PROTEIN RESEARCH FOUNDATION

2008/2009 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 competitive 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:

1 The pro-active stimulation and funding of applicable purposeful research in order to fulfil the increasing protein needs for animal nutrition in the RSA.

2 The PRF ascribes to –

- 2.1 a balanced, objective approach;
- 2.2 a critical awareness of the latest developments regarding the protein supply and utilisation;
- 2.3 the promotion of cost-effective research;
- 2.4 the dynamic promotion of the implementation of research results;
- 2.5 the effective sustained utilisation of natural agricultural resources.

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RESEARCH REPORT 2008/09

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1. INTRODUCTION

Researchers, contractors, co-workers and other interested parties are involved in so many of the actions and activities of the PRF, accordingly an annual research report is essential in providing feedback to these parties regarding the activities in the past year and the decisions that have been taken during that time by the Board. In this way everyone involved has an opportunity of obtaining a broad picture of these activities.

This research report is all-encompassing and its contents have been kept as objective as possible, which means that it includes both the good and bad news, this being typical of research. The Board is satisfied that good progress continues to be made in promoting the vision and mission of the PRF. In fact, there is an overall air of optimism because of the snowballing effect that progress in soybean production is having on the Industry. Ultimately though, we continue to be dependent upon the cooperation of specialists who are seldom readily available.

The PRF is in the privileged position of always having had resources available to fund projects that have merit, but unfortunately a recurring trend is that, in spite of funds being available, shortages of skilled manpower have resulted in some projects not being executed. Such problems, as well as others, are monitored on an ongoing basis and where possible, alternative strategies are employed to resolve these issues.

The serious worldwide economic decline did not leave the PRF unscathed, but we are grateful that our cash flow has not been affected and that all activities are continuing as normal. Thus all people in South Africa will continue to benefit from the efforts of the PRF to promote an increase in the production of local protein for animal consumption, thereby replacing imported protein and thus also improving South Africa's balance of payments.

2. GENERAL OVERVIEW

The support structure of the PRF remains under pressure due to political and economic circumstances. This has resulted in the PRF investigating first a 'Plan B' and then a 'Plan C', at great expense, in order to minimise the potential damage to certain industries. In certain instances the policy of the PRF has had to be amended drastically. This is discussed in greater detail later in this report (paragraph 3).

When the trend setters in agriculture do not have all the facts, many conflicting reports and views are expressed in discussions and in the press. The PRF therefore believes that it is extremely important to enter into discussions with these influential groups in order to avoid these problems. One such influential body is the Bureau for Food and Agricultural Policy (BFAP) at the University of Pretoria (UP), which does outstanding research and is highly respected both locally and internationally (for more information see paragraph 5.26 in this report). With their

help, different scenarios are to be used for predicting the protein market for animal consumption, and finality will be reached on this issue in 2009/10.

Additional co-operation with UP is also running smoothly with continued trial work on their experimental farm by Mr. W. van Wyk, a PRF contractor (see paragraph 5.2 below). An information day on soybeans is hosted there annually.

The Agricultural Research Council (ARC) has again made very little effort in the past year to support the soybean industry. The position left vacant eight years ago by the resignation of the plant physiologist/soybean expert has not yet been filled. Consequently, the PRF made the decision to send Mr. W. van Wyk, a soybean expert contracted by the PRF, Mr. Gerhard Keun, chief executive officer of the PRF and Mr. Frans Potgieter, Board member of the PRF and chairman of the soybean working group of Grain South Africa, none of whom had ever had any international exposure with regard to soybeans, on a study tour to the USA under the leadership of the PRF Chairman, Mr. G.J.H. Scholtemeijer. Similar exposure with regard to canola production was given, during a study tour to Australia, to a canola researcher of the Department of Agriculture Western Cape (DAWC), Mr. P. Lombard, as well as to a canola researcher of the Central South Cooperative (CSC), Mr J. Bruwer, under the leadership of Dr. Jos de Kock, Board Member of the PRF. Both study tours were extremely beneficial and are deemed to be a good investment in guaranteeing the successful production of these two protein sources in South Africa in the future.

In the same vein the policy of continued technology transfer is still regarded as being of extreme importance. Industry experts are repeatedly invited to attend Board Meetings and Working Group Meetings in order to give Board members and co-workers the benefit of their knowledge and expertise. Speakers during the year included Mr. Dave Foord of Foord Asset Management, one of the most highly recognised investment specialists in South Africa, and also Mr. Guy Thibaud, well known in agricultural circles and especially well known as a specialist in rotational crop farming methods. In addition, continuous efforts are made on several fronts to further the cause of the PRF through articles, interviews, speeches, lectures, demonstration-plantings etc. The PRF would like to acknowledge the outstanding contributions made by all the journalists, writers, researchers and speakers who have been involved in this way with the PRF in the past year.

Various sponsorships were again awarded this year. One of these was of the annual symposium on Soil Health and Soil-borne Plant Diseases which makes a unique contribution to a greater understanding of soil-borne diseases.

Prof. Fabricio Rodrigues of the University of Viçosa, Brazil, was sponsored by the PRF to attend, as a speaker, the international ‘Silicone in Agriculture conference’ in South Africa. Good relations have subsequently been maintained with him as well as with another sponsored speaker, from China, Prof. Liang. Similarly, Dr. Sandra Lamprecht received sponsorship to attend various plant pathology presentations in Europe, specifically, the Fourth International Rhizoctonia Symposium; the Ninth International Congress on Plant pathology; and the Tenth International Fusarium Workshop.

International pressure with regard to the health aspects of oils from protein seeds persuaded the PRF to utilise various sources of information to become more acquainted with these critical issues. Within a short space of time, thanks to the efforts of Mrs. E. Harmse, a PRF contractor, other PRF co-workers, and reports from the study tour to Australia, the Board became well informed of the facts. This issue continues to be monitored so as to prevent international pressure on food standards catching our interest groups in the different oilseed industries in South Africa unawares.

The PRF website plays an increasingly important role in supporting current attempts to enhance technology transfer (for more information, see paragraph 5.2.7). All documented activities since the inception of the PRF are being placed on the website, but this will not be completed before the end of 2010. This exceptional and important action is being executed under the leadership of the Vice Chairman of the PRF, Mr. J.S.G. Joubert, and Mrs. M. Du Preez, and the PRF would like to acknowledge their determination and perseverance.

A recurring problem in the agricultural industry has been the inability of the office of the Registrar, Act 36 (Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies) to complete applications and registrations within a reasonable time frame. Many industries are suffering severe losses as a result of this inefficiency and the PRF would like to express the belief that this problem will receive the necessary attention from authorities very soon.

In our Research Report last year we reported on the Government policy regarding Biofuels. Initially, the PRF had high expectations that this would provide a potential boost to protein production, but unfortunately nothing substantial has since materialised. Behind the scenes, however, there are interesting developments and all is not lost. In the mean time, the PRF has contracted Dr. L. du Plessis to keep the Board and working groups abreast of developments in this area, both locally and internationally. All the reports by Dr. du Plessis appear on the PRF website and these make for interesting reading.

Several Board members received special awards in the past year and we would like to congratulate them on the following:

1. Prof. Rob Gous, special award by the South African Poultry Association (SAPA) – ‘Recognition for his contribution to the Poultry Industry’.

   Prof. Gous was elected as senior vice-president of the World’s Poultry Science Association and also delivered two keynote addresses at the World Conference on Animal Production in Cape Town;

2. Dr. Munro Griessel, lifelong honorary membership of SAPA, and also a special honorary award from the PRF.

3. Mr. J.S.G. Joubert, special honorary award from the PRF.

3. POLICY DECISIONS

The annual PRF Research Report includes policy decisions that have been taken by the Board in order to function smoothly and efficiently in an ever-changing environment.

In the past year the Board once again completed an audit of available expertise versus that required to execute the various tasks undertaken by the PRF. Due to a lack of support, and in some instances a total absence of support, at both the national and provincial level, the Board took a decision to provide additional support to those Board members who are under the most pressure, but also with a view to providing continuity within the Board. It was envisaged that support would be in the form of additional appointments to Board committees and of supplementing PRF working groups with experts as required. The first such appointment was Dr. Jan Dreyer, an experienced and nationally recognised agronomist with regard to summer crops, who was co-opted to the Technology committee for a period of one year. Similarly, at the end of 2008, an agreement was reached with Prof. M. Karaan, newly appointed Dean of the Faculty of Agricultural Sciences at the University of Stellenbosch, to increase the involvement of Prof. André Agenbag, experienced and nationally recognised agronomist with regard to winter crops in the Western Cape. More on this topic will be reported in the next Research report.

