
Soya beans	165 400	237 750	311 450	418 000	472 000	504 000
Wheat	632 000	748 000	642 500	558 100	604 700	551 200
Canola	33 260	34 000	35 060	34 820	43 510	44 100
Total	4 334 960	4 223 100	4 273 235	4 150 270	4 366 760	4 466 950

Source: National Crops Estimates Committee: Intentions to plant Summer crops 2012/2013 Production season (25 October 2012)
Fifth area estimate to plant Winter crops 2012 production season (20 December 2012)

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	Jan - Dec
Soya beans	Jan - Dec
Wheat	Oct - Sept

PRF STRUCTURES



LIST OF GRANT APPLICATIONS: 1995 - 2013

STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	YEAR STARTED	YEAR ENDED
1995							
Me E Upton	BSc (Agric), BSc (Agric) (Hons)	Universiteit van Stellenbosch	Dierevoeding: Ontwikkeling van polimeerbedekte ureum	Development and evaluation of polymer coated urea as a potential slow-releaseurea supplement for ruminants.	**M.Sc**	1995	1996
Mnr GE Schroeder	BSc (Agric), BSc (Agric) (Hons), MSc (Agric)	Universiteit van Pretoria	Melkbeesvoeding	Availability and partitioning of amino acids from various heat processed Protein sources to the Mammary gland of Lactating Dairy Cows.	**PhD**	1995	1997
1996							
Mnr HM Böhme	BSc (Agric), BSc (Agric) (Hons)	Universiteit van Stellenbosch	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**	1996	1997
Me MB Young	BSc (Agric)	Universiteit van 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**	1996	1997
Mnr AV Ferreira	BSc (Agric), BSc (Agric) (Hons), MSc (Agric)	Universiteit van die Vrystaat	Die essensiële aminosuurbehoeftes van SA Vleismerinoramlammers.	The essential amino acid requirements of South African Mutton Merino lambs.	**PhD**	1996	1997
Mnr CA Loëst	BSc (Agric), BSc (Agric) (Hons), MSc (Agric)	Universiteit van die Vrystaat	Amino acid utilization by beef cattle.	Amino acid profile of lamb carcass and duodenal digesta content	**PhD**	1996	1998
1997							
Me L McLouglin	BSc (Agric)	Universiteit van 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**	1997	1998

STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	YEAR STARTED	YEAR ENDED
Mnr PDR van Heerden	BSc, BSc (Hons), MSc	PU vir CHO	Die evaluering van de novo proteïensintese, chlorofilfluoressensie-induksieparameters en ensiemaktiwiteite van oksidatiewe stresmetabolisme as indikatore van droogte toleransie in Glycine max(sojaboon).	Physiological and Biochemical basis of dark chilling and superimposed drought stress in Glycine max (L.) Merrill.	**PhD**	1997	1999
1998							
Me A Booysen	BSc, BSc (Hons)	PU vir CHO	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. (Merrit) and its implication on soybean production in South Africa	**M.Sc**	1998	2001
Me GJM Coetzee	BSc (Agric)	Universiteit van Stellenbosch	Gebruik van canola-oliekoek vir visvoeding.	Effects of feeding omega-3 fatty acids and Vitamin E on the chemical composition and microbial population	**M.Sc**	1998	2000
Mnr CM Coetzer	BSc (Agric), BSc (Agric) (Hons), MSc (Agric)	Kansas State Universiteit	Manipulation of ruminal degradability characteristics of various protein sources.	Methionine metabolism in growing cattle	**PhD**	1998	2001
1999							
Mnr J van E Nolte	BSc (Agric)	Universiteit van Stellenbosch	An evaluation of degradable intake protein and non-protein nitrogen on intake and digestion by Dohne Merino sheep fed wheat straw.	An evaluation of degradable protein and non-protein Nitrogen on intake and digestion by Dohne Merino sheep fed wheat straw.	**M.Sc**	1999	2001
Mnr PGW Wessels	BSc (Agric)	Universiteit van Stellenbosch	Canola en lupien as wisselbougewasse.	Soil Nitrogen Dynamics and spring wheat (Triticum Aestivum)production in different cropping systems in the Swartland.	**M.Sc**	1999	2001
Mnr WD Jonker	BSc	PU vir CHO	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**	1999	2000

STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	YEAR STARTED	YEAR ENDED
2000							
Mnr GDJ Scholtz	BSc (Agric), BSc (Agric) (Hons)	Universiteit van die Vrystaat	Lusern gradering stelsel.	Models for lucerne quality grading.	**M.Sc**	2000	2002
Mnr S Tyiso	BSc, HDE, BSc (Hons), MSc	Universiteit van 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**	2000	2004
Mnr JR Sara	BSc, BSc (Hons), MSc	Universiteit van 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**	2000	2007
Mnr JD Thornton	BSc (Agric)	Universiteit van Stellenbosch	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**	2000	2003
2001							
Me S Nel	BSc, BSc (Hons)	Universiteit van 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**	2001	2002
Mnr SG de Jager	BSc (Agric), BSc (Agric) (Hons)	Universiteit van die Vrystaat	Groei en ontwikkeling van sojaboon-kultivars by verskillende rywydtes.	Groei en ontwikkeling van sojaboon cultivars by verskillende rywydtes.	**M.Sc**	2001	2004
Mnr M de Beer	BSc (Agric)	Universiteit van Stellenbosch	Animal Nutrition	The influence of processing of Soya-beans and Sunflower seed on their Energy and Amino Acid availability for poultry.	**M.Sc**	2001	2003
Me L Brundyn	BSc (Agric)	Universiteit van Stellenbosch	Die voedingswaarde en benutting van canola- en koringstoppel deur skape.	The utilization and supplementation to stubble lands for South African mutton Merino ewes.	**M.Sc**	2001	2003

STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	YEAR STARTED	YEAR ENDED
2002							
Me 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 Meloidogyna incognita race 2 (Nematode: Tylenchida) and identification of genetic markers for this trait in soybean (Glycine max).	**PhD**	2002	2005
Me MM Viljoen	BSc, BSc (Hons)	PU vir CHO	The influence of dark chilling on the endogenous rhythms of photosynthesis and sucrose synthesis in *Glycine max (L.) Merr*.	The influence of dark chilling on the endogenous rhythms of photosynthesis and sucrose synthesis in *Glycine max(L.) Merr*.	**M.Sc**	2002	2004
2003							
Me LR Breytenbach	BSc (Agric) (Hons)	Universiteit van Stellenbosch	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**	2003	2006
Mnr SG Payne	BSc (Agric) (Hons)	Universiteit van Stellenbosch	Evaluasie van grondstowwe in pluimvee-en varkvoeding.	The Phosphorus availability of feed phosphates in broilers.	**M.Sc**	2003	2005
Me JB Griffiths	BSc (Agric) (Hons)	Universiteit van Stellenbosch	Herkouer voeding	The effect of extrusion on the degradability parameters of various vegetable protein sources.	**M.Sc**	2003	2006
Mnr D Backhouse	BSc (Agric)	Universiteit van 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**	2003	2005
2004							
Me ER Malleson	BSc (Agric) Veekunde	Universiteit van 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**	2004	2008
Me Z Bester	BSc (Agric) Veekunde	Universiteit van Pretoria	Die effek van rumen-beskermde metionien (RPMet) op die produktiwiteit van Holstein-koeie gedurende vroeë laktasie.	Evaluation of a liquid rumen protected methionine source using different techniques	**M.Sc**	2004	2011

STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	YEAR STARTED	YEAR ENDED
Me N Smith	BSc (Agric) Veekunde	Universiteit van Stellenbosch	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**	2004	2005
2005							
Mnr W Visagie	BSc (Agric) Veekunde	Universiteit van Stellenbosch	Essential amino acid requirements of goats.	The digestibilty and degradability of feeds and protein sources in dohne - merino sheep and boer goats	**M.Sc**	2005	2010
Mnr J Fourie	BSc (Agric)	Universiteit van Stellenbosch	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**	2005	2007
Me M Kritzinger	BSc (Agric)	Universiteit van Stellenbosch	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**	2005	2009
2006							
Me MR Modiba	BSc Microbiology	Universiteit van 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**	2006	2009
Mnr SF Magoda	BSc (Agric)	Universiteit van KwaZulu-Natal	Poultry nutrition (alternative protein source for Laying Hens).	Poultry nutrition (alternative protein source for Laying Hens).	**M.Sc**	2006	2010
H Nienaber	BSc (Agric), BSc (Hons)	Universiteit van 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**	2006	2008
2007							
Me M. Strydom	BSc (Agric)	Universiteit van Stellenbosch	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 (*Medico stiva*) pastures	**M.Sc**	2007	2011

STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	YEAR STARTED	YEAR ENDED
BK Theeruth	BSc (Animal & Poultry Science) MSc (Animal Science)	Universiteit van 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**	2007	2009
DB Strydom	B.Com	Universiteit van die Vrystaat	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**	2007	2009
2008							
Mr TL Khetani	BScAgric	Universiteit van 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**	2008	2011
Ms PT Mabulwana	BSc (Botany & Microbioloby), BSc Honour (Botany)	Universiteit van 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**	2008	2013
2009							
Mr SB Ruck	BSc Honours (Animal Science)	Universiteit van 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**	2009	2012
Ms J Patel	BSc Honours (Animal & Poultry Science)	Universiteit van KwaZulu-Natal	Broiler breeder nutrition	Broiler breeder nutrition	**M.Sc**	2009	
Mnr TR Olivier	BSc (Agric)	Universiteit van Stellenbosch	Monogastriese voeding	Determination of the nutrient requirements of breeding ostriches	**M.Sc**	2009	2010
Mnr EJ van der Westhuizen	BSc (Agric)	Universiteit van Stellenbosch	Veekunde (Vleiskunde)	The effect of slaughter age on the lamb characteristics of Merino, South African Mutton Merino and Dorper lambs	**M.Sc**	2009	2010

STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	YEAR STARTED	YEAR ENDED
2010							
Me MM Minnaar	Honneurs (Plantbeskerming) BSc (Omgewingswetenskappe)	Noordwes Universiteit	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**	2010	2013
Me AM Jooste	B.Sc (Agric)	Universiteit van 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**	2010	2012
Me S Greaves	B.Sc (Agric)	Universiteit van Pretoria	The effect of specific amino acids-lysine, Tryptophan, Threonine on the immune system of weaner piglets	The effect of specific amino acids-lysine, Tryptophan, Threonine on the immune system of weaner piglets	**M.Sc**	2010	2012
Mnr WJ Kritzinger	B.Sc (Agric)	Universiteit van Stellenbosch	Volstruis (Groei en voeding)	Allometric description of ostrich (*Struthio camelus var. Dometricus*) growth and development	**M.Sc**	2010	2012
2011							
Mnr PD Carstens	B.Sc Agric	Universiteit van Stellenboch	Diere Voeding en Vleiskunde	Optimisering van nutrente (proteien en energie) in voeding van volstruise	**M.Sc**	2011	
Mnr FV Meyer	B.Sc (Agric) Animal Science	Universiteit van 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**	2011	2012
Me M du Plessis	B.Sc (Biotechnology) B.Sc (Hons) Plant biotechnology	Universiteit van Pretoria	Soybean nodule development	Cysteine proteases activity and gene expression studies in soybean nodules during development and drought stress	**M.Sc**	2011	2013
Me SL von Waltsleben	B.Sc (Agric)	Universiteit van 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**	2011	2013
2012							
Me MP Genis	BSc Agric (Veekunde met Agronomie)	Universiteit van Stellenbosch	Herkouer voeding	Herkouer voeding	**M.Sc**	2012	

STUDENT	QUALIFICATIONS	INSTITUTION	PROPOSED RESEARCH AREA	TITLE OF THESIS	DEGREE	YEAR STARTED	YEAR ENDED
Me L van Emmenes BSc Agric (Veekunde)		Universiteit van Stellenbosch	MSc Monogastriese voeding	Evaluation of commercial phytase enzymes on performance, bone mineralization and carcass characteristics of broiler chicks fed maize-soybean-meal diets	**M.Sc**	2012	
Mnr R Steyn	BScAgric (Veekunde / Landbou - ekonomie) Landbou ekonomie Honneurs	Universiteit van die Vrystaat	Canola-olie	When does a market qualify as a niche market: A canola case study	**M.Sc**	2012	
Me GA Tesselaar	BScAgric (Veekunde met Bewaringsekologie) 2010 MScAgric (AB) 2011	Universiteit van Stellenbosch	MSc Monogastriese Voeding	Development of a methematical optimization model for breeding ostriches: Identification of possible factors affecting feed intake and production	**M.Sc**	2012	
2013							
Mnr LL Eksteen	BScAgric (2012)	Universiteit van Stellenbosch	Die gebruik van groeireguleerders in canola	Die gebruik van groeireguleerders in canola	**M.Sc**	2013	
Mr H Schuurman	B.Sc Agric	Universiteit van Stellenbosch	Dierevoeding	Evaluation of bypass protein supplementation in sheep	**M.Sc**	2013	
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**	2013	
Me M Du Plessis	B.Sc (2009) B.Sc Hons (2010) M.Sc (2012)	Universiteit van Pretoria	Molecular markers for drought tolerance in soybean	Molecular markers for drought tolerance in soybean	**PhD**	2013	
Me GC Buitendach	B.Sc Animal Science (2009) B.Sc (Hons) 2011	Universwiteit van die Vrystaat	Animal Nutrition	The effect of long term exposure to different dietary fatty acids on production and egg quality of layers	**M.Sc**	2013	

LIST OF RESEARCH PROJECTS: 1976 - 2013 (separate addendum)