The most important policy decision taken by the PRF in the period under review was to engage in an international liaison and cooperation program with countries abroad. This followed a Think Tank held during April 2008 and is the result of the declining funding for research at research institutes, provincial departments and universities, as well as increasing pressure on those who remain. Very few vacant research positions are being filled and this has negatively affected many agricultural industries, resulting in increasing international isolation. Following the decision to give broader and international exposure not only to researchers but also to PRF co-workers, the decision was taken to liaise with Argentina and Brazil, mainly in the light of the dramatic progress in soybean production that has been made there in the past few years.

This decision was hastened by the temporary suspension of the soybean breeding program by the ARC-IGG as a result of a shortage of manpower. Consequently the PRF decided to suspend further funding of the soybean breeding program and to look elsewhere to assist commercial seed companies that continue to maintain breeding programs in South Africa. As a result, visits were undertaken to Brazil and Argentina where PRF missions had always in the past been received in a friendly and enthusiastic manner. A Memorandum of Understanding (MOU) was signed with EMBRAPA in Brazil in January 2009, whilst negotiations with INTA in Argentina are still underway. The initial goal is to test South American soybean cultivars and lines with specified characteristics during the 2009/2010 season, and to encourage the exchange of researchers to the advantage of both parties. Discussions will also be held continuously with local seed companies in an attempt to stay abreast of the latest developments with regard to higher yield, healthier oil, disease resistance, etc.

Locally, attention will also immediately be given to drawing up a map that identifies the area in South Africa available for soy planting as well a climatological map of regions where soy beans can be cultivated.

From the study tour to Australia it became evident that approximately 90 % of all their crops are planted using a system of no-till cultivation. Similarly, almost all soybeans in Argentina are planted using the no-till system and it is deemed to be the single most important factor contributing to the successes that have been achieved with soybean production in that country. As a result of this and other confirmatory and supporting facts, the Board has taken a policy decision to promote this system in South Africa. Dr M. Hardy and co-workers in the Western Cape have been conducting research with this system for a number of years with regard to canola production, and the Board decided that urgent attention must be given to launching a similar program for soybeans.

These aspects will all form part of a generic soybean marketing campaign that the PRF has embarked upon, and will form the core of soybean activities over the next few years. More information regarding this initiative will be covered in the press on an ongoing basis as well as in the next few research reports.

4. PROJECTS FINANCED IN 2008/2009

The PRF funded 27 research projects in 2008/2009 (see Annexure I). This is five less than in the previous year. Four of the 27 projects were new projects whilst 23 were continuations of existing projects. There were 32 applications for financing of which one was declined, one was withdrawn and three were never started.

Seven projects (see Annexure II) were completed during the year, but final reports are only expected in the first half of 2009.

Regarding new research projects, two deal with the cultivation of canola in the Western Cape, one with soybeans and one seeks to improve the utilisation of protein in animal feed.

For 2009/2010, 30 applications were received of which six are new applications. These applications will be discussed in the next research report.

5. PROJECTS COMPLETED SUCCESFULLY OR IN WHICH SIGNIFICANT PROGRESS WAS MADE (Annexure I and II)

5.1 NATIONAL SOYBEAN CULTIVAR TRIALS: Mr J.L. Erasmus, H.S.J. Vermeulen, NN Mogapi; ARC-Institute for Grain Crops

A total of 20 soybean cultivars were evaluated nationally in selected localities over the soybean production areas and an additional eight were evaluated as a phase-1 test at 11 additional locations. Trials were planted at research

stations where the necessary infrastructure exists in order to carry out a comprehensive agrometeorological study. Trial sites were also selected in areas where a need for information exists and where the optimum amount of data could be collected. The comprehensive data set comprises phenological data such as days to flowering, physiological and crop maturity, maximum plant height and minimum pod clearance, lodging, shattering and green stem, relative disease or pest susceptibility, seed characteristics and yield, physical and chemical quality, and soil and weather data. All data from the trials were entered into a computerised data basis and used to calculate yield reliability and regression lines for the three main production areas differentiated as cool, moderate and warm. At the Cultivar Evaluation Committee meeting held during September 2008 one entry was approved for registration on the variety list namely, Lex D 2103 R. The 2007/08 report on the national soybean cultivar trials was also accepted for publication. Mean seed yield at all localities evaluated was 2 456 kg ha^{-1} (1 717 kg ha^{-1} for 2007 and 2 811 kg ha^{-1} for 2006). Highest yields were obtained at Vaalharts (4 399 kg ha^{-1}), Cedara (3 394 kg ha^{-1}) and Koedoeskop (3 190 kg ha^{-1}). The cultivar LS 678 (2 611 kg ha^{-1}) yielded best on average overall and SNK 500 (2 171 kg ha^{-1}) the poorest. The cultivar with the highest percentage protein content was Stork with 42.9 % and lowest was LS 6150 R with 40.0 %.

5.2 THE INCREASE IN SOYBEAN PRODUCTION ON THE HIGHVELD: Mr W.F. van Wyk; Contractor, Protein Research Foundation, Pretoria

The aim of this project is to define guidelines for the cultivation of soybeans on the Highveld.

The following three trials were executed under this project:

- Evaluation of row width, plant density and cultivar;
- Evaluation of fertilisation (potassium and phosphate levels); and
- Evaluation of different pesticides.

Row width, plant density and cultivar:

The various plant densities showed significant differences in terms of yield between low and high densities in the 2006/2007 season. However in this season there were no significant differences. The yield on the 25 cm row width was significantly better than the 100 cm row width, but not significantly better than the 50 and 75 cm row widths. The plant and seed heights varied significantly between the different cultivars, row widths and plant populations. The protein and oil contents were lower than last season.

The difference in yield from a plant population of 400 000 pl/ha at a row width of 25 cm (3965 kg/ha) and a plant population of 400 000 pl/ha at a row width of 100 cm (3435 kg/ha) was 530 kg, which is not significant. However, if a

monetary value were to be assigned to this (at R3500/ton) then an additional R1855/ha would be realised for the 25 cm row width in the high population. The straight-type cultivar which was planted this season (LS 6162) did not cover the leaf roof in the 75 and 100 cm rows in either the 300 000 or 400 000 plant stands. This is also a very fast cultivar and could possibly be used in the future to fight sclerotinia due to the fact that flowers form before any infection and also due to the fact that the micro-climate within the rows is not optimal for the formation of sclerotinia.

Fertilisation trial:

In the fertilisation trial, significant differences in yield resulted from different potassium levels. It is also evident that yield correlates positively with the quantity of potassium, but that there is no pattern with regard to phosphate levels. This observation indicates once again the importance of the amount of calcium in the soil for absorption by the plant. The lack of reaction with the phosphate levels can probably be ascribed to the fact that the soil P (13 mg/kg P) is still sufficient even at the phosphate 0-level. All treatments were applied on the same research area. The Phosphate 0-level would therefore decline over time. Since potassium and phosphorous levels are currently being built up, it is now necessary to let this trial run in order to determine the optimum levels of both these minerals in the soil. This information will answer many questions on the fertilisation of soybeans.

Pesticide trial:

The pesticide trial was planted with a better understanding than last season of the nature of the pest spectrum in the soil. Specific pesticides were used alone or in combination in order to test their efficacy on pests and their effect on the yield of soybeans. Unfortunately, most of the problem (or hard-to-manage) pests such as edible bulbs (a few), morning glory (none) and wandering Jew (none) did not occur and therefore certain pesticides could not be tested to their full potential. There were no significant differences in the yield between the different treatments.

It is a given that pests in soybeans should be controlled, whether there is good yield or not. Pests lead to many secondary problems such as harvesting problems, multiplication of the pest population and the difficulty of controlling these in the following seasons.

5.3 EFFECT OF SO_2 AND THE INTERACTION OF GROWTH, PHYSIOLOGY AND BIOCHEMISTRY OF SOYBEAN *(GLYCINE MAX)*, STUDIED IN AN OTC SYSTEM: Mr J.M. Berner, S. Lindeque, Dr P.D.R. van Heerden, Prof G.H.J. Krüger; School of Environmental Science, North-West University, Potchefstroom

The effect of SO_2 fumigation on two soybean cultivars, LS 6164 and PAN 1666, were investigated. The aim of this study was 1) to establish exposure-response relationship for SO2 in soybean and to determine the critical levels leading to yield reduction under South African growth conditions, and 2) to determine the extent of genotypic variation in tolerance against these air pollutants in the South African soybean gene pool.

The dry weight of the roots of LS 6164 fumigated with 25 ppb increased by 42%. After a period of 70 days of fumigation, the 75 and 150 ppb treatments resulted in a 25 and 26 % decrease in root biomass. PAN 1666 showed decreases in root biomass at all three levels of SO_2 of between 50 – 60 %. The number of nodules of both cultivars decreased as the levels of SO_2 increased. Decreases for LS 6164 were between 8 and 33 %. For PAN 1666 the 150 ppb treatment resulted in an 80 % decline in nodules while the 25 and 75 ppb treatments showed declines of 21 and 24 %. The photosynthetic performance index (PIabs) measured after 4 weeks indicated that the 150 ppb treatment was 33 % lower compared to the control and the 75 ppb treatment was only 6 % lower. There were no differences between the control and the 25 ppb treatment. However, with the PAN 1666 cultivar the PIabs of the 75 and 150 ppb treatments dropped by 37 and 28 % respectively. From these results it appears that the PAN 1666 is more susceptible to SO_2 pollution especially when levels reach 150 ppb.

5.4 PHENOTYPIC MARKERS FOR NODULATION CAPACITY OF SOYBEAN CULTIVARS: Ms Urte Schlüter, Dr Riekert van Heerden, Dr Karl Kunert; Universities of Pretoria and North-West

Nitrogen fixation in nodules offers an important advantage in that soybean nodules fix the nitrogen required for plant growth resulting in the production of high-protein seeds. The life of a nodule is, however, remarkably short (11-13 weeks). Nitrogen fixation declines rapidly as the nodules age, and has normally almost ceased by the time pod-filling starts. Soil drying and high temperature stress can cut short the nodule lifespan affecting seed production, crop quality and yield. The objective of the project is therefore to identify easily measurable physiological and biochemical markers which might be applicable in a soybean breeding program to allow soybean cultivars to be selected for growth in the drier areas of South Africa.

Research is carried out at the University of Pretoria in collaboration with North West University and the University of Limpopo comparing high-yielding soybean cultivars with potential for South Africa with a reference (benchmark) cultivar (Jackson) known to have water deficit tolerance.

Research activities have focused on optimisation by conducting experiments using special glass-fibre wigs located at different vertical positions in potting medium to control water supply to plants. This method allows for precise control and standardisation of plant growth/soil water status. Experiments have shown that drought stress reduces stomatal conductance and net photosynthetic assimilation rate of the tested cultivars Prima, A-54 and Jackson. However, reduced stomatal conductance and net photosynthetic assimilation rate were immediate and the decline was high in A-54 when compared to Jackson and Prima. The quantum yield of photosynthetic electron transport efficiency measurement was less affected during the course of stress period but was affected at the end of the drought treatment in all cultivars. Despite the fact that comparable effects of drought stress in nodule parameters in A-54 and Jackson were observed, the decrease in nodule number and fresh weight were higher in A-54 than in Jackson. This decrease in nodules, fresh weight and number was not related to nitrogenase activity in Jackson. The nitrogenase activity of A-54 under well-watered conditions was higher than in Jackson. However, at the onset of the drought period, activity declined which was not found in Jackson. The drought-induced ageing effect might be less severe in Jackson than in A-54. Overall, Prima was superior for most parameters with A-54 the most sensitive. In our experiments so far carried out, Jackson showed under drought higher stomatal conductance, net photosynthetic assimilation rate and root biomass when compared to A-54.

5.5 ESTABLISHMENT OF AN EARLY WARNING SYSTEM FOR SOYBEAN RUST: Dr M Craven, Mr T.M. Ramusi; ARC-Institute for Grain Crops

Due to the destructive nature of soybean rust and the apparent lack of adequate resistance to the disease an effective disease-management system is required until such time that resistant cultivars become available. Disease scouting to detect the presence of the pathogen as early as possible is an important factor in an effective management programme. It has been used in the USA with great success.

Since April 2005, ARC-GCI together with the Protein Research Foundation (PRF) and other co-workers such as PANNAR, the KwaZulu-Natal provincial department of agriculture and a number of soybean producers have attempted to create a soybean-rust-early-warning system that is based on trap crop trials, also referred to as indicator plots. During 2007/08, 10 localities were identified, representative of the major soybean production areas in the Free State, KwaZulu-Natal, Mpumalanga and Gauteng provinces. During 2007/08 rust was first detected at Greytown (28/01/08) followed by Vryheid (01/02/2008) and Normandien (05/03/08). Kestell, Kinross, Greylingstad and Potchefstroom remained free of rust during this season.

5.6 DETERMINING THE EPIDEMIOLOGICAL VALUE OF RESISTANCE TO RUST CAUSED BY *PHAKOPSORA PACHYRHIZI* IN SOYBEAN LINES: Prof N.W. MaLaren, Ms C Botma: University of the Free State

A study to identify key driving variables in rust epidemics and to relate these to disease severity and concomitant yield and quality losses has been completed and is being prepared for publication.

Sequentially planted field trials over a five year period included 90 and 45 cm row spacings and three varieties that differed in maturity group i.e. PAN494, LS666 and SCS1. Plots were duplicated to include applications of fluzalizole/ carbendazim against which to measure yield and quality losses in unsprayed plots. At maturity, grain yield, 1000 kernel mass and oil and protein concentrations were determined. No relationship between first detection and planting date could be determined. Significant, negative relationships between Relative Life Time at first detection and Area Under the Disease Progress Curve (AUDPC) (R^2=-0.53, -0.71, -0.52, in PAN494, LS666 and SCS1 respectively) were recorded. Similarly, the rate of rust development subsequent to onset differed depending on prevailing conditions and this criterion was positively related to AUDPC (R^2=0.64, 0.59, 0.53, in the three genotypes respectively). Pooling of these criteria into a multiple regression model increased the relationship to R^2=0.82, 0.81, and 0.67 in the short, medium and long season varieties, respectively indicating that these are major driving variables in rust epidemics. Since rust occurred in the fungicide sprayed plots, the AUDPC x yield loss analysis was performed by relating the difference in AUDPC in corresponding fungicide and untreated plots with the difference in yield loss percentage. Regression relationships of R^2=0.72, 0.85 and 0.77 in PAN494, LS666 and SCS1 between AUDPC and yield loss were recorded. In addition, the ratios of AUDPC in the respective sprayed and unsprayed plots were used to determine the spray efficiency in each plot and this ranged from 16.4 to 93.9 %. Application of the respective yield loss models to rust development in fungicide sprayed plots allowed the calculation of yield losses associated with fungicide treated plots and these ranged from 4.0 to 64.8% indicating that despite fungicide application, some degree of yield loss can be expected depending on spray efficiency. No significant relationship between disease development and oil or protein content was recorded.

This study has indicated that selection of genotypes or promoting conditions that delay the onset of disease and reduce the rate of disease development can have a significant effect on the severity of rust epidemics. Despite fungicide applications, losses of varying magnitude may still occur and careful attention needs to be given to spray efficiencies.

A collection of isolates of *P. pachyrhizi* has been initiated to determine races of the pathogen. These will be analyzed using AFLP analysis as well as a differential set of lines. Isolates will also be used to determine differential infection on a set of selected lines.

5.7 THE USE OF SILICON TO CONTROL SOYBEAN RUST *(PHAKOPSORA PACHYRHIZI)*: Dr Dael Visser, Dr Pat Caldwell: University of KwaZulu-Natal

Aim: To determine the effect of root application of silicon for the control of soybean rust.

Materials and Methods: For pot trials, soybean seed (LS 6161) will be planted in pots and placed in a greenhouse. Si (0, 50, 100, 250, 500, 1000, 1500 and 2000mg/ℓ) will be applied by drenching pots for 6 weeks. Plants will be naturally infected in the glasshouse with urediospores during the summer months. Thereafter plants will be rated for percentage disease and the AUDPC calculated. For field trials soybean seed (LS 6161) were planted at Baynesfield (2007/2008) and Cedara (2008/2009) in 3 x 1.75 m plots. Plants were treated with Si at 0, 50, 100, 250, 500, 1000, 1500 and 2000 mg/ℓ at Baynesfield and 500, 1000 and 2000 mg/ℓ (2 and 4 times applications), a slow release Si fertilizer spread throughout the rows and broadcast over the plot. A Punch C and untreated control was also included. Soil samples were taken before Si was applied and after the first and last Si application and analyzed for Si concentration. Plants were rated for percentage disease and the AUDPC calculated. Yield was also determined.

Status: Field trials at Baynesfield in the 2007/2008 season have been conducted and analyzed. The 2007/2008 soil results from Baynesfield show no significant difference in Si after the first Si application. After the last Si application, the 2000 mg/ℓ showed a significantly higher concentration of Si than all other treatments. The untreated control had the highest AUDPC, with 100, 250, 500 and 1000 mg/ℓ being significantly lower. Plants treated with Punch C has had significant higher yields. No applications of Si resulted in increased yield but Punch C had the significantly highest yield. Possibly the first application of Si was not applied early enough and a third application should have been applied. This trial was repeated at Baynesfield in the 2008-2009 season but plants were not infected with soybean rust and so the trial was not harvested. A similar trial was run at Cedara in 2008-2009 and results are currently being analysed. Pot trials will be run in November 2009.

5.8 GENERATING MANAGEMENT-ORIENTATED MAPS OF LONG-TERM SOYBEAN RUSTSUSCEPTIBLE AREAS IN SOUTH AFRICA: Ms Lauren van Niekerk, Dr Pat Caldwell: University of KwaZulu-Natal

Soybean rust (SBR) poses a serious threat to soybean production worldwide and in South Africa. Research has been done on the epidemiological characteristics of SBR, resulting in an understanding of the effects of temperature and moisture conditions on *Phakopsora pachyrhizi* urediospore germination. However, limited knowledge exists as to whether certain locations in South Africa are susceptible to SBR infection. This means that farmers do not know whether SBR is a risk in their area and hence may not

manage their risk appropriately. The objectives of this research are to (1) create management-orientated spatial maps showing areas at risk to SBR infection and, (2) develop a framework for near real-time rust susceptibility forecasting.

A literature review has been completed in order to gain insight into history, geographic extent and most importantly the epidemiological characteristics of the pathogen. An overview of different SBR models was done in order to better understand the advantages and short-comings of present models and to gain understanding of the current SBR models applicable to Southern Africa. It was found that little had been done to map the extent and frequency of risk from SBR in South Africa.

An algorithm (Eq. 1) was created based on first principles gathered from literature regarding the conditions needed for SBR. The algorithm was developed using 2001/2002 SBR outbreak data from fungicide trial data and weather data from an automatic weather station at Cedara for the same period.

$$I_T = \max\left[0, \min\left(1, if\left(T < 22, \left(T - 15\right) \times 0.2, 1 - \left(T - 25\right) \times 0.3333\right)\right)\right] \times D \quad (1)$$

where:

I_T	=	Index
T	=	Hourly temperature (°C)
D	=	Darkness indicator

This algorithm was tested against the 2002/2003 SBR outbreak trial data and weather data from the Cedara automatic weather station. The results were presented to a few SBR experts who agreed that it appeared accurate. Unfortunately no other data record could be found against which the model could be validated.

The algorithm was then programmed and run over a 50-year historical weather dataset, for the period 1950 – 1999 for relatively small climate zones throughout the country. The results of this were mapped using Arcview 3.3. In addition a time series graph was created for all the following soybean production areas, Bergville, Cedara, Vryheid, Delmas, Groblersdale, Marble Hall, Marken, Naboomspruit, Parys, Potchefstroom and Rustenburg.

An analysis of the result is currently being completed after which the forecasting framework will be developed. A hind casting chapter will be included, where the algorithm will be tested against weather data from an independent location where outbreaks of SBR have been recorded. A statistical analysis of the accuracy of the algorithm to predict conditions suitable for SBR outbreaks will be done.

5.9 STUDY OF INOCULANTION AND DISEASE EVALUATION TECHNIQUES FOR *SCLEROTINIA* STEM ROT OF SOYBEAND: Prof N.W. McLaren, Ms C Botha: University of the Free State

The objective of the study is to evaluate cultivars and alternate germplasm (imported lines) for environment x physiological stability and Sclerotinia stem rot resistance.

Soybean lines and commercial cultivars were planted in Greytown (Pannar) for Sclerotinia stem rot evaluation. Five planting dates were used spaced approximately two weeks apart to ensure environmental diversity during the critical susceptible stage of host growth. At flowering, plants were inoculated with *Sclerotinia sclerotiorum.* Plants were scored at the end of the season for disease severity and host responses are being quantified using the regression methodology (McLaren & Craven, 2008). Results of screening trials to date indicate that most germplasm is susceptible to Sclerotinia stem rot even under less than optimal conditions for disease development although some cultivars, notably A 5601 RG, may be regarded as lower risk cultivars.

Field trials are also being used to model the relationship between weather variables and Sclerotinia stem rot severity. Temperature and leaf wetness duration studies indicate the optimum temperature for disease development at 20-25°C although greenhouse trials have indicated that disease may occur within the range of 18-28°C providing that sufficient moisture is available. High humidity or free moisture is critical for disease development with optimal disease development at relative humidity (RH) >95% whereas disease incidence and severity decreased rapidly with decreased RH with little or no disease at RH< 90 %. Although the relationship between disease severity and weather variables could be modelled, more data points are required to optimize the relationship and ensure more reliable conclusions.

Samples of *S. sclerotiorum* were collected from areas where the disease was prominent and are being used to determine the genetic relationship between isolates from the different areas and their effect on pathogenicity. Laboratory evaluations of oxalic acid production by *S. sclerotiorum* isolates were carried out and a series of tests are being conducted to evaluate the importance of oxalic acid produced by *S. sclerotiorum* and their relevance to pathogenicity, while also focusing on the ability of plants to resist the activity of this acid i.e. oxalate oxidase is generally associated with a resistant response to the pathogen. Growth studies on the different isolates also suggest that there may be different ecotypes adapted to different temperature ranges. AFLP analysis will be used to quantify population diversity.

5.10 SUPER SOYA COMPETITION, KWAZULU-NATAL: Mr C Havenga, Contractor, Protein Research Foundation

The Super Soya Competition in KwaZulu-Natal is now in its nineteenth year and interest in the competition is still high.

This competition is an extension programme to promote the production of soybeans in KwaZulu-Natal. Interest in soybean production as well as knowledge about its production has increased significantly over the past 19 years. However, the extent to which soybeans are planted annually is, to a large degree, influenced by the maize/soya price ratio.

Winterton and Bergville still fall under the South Region (S-KZN). This season there were 17 entries into the competition for S-KZN and 33 entries of N-KZN.

In S-KZN yields varied between 2.6 and 4.8 t/ha with an average of 4.0 t/ha which is an average of 1.0 ton/ha higher than the previous season.

Five fields (29 %) were under irrigation with an average yield of 4.1 t/ha ranging between 3.6 and 4.8 t/ha. Yields under dry land ranged from 2.6 to 4.6 t/ha with an average of 3.7 t/ha.

The yields for this season's Super Soya Competition in N-KZN varied between 1.2 and 5.1 t/ha with an average yield of 2.8 t/ha. The average yield under irrigation was 3.7 t/ha which is considerably higher than the average dry land yield.

In general the protein content of the soybeans in S-KZN was good to very good, with an average protein content of 39.8% (dry matter basis) which varied between 37.6% and 41.2 % (dry matter basis).

In N-KZN the protein content of the soybeans was satisfactory to very good. The average protein content was 39.9 % (dry matter basis) which is higher than the previous seasons 38.8 %. The protein content ranged from 36.5 to 46.7 % (dry matter basis).

The oil content of the soybeans in S-KZN varied between 20.5 and 22.3 % (dry matter basis), with an average of 21.3 % which is a big improvement on the previous season. There was no significant difference between the average oil content of soybeans under irrigation (21.1 %) and those under dry land (21.4%).

The average oil content of N-KZN soybeans was 20.8 % (dry matter basis) and varied between 13.2% and 28.1 %.

This competition also creates an opportunity to record and evaluate production practices and assists in identifying production problems which can, in turn, lead to research projects targeted at solving these problems.

5.11 CULTIVAR EVALUATION OF OIL AND PROTEIN CROPS IN THE WINTER RAINFALL REGION: Mr P.J.A. Lombard: Department of Agriculture, Western Cape

National cultivar trials: Canola and Lupins

The Department of Agriculture Western Cape conducted several canola and lupin trials in the Swartland and Southern Cape during 2008. The trial sites at Riversdal and Tygerhoek were planted at the end of May. The rest of the Southern Cape trials were planted late in May and beginning of June due to a drought period in May. The germination in those trials was slow and not good.

Canola

The average yield of the trials in the Southern Cape were 1.75 and 1.78 ton/ha at Riversdal and Tygerhoek respectively. The average yield of the triazine tolerant (TT) and Clearfield (CL) cultivars were on average 19 and 12 % lower than the conventional cultivars.

The yield from cultivar Garnet (2.8 ton/ha) was significantly better at Tygerhoek than from the other cultivars in the trial. Bravo TT (1.92 ton/ha) was the best TT and 45Y77 (2.04 ton/ha) the top producing Cl cultivar. The top producer at Riversdale was NPZ SR 10308 (2.34 ton/ha), followed by 44Y06 and Garnet. There was no significant difference between the top 5 cultivars in the trial.

The average yield in the Swartland differed between 2.39 ton/ha (Darling) and 2.67 kg/ha at Langgewens 2. The yield of the first planting at Langgewens 1 (14 May) was 8.8 % lower than the second planting (27 May). This was the first time since 1999 that the yield of the second trial was higher than that of the first. The reason was the low average temperatures in September with good rainfall.

Garnet was the best producing cultivar in 3 of the 4 trials that were included in Canola Focus. The cultivar 44Y06 (3.15 ton/ha) was the top producer at Langgewens followed by 44C11 and Garnet. Bravo TT was the best TT and 45Y77 (2.04 ton/ha) the top producing Cl cultivar.

Lupins

The average trial yield in the Swartland was above average in 2008. The cultivar Mandelup (2.3 ton/ha) was, as in 2006 and 2007, the highest yield producer followed by Quilinock (2.2 ton/ha) and Tanjil (1.7 ton/ha). The highest yielding line was 2224 (2.35 ton/ha).

The new lines performed very well in the Southern Cape. The lines 42 (2.75 ton/ha) and 23 (2.79 ton/ha) gave a higher seed yield than Mandelup (2.7 ton/ha). The trials at Riversdale and Klipdale were planted on 24 April and 5 June and their respective average yields were 2.42 and 2.58 ton/ha.

5.12 AN INVESTIGATION INTO THE PRODUCTION DYNAMICS OF EIGHT CROP ROTATION SYSTEMS, INCLUDING WHEAT, CANOLA, LUPINS AND PASTURE SPECIES IN THE SWARTLAND, WESTERN CAPE: Dr J Strauss, Dr M.B. Hardy, Mr W Langenhoven: Department of Agriculture, Western Cape

Climatic conditions during 2008 were favourable for dry-land crop and pasture production at Langgewens. Above average rainfall was experienced over the growing season (April to October) and rainfall was well distributed. Temperatures remained mild and the hot dry periods that often occur during the growing season did not materialise. The average temperature in September was lower than that in August, which contributed to the high yields obtained in the canola and wheat crops.

Mean wheat yield over all systems was 3818 kg/ha. This was slightly lower than the previous season. As has been recorded over almost all seasons (2005 was an exception) there were clear differences in yield among the different crop sequences. Wheat yields following legume pasture and lupins were greater than wheat yields in all other systems.

Canola was harvested at the beginning of November. The yields obtained during harvesting (“straight”) ranged from 1381 to 2901 kg/ha. The average crude protein (% CP) over all plots was 23 % and the oil content averaged 34%.

The project is progressing according to the research proposal and protocols. Management and production data are regularly presented to the local farming community in popular publications and on occasions such as farmer’s days. The information is also made available to technical advisors of the various Agri-businesses that operate in the area.

5.13 ECONOMIC SUSTAINABILITY OF SHORT- AND LONG-ROTATION CROP/PASTURE PRODUCTION SYSTEMS IN THE SOUTHERN CAPE: Dr M.B. Hardy, Dr JA Strauss, Mr W Langenhoven: Department Agriculture, Western Cape

The aim of this study is to determine the short- and long-term effects of a number of the most feasible short- and long-rotation crop and crop/pasture rotation systems identified for the Southern Cape region on; crop yields, weed control, disease suppression, soil production potential, sheep production and economically sustainable land-use in the Southern Cape.

The 2008 year was the 7th year of production. The trial comprises two main components namely; short-rotation systems that are being tested at Tygerhoek experimental Farm at Riviersonderend and long-rotation systems that are being tested on farms in the Riversdal and Swellendam districts respectively.

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

Low and erratic rainfall occurred for much of the season throughout the southern Cape region. The Swellendam site experienced its worst rainfall season since the trial started in 2002.

Poor soil moisture before and after the start of the planting season limited the emergence, establishment and growth of crops at the Tygerhoek site, with the crops in the continuous cropping treatment experiencing less moisture stress than those in the other treatments. It appears that there was greater soil moisture availability in the continuous cropping treatments (their crop residues not being disturbed or removed by sheep) and the soils were not compacted (as occurs with sheep grazing).

Soil moisture availability remained favourable at the Riversdale site throughout the season resulting in excellent yields at the site.

Canola production – Canola (Spectrum) was planted at Riversdale following wheat. A seeding rate of 3.0 kg/ha was used and a total of 48 kg N/ha was applied to each plot (24 kg N/ha at planting and 24 kg N/ha top-dressing).

Jade was planted at Swellendam at 5 kg seed/ha and with 24 kg N/ha at planting. Canola (Thunder) was planted at Tygerhoek. A seeding rate of 3.8 kg/ha was used and a total of 54 kg N/ha was applied to each plot (24 kg N/ha at planting and 30 kg N/ha top-dressing).

Canola yields at Riversdale ranged from 1900 to 2100 kg/ha. These yields were approximately 50 % of the yields obtained from wheat and Triticale (see below).

No canola seed was harvested at the Swellendam site because of the severity of the dry conditions at the site.

The average canola yield over all plots at Tygerhoek was 1016 kg/ha, which is acceptable in comparison to the expectations of the region but still only about 44% of the average yield for wheat at the same site. Estimated average plot yield was, however, about 100 % greater than the harvested yield i.e. an estimated yield loss of 50 % was observed. Note that we need to refine the sampling technique used to estimate potential yield, but over that past few seasons the yield loss estimates have been consistently high (in the region of 20 to 50 % loss).

As has been reported for previous seasons the average oil content of seed from the Riversdale site, as determined at the SSK facility in Swellendam, was again higher (41 % oil) than for duplicate samples analysed at the Elsenburg Laboratory (33 % oil).

Lupin production – Lupins (Quillinock) were planted at the Riversdale and Tygerhoek sites at a seeding rate of 100 kg/ha. The Riversdale site produced the highest yield ranging from 2100 to 2350 kg/ha. At Tygerhoek yields were more variable ranging from 1100 to 1950 kg/ha. Soil physical limitations in one of the plots are thought to have contributed to the low yield recorded in that plot. Lupin yields were higher than expected considering the poor rainfall experienced at the Tygerhoek site.

5.14 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: Dr J Labuschagne: Department of Agriculture, Western Cape

The aim of this project is to quantify the effects of tillage practice and crop sequence on soil physical and chemical properties, and soil biological activity with a view to gaining a better understanding of soil parameters that will promote sustainability in crop production systems on the shale derived soils of the Western Cape.

Tillage treatments and planting

At the Langgewens site the scarifying (tine) operations in the conventional and minimum tillage sub-plots were done on 12 February and 13 May respectively. At the Tygerhoek site the scarifying (tine) and plough operations were done on 29 January and 3 May. The loose seedbeds in the conventional treatments caused some difficulty in achieving uniform seeding depths.

The wheat monoculture crop sequence treatments at Tygerhoek had serious herbicide resistant annual ryegrass infestations. Since the trial's main objective is to determine the effects of tillage and crop sequence on the soil, the wheat zero till plots were killed off using a broad-spectrum herbicide (glyphosate) after wheat ears had emerged but before the ryegrass seed heads could produce viable seed. It is assumed that any effect that a wheat crop would have on soil physical and chemical status would be expressed due to the wheat being present for the greatest part of the growing season.

Rainfall

Climatic conditions during 2008 were favourable for dry-land wheat production especially at the Langgewens site. September was however wetter and cooler than normal, at both sites. The Langgewens site experienced periods of waterlogged conditions early in the growing season

causing dying off of lupin and canola plants leaving open areas ideal for weed infestation.

Crop production data

Seedling/plant densities

The mean seedling density for wheat at Langgewens was 111.8 seedlings/m^2 and later in the season mean ear counts of 278 ears/m^2 were recorded. The lowest seedling density (92 plants/m^2) was observed in the conventional till sub-plot of the LKCK rotation system. The plants compensated as 260 ears/m^2 were recorded on the same plots in October 2008. As a result of continuous high rainfall during the first part of the growing season at Langgewens, lupin and canola sub-plots became waterlogged causing dying off of the crops mentioned. Weed infestation occurred in the bare spots and it was decided to use a non-selective herbicide to kill all growth (except one canola replicate) on these treatments.

Plant density for wheat was much lower at Tygerhoek at 61.2 plants/m^2, excluding the zero-till sub-plots where only 26.4 plants/m^2 were counted. Unfavourable seedbed and soil water conditions could be the reason for the low seedling counts. The zero-till plots were sprayed with a non-selective herbicide to minimise weed seed production on these plots.

At Tygerhoek a mean of 30.69 canola seedlings/m^2 were counted.

Grain yield

Wheat yields of 4.56 and 2.92 tons ha^{-1} were recorded for Langgewens and Tygerhoek respectively. At Langgewens the highest yield of 4.96 t/ha recorded on the conventional plots was not significantly higher than the 4.90 t/ha harvested on the no-till sub-plots. At Langgewens the lowest yield of 3.99 t/ha was recorded on the zero-till plots. The minimum till canola plot yielded 2.06 t/ha (highest) and the lowest yield was recorded on the conventional till sub-plot (1.47 t/ha).

Wheat yields at Tygerhoek from the conventional, minimum and no till plots were 3.08, 3.01 and 2.68 t/ha, respectively. Canola at Tygerhoek yielded 1.59 t/ha, with the conventional plots the highest at 1.64 t/ha. Minimum and no-till canola yielded 1.57 and 1.58 t/ha respectively.

Remarks

The project is progressing according to the research proposal and protocols. The severe ryegrass problem is being managed without compromising the integrity of the treatments and their potential effects on the physical and chemical status of soils. Short-term effects of tillage system, crop sequence and site on crop yields should become more apparent over time.

5.15 ASSESING CANOLA SEED LOSSES DURING SEED RIPENING AND HARVESTING IN THE WESTERN CAPE PROVINCE: Dr J Strauss: Department of Agriculture, Western Cape

The farming community of the Western Cape has raised questions about the difference between the potential yield of canola (as indicated by several seasons of canola cultivar trials) and the actual (or realised) yields achieved by producers and delivered to the silo. An average of 21 seeds on an area the size of a matchbox relates to 400 kg/ha, where the seed has a thousand kernel weight of 4 g. Avoidable seed losses currently exacerbate the perception that canola production is less profitable than wheat production.

The trial consisted of a farm survey and statistical trial that compared canola seed losses between the two types of harvesting methods, namely swathing and straight. In the first production season high losses in canola yield of between 31 and 43 % were measured in the farm survey and between 24 and 28 % in the statistical trial. In the farm survey, swathed canola showed the lowest losses, while the straight canola had a higher yield in the statistical trial. The biggest losses occurred during the harvesting process. The survey and statistical trial will be repeated in 2009.

5.16 THE PROMOTION OF CANOLA AS A ROTATIONAL CROP WITHIN A CONSERVATION FARMING SYSTEM IN THE DRY LAND PLANTING REGION OF THE SWARTLAND AND SOUTHERN CAPE, THROUGH THE USE OF PRODUCER COMPETITION: Mr I.F.V. Slabbert and Mr C.L. van Rooyen: Department of Agriculture, Western Cape

A. SWARTLAND CANOLA COMPETITION 2008

Thirteen farmers entered the Canola Competition in the Swartland and information from all competitors could be used.

Although the first rains were somewhat late to ensure a good canola potential, favourable weather conditions persisted till the beginning of September. Thus the average yield of the participants was 1.34 t/ha, which was 0.24 ton less than the previous year (2007).

Mr Frikkie Russouw from Moorreesburg was the participant with the highest yield (1.7 t/ha) and Mr Michiel Smuts from Malmesbury recorded the highest gross margin (R3532/ha).

The runners up, Mr Daniel Rossouw (1,62 t/ha) and Mr Abrie Richter (R2601/ha) are both from Piketberg.

Canola was more profitable than wheat during 2008.

B. SOUTHERN CAPE CANOLA COMPETITION 2008

The competition started out with 22 respondents but the drought whittled the number down to 12 at the end. The climate was not conducive to early sowing and the bulk of the rain only fell from mid-June. The shorter growing season cultivars performed better than anticipated because of the late rains. Early sown canola took 75 – 90 d before emerging. The pre-emergence weed control failed due to lack of rain in the critical periods. The yields were better in the western parts because the canola could make better use of the late rains.

Some of the triazine-tolerant cultivars have been around for a long time and needs to be replaced. The availability of the best cultivars were lacking and producers sowed more farm seed than normal. In the Clearfield types the situation was even worse in the 2009 planting season as seed for certain areas were to late for early sowing. Canola looks to have reached a point of stagnation in hectares planted and only an increase in price will contribute to further expansion of canola in the Southern Cape.

The winner of 2008 was Mr Andrew Beukes of the farm Vrede with a yield of 2.4 t/ha and in 2nd place, the Blom brothers of Bredasdorp.

5.17 N-FERTILIZATION OF CANOLA BASED ON N-MINERALISATION AND N LEACHING: Prof G.A. Agenbag: University of Stellenbosch

Field experiments were again conducted at Langgewens-, Elsenburg-, Welgevallen- and Roodebloem Experimental Farms during 2008 to evaluate the response of canola to increasing (0-120 kg N ha^{-1}) N application rates. Unfortunately no results were obtained at Welgevallen because the experiment had to be abandoned due to very wet and flooded conditions. Soil and plant analyses were conducted at Langgewens and Elsenburg.

At both localities, sub-optimal soil pH (<5.0 pH_{KCl}) and S (<6.0 mg kg^{-1}) content occurred, while B was shown also to be low (<0.2 mg kg^{-1}) at Langgewens. Plant analysis showed sub-optimal S contents (<0.5%) at both localities. In comparison to general norms for Na, Al and Fe of 300 - 5000 mg kg^{-1}, 200 mg kg^{-1} and 150-200 mg kg^{-1} respectively, high contents were found at both localities.

As was the case during previous years, yield responses varied considerably between localities. In contrast to Langgewens and Elsenburg, low rainfall and very dry conditions were experienced at Roodebloem for most of the growing season. At Roodebloem, grain yields of 582 kg ha^{-1} were obtained without any nitrogen fertiliser, compared to yields of 890 kg ha^{-1} with 120 kg N ha^{-1}. There were no statistical differences in yield with 90 or 120 kg N ha^{-1}. Yields at Elsenburg varied between 1435 with no nitrogen application and 2235 kg ha^{-1} with an application of 120 kg N ha^{-1}. In comparison, a yield of

2649 kg ha^{-1} was obtained at Langgewens without any N fertiliser. At this locality the highest grain yield of 2961 kg ha^{-1} was produced when 60 kg N ha^{-1} was broadcast at planting and a further 60 kg N^{-1} applied as topdressing 60 d after planting. At both Langgewens and Elsenburg, no statistical increas in yield was achieved when N application rates increased from 60 to 120 kg N ha^{-1}, on condition that N application at lower rates were band placed at planting. Due to high rainfall and, presumably, large leaching losses, similar yields were obtained when 30 kg N ha^{-1} was band placed at planting and 30 kg N ha^{-1} applied as topdressing 30 d after planting, compared to a total broadcast application of 120 kg N ha^{-1}.

The large differences in grain yield produced without any N application again emphasises the need to consider the N mineralization potential of the soil when N fertiliser requirements are determined.

5.18 OPTIMAL SOIL TILLAGE METHODS TO BE USED IN A WHEAT/CANOLA/ WHEAT LUPIN CROP ROTATION SYSTEM IN THE SWARTLAND PRODUCTION AREA: Prof GA Agenbag: University of Stellenbosch

In this experiment on Langgewens Experimental Farm, the effect of soil tillage methods on soil fertility and crop yields has been studied for the past 30 years and that of two crop rotation systems for more than 15 years.

During 2008, an average grain yield of 2474 kg ha^{-1} was produced when wheat was planted in a four year crop rotation with lupins (2007) and canola. In comparison to this, wheat planted in a monoculture system yielded only 2062 kg ha^{-1} on average. From these results it became clear that although wheat is planted only every second year in the crop rotation systems, grain yields are increased by 20 %. In the crop rotation system where wheat was planted after lupins, the highest yield of 2567 kg ha^{-1} was produced with only 20 kg N ha^{-1} band placed at planting. In the monoculture system, the highest wheat yield of 2157 kg ha^{-1} required an application of 100 kg N ha^{-1} which was divided between 20 kg N band placed at planting and two topdressings at 30 and 60 d after planting. In the monoculture system high yields were achieved only when seedbed preparation was done by intensive, time consuming and costly mouldboard ploughing, but in the crop rotation system, no tillage planting resulted in similar yields compared to mouldboard ploughing. This tendency can to a very large extent be ascribed to the more effective chemical wheat control which is only possible when crop rotation is practiced.

These results showed that when sound crop rotation systems that include crops such as canola and lupins are used, increases in wheat yield can be obtained with reduced fertilizer and soil tillage inputs.

5.19 MANAGEMENT OF HERBICIDE RESISTANCE IN THE WESTERN CAPE: Dr P.J Pieterse, University of Stellenbosch

The testing for herbicide resistance and record keeping progressed satisfactorily. Only 43 of 47 seed samples harvested in 2008 were tested due to insufficient seed being received or to poor quality seed. Currently only two plant samples for the 2009 season are tested.

Counts of weed seedlings in the rotational cropping and soil tillage trials on Langgewens experimental farm were carried out in June and August 2008. Samples of wheat and weeds in these two trials were collected in October 2008 to determine biomass. Results showed that from a ryegrass control point of view, mouldboard ploughing was the superior tillage method and in terms of crop rotation, annual pastures such as medics and clover were superior to any other cropping system to reduce ryegrass numbers in fields on Langgewens. Seed from weeds in these plots was harvested and the resistance profile will be investigated later in this season.

The glasshouse trial to investigate the competitive ability of canola and wheat cultivars was completed in 2008 and a trial was sown on Welgevallen experimental farm where four wheat cultivars with varying degrees of competitiveness will be evaluated under different weed pressure levels. The first data have been collected but not yet analysed. The canola trial will be planted in 2010.

5.20 CHARACTERIZATION AND MANAGEMENT OF *RHIZOCTONIA* ON CANOLA AND LUPIN CROPPING SYSTEMS IN THE WESTERN CAPE PROVINCE: Dr SC Lamprecht: ARC-Plant Protective Research Institute

In this study several aspects with regard to the management of *Rhizoctonia* diseases of canola and lupin such as disease resistance, seed treatment and biological control using binucleate *Rhizoctonia* anastomosis groups (AGs) were investigated under glasshouse conditions. The resistance of eight canola and eight lupin cultivars/selections to damping-off and hypocotyl/root rot caused by the multinucleate *Rhizoctonia* AG-2-1, 2-2, 4 and 11 was evaluated. The canola cultivars included were the conventional cultivars, Comet, Outback, Spectrum and 44C11, the clearfield cultivars Rocket and 44C73 and the triazine tolerant cultivars Thunder and Tornado. Cultivars/selections of three lupin spp. were included viz. Cedara 6150 and E16 (*L. albus*), Mandelup, Tanjil, Quilinock and E42 (*L. angustifolius*) and E80.1.1.2 and E82.1.1 (*L. luteus*). Three isolates of each multinucleate AG were tested and trials were conducted in a glasshouse. The AGs most virulent on canola were AG-2-1 and 4. Canola cultivars did not differ significantly in their susceptibility to AG-2-1. However, Spectrum and 44C11 were more resistant to AG-4 than the other cultivars. On lupin, AG-2-2 and 4 were most virulent and the cultivar Cedara 6150 and selection E16 were most resistant to AG-2-2, and Cedara 6150, E16, Mandelup and Quilinock were also more resistant to AG-4 than the other cultivars/selections. The *L.*

luteus selections, E80.1.1.2 and E82.1.1 were most susceptible to AG2-2, 4 and 11. Seed treatment with Cruiser OSD and SA-combination significantly increased survival of canola (cvs Muster, Rocket and Thunder) and lupin (cultivar/selection Cedara 6150, E82.1.1 and Mandelup) seedlings, decreased hypocotyl/root rot and improved the percentage healthy seedlings, with SA-combination being significantly more effective than Cruiser OSD. The binucleate *Rhizoctonia* AGs (A, Bo, K and I) significantly increased the survival of lupin seedlings inoculated with AG-2-2 and 4. A low inoculum ratio of the binucleate AGs [1:1 (multinucleate AG :binucleate AG)] was less effective than a high inoculum ratio [1:10 (multinucleate AG :binucleate AG)]. It appeared that AG-Bo and I were more effective in protecting lupin seedlings against multinucleate AGs than the other binucleate AGs. The binucleate AGs did improve survival of canola inoculated with AG-2-1, 2-2 and 4, but it was not statistically significant. This is the first report of the potential of binucleate AGs to protect lupin seedlings against multinucleate AGs. Results obtained in this study can contribute significantly to management strategies that can be employed against *Rhizoctonia* diseases of canola and lupin in the Western Cape province of South Africa.

5.21 INSECT AND OTHER PESTS OF CANOLA: Dr G Tribe: ARC-Plant Protective Research Institute

The most promising treatments resulting from the 2008 trial were slug pellets containing both metaldehyde and carbaryl broadcast on the surface at planting, followed by treatment of seeds with Cruizer. A combination of the two treatments promises to give satisfactory protection.

Isopods once again were shown from the trial data to be the most important organism responsible for the loss of canola seedlings, where treatments which caused the death of isopods also had the highest number of surviving seedlings, and vice versa. The slug population in the 2008 season was relatively low with the result that no definite conclusions could be drawn with respect to the different treatments on them. Slugs were classified into four size cohorts and 89.3 % of the slugs occurred in the ‘small’ and ‘medium’ cohorts which are a result of eggs laid in autumn and winter of the previous season. This indicates that it is those slugs that successfully over-summered from the previous season which are to blame for the losses of seedlings.

Three species of exotic slugs were identified within the canola fields but one species, *Deroceras panormitanum*, comprised ±85 % of all the slugs. The size of this slug when elongated would allow it to enter the tunnels of earthworms and this may be the reason why it predominated. Soil excavated under traps at the end of the season revealed no slugs or isopods, and indications are that both species do not occur as deep in soil as previously thought.

Trials comparing four slug pellet formulations showed that all were extremely effective in attracting and killing slugs, but that only those which contained a

carbamate insecticide killed isopods as well. However, carbaryl also killed millipedes and other insects but did not kill crickets, neither of which have been shown to injure canola seedlings and therefore could be considered beneficial in recycling stubble.

The marking and recapture of isopods revealed that populations within a canola field may vary between 51 and 170/m². Of the few marked isopods that were recaptured, most had remained under the traps where they had been marked, and only two were found to have migrated four metres to adjacent traps. The vast majority of marked isopods simply disappeared.

Plants containing the cabbage stem weevil, *Ceutorhynchus pallidactylus*, had on average 17.8 larvae per plant where most were aggregated within a small area of the plant, usually near unconsumed pith. The inner pith of the entire plant was often totally consumed making translocation of nutrients in the plant impossible.

5.22 CALIBRATION OF NEAR INFRARED (NIR) SPECTROMETER FOR AMINO ACID ANALYSIS IN ANIMAL FEED: Dr M Ciaciariello: University of KwaZuly-Natal

The aim of this project is to determine whether NIR technology could be used to determine the protein, lipid and digestible amino acid content of feed ingredients, mixed feeds and carcass samples rapidly, accurately and inexpensively. A wide range of feeds and carcass samples has been analysed over the years in Animal and Poultry Science at the University of the KwaZulu-Natal for protein, energy, total and digestible amino acids, and these were used as the basis of the evaluations. If this technology could be used successfully, this would reduce considerably the cost and time involved in such analyses.

Calibration curves for protein and total amino acid contents of fishmeal, lupins, maize, full-fat soya and soya oilcake have thus far been performed, with promising results. Further calibrations for the digestible amino acid contents of the above ingredients are currently being conducted, whilst carcass samples will also have been analysed by the end of this year.

5.23 THE EFFECT OF LIGHTING ON THE EFFICIENCY OF UTILISATION OF DIETARY PROTEIN BY COBB AND ROSS BROILER STRAINS USED IN SOUTH AFRICA: Prof RM Gous: University of KwaZulu-Natal

Two broiler trials were conducted during the year, making use of a total of 7960 Cobb and Ross broiler males, which were reared to 35 d on various photoperiods between 2 and 21 h or under continuous illumination. There were no significant influences on either feed intake or growth for photoperiods less than 6 h, but significant depressions in intakes and growth for daylengths shorter than this. Feed conversion efficiency was maximised

by 12-h photoperiods, with decreases in efficiency above and below 12 h. Mortality was unaffected by photoperiods of less than 12 h, but increased proportionately with longer photoperiods. The incidence of Sudden Death Syndrome (SDS) decreased between 2 and 10 h, but was positively related to photoperiod above 12 h. The European Efficiency Factor was curvilinearly related to photoperiod; with the highest efficiency occurring at 12 h.

By 5 d, birds given less than 15 h illumination had learned to eat in the dark at a rate inversely proportional to photoperiod; further increases in nocturnal feeding rates occurred between 5 and 20 d in birds on these shorter photoperiods. The hourly rate of nocturnal feeding was consistently lower than diurnal feeding, irrespective of photoperiod.

There are thus many advantages in using daylengths shorter than those conventionally used in South Africa at present: bird welfare is improved, with a lower incidence of SDS and mortality and with bone strength being increased; electricity usage would be decreased by 1.6 mWh p.a., and because the efficiency of utilisation of feed is improved, annual feed protein usage in South Africa could be decreased by as much as R400m.

5.24 THE EVALUATION OF RAW SOYBEANS IN DIETS OF GROWING OSTRICHES: Prof TS Brand: Department of Agriculture, Western Cape

Due to the presence of trypsin inhibitor, raw soybeans are either excluded from or included at a very low level in diets fed to farm animals. The effect of the inclusion of raw soybeans in diets of ostriches is however unknown.

Two experiments are therefore currently being executed at Elsenburg to determine the effect of including raw soybeans in diets on the performance of ostriches. In the first experiment diets with varying amounts of raw soybeans were presented to birds on a free choice basis to determine whether the birds would be prepared to eat the diet containing raw soybeans. In the second experiment birds will be fed diets with an increasing percentage of raw soybeans and a decreasing percentage of heat-treated soybeans. Production (feed intake, growth and feed conversion ratio) will be monitored. This experiment will enable soybean producers that cannot heat-treat the beans to use this valuable protein source unprocessed.

5.25 INCOME AND COST BUDGETS: Mr JSG Joubert: Protein Research Foundation

During the report year, the services of a contractor were utilised to assist with the compilation of economical and technical/biological information used in the calculation of income- and expenditure budgets of crops in which the PRF have an interest. In the Winter rainfall region, information for the calculation

of budgets were obtained from Agri-organisations for the southern Cape regions, whilst group discussion forums were utilised in the Porterville and Malmesbury areas for obtaining information for the Swartland. Information from the Moorreesburg area was once again obtained from the Cooperative. Given the new policy adopted by the Moorreesburg Cooperative, the group discussion method will probably be used in future to obtain this information.

With regard to soya, maize and sunflowers in the summer rainfall regions, there was also a deviation from the standardised work method. All the budgets in the Mpumalanga area were re-done by assimilating new information from producers via the group discussion method.

The areas for which information was assimilated for Mpumalanga were also adapted. Regarding KwaZulu-Natal, the numbers from the Department of Agriculture were not used and information was assimilated through the group discussion technique. Information for the Free-State was obtained from the "Vrystaat Koöperasie Beperk (VKB)", as in the past.

Sunflower as a crop was included in the budgets for the first time in areas where it is deemed to be an important competitive crop.

Income- and cost estimations of soya, maize and sunflower (not for all areas listed below) were compiled in the following summer rainfall areas:

Mpumalanga	- Kinross - Middelburg - Groblersdal (Irrigation)
North West	- Brits / Koedoeskop / Makoppa (Irrigation) - Tarlton / Boons - Koster - Lichtenburg / Coligny - Zeerust
Free State	- Vrede and Frankfort - Reitz, Bethlehem and Harrismith
KwaZulu-Natal	- Karkloof - Vryheid

In the Winter rainfall area of the Western Cape province, income- and expenditure estimates of canola, wheat and lupins (last mentioned not compiled for Malmesbury and Porterville) were compiled for:

Western Cape	- Moorreesburg - Malmesbury - Porterville - Caledon / Riviersonderend - Bredasdorp / Napier - Swellendam / Heidelberg

The income- and expenditure estimations contain information on a per hectare basis of gross incomes, directly allocatable variable costs and gross margins. Managers and prospective producers can utilise this information to compile or adapt their own budgets in order to be empowered to make informed decisions. The information reflects typical situations under normal climatic conditions and is not an average.

5.26 MODELS: ARP- and Nieuwoudt/McGuigan Model

During the 2008 report year, the APR- and Nieuwoudt/McGuigan models were once again utilised to make projections of the protein requirements for animal consumption for 2010 and 2015. The APR-model was used to project the total protein requirement in the basis year 2006/2007 by animal species after which the Nieuwoudt/McGuigan model was used to make projections of protein requirements by animal species as a whole for 2010 and 2015.

For the purposes of this exercise, the PRF was interested only in the projections of oilcake requirements for the abovementioned periods and the other protein sources, such as fish meal, gluten, poultry by-product meal etc., were disregarded.

The projected oilcake consumption for 2010 was estimated to be 1 918 763 ton and for 2020, 2 681 414 ton.

The 2007 research report mentioned that the PRF was interested in investigating what could be delivered by the BFAP model of the University of Pretoria. This model analyses international and local markets through base-line projections and the development of scenarios based on possible market- and policy variables. The impact of changes is then translated/relayed to local markets regarding farming profitability and sustainability. When scenarios are developed for organisations such as the PRF, the following variables, amongst others, are considered:

- Urbanisation and population growth;
- Increasing concentration of protein markets;
- Availability of research capacity, knowledge and experience;
- Efficiency in protein consumption by animals;
- Profitability and risk of soya production versus, for example, maize production;
- Tariff policies;
- Economic growth both internationally and in the RSA;

- Oil expressing capacity;
- Climatic changes;
- Policy directions the Government might take; and
- Energy consumption and types of energy;

The PRF has reached an agreement with the University of Pretoria to develop ready-made scenarios for the PRF that will generate information leading ultimately to more accurate predictions with regard to the protein market for animal consumption. Initially the idea was to integrate the BFAP-model with the existing APR- and Nieuwoudt/McGuigan models in order to make more accurate predictions. Unfortunately, this does not seem to be a practical possibility and therefore the results from the BFAP-model will be used in the other two models for the annual projections of protein requirements.

PRF Board members, as well as other invited experts from various disciplines, attended a workshop in 2008 with the BFAP personnel and developed concept scenarios. Unfortunately, the PRF continues to have issues with certain assumptions that were used and these are currently receiving attention, prior to the finalisation of the scenarios which will hopefully be completed for the next report year.

5.27 PRF Website

The website remains one of the most powerful and important vehicles of communication of the PRF. It is for this reason that the PRF is continuously marketing the website to a wider audience and striving to make it increasingly user friendly.

During the report year, the website was evaluated by peers in order to determine whether large scale changes were required. The conclusion of the peer evaluators was that the website design was neat and functional and well programmed. A few cosmetic suggestions were made, such as font size, colours, etc, of which some were implemented.

During the report year, much attention was again paid to the database which is now well established and to which new research information is entered as it is received. We have also started loading historical information into the database. News snippets remain a popular item; it is also now managed by removing old news on an ongoing basis and also adding news items from work groups. Links with other websites remain a high priority and during 2008 we created reciprocal links with an Australian website following a visit to that country by one of our Board members. This specific website has since become an important source of reference for visitors to the PRF website.

The popularity of the PRF website can be measured by the number of unique visitors over time which numbers are as follows:

- 2004 - 1 691 unique visitors
- 2005 - 3 285 unique visitors
- 2006 - 4 552 unique visitors
- 2007 - 5 404 unique visitors
- 2008 - 11 104 unique visitors

Search engines remain the most important source of reference and currently around 70 % of all visitors are referred via search engines. One of the most important search engines is www.aardvark.co.za.

6. PROTEIN SOURCES

6.1 General

The actions of the PRF centre around protein for animal consumption as well as better utilisation of protein as already mentioned. In the past, a large variety of protein sources was researched, but in accordance with the policy of the PRF, the current focus is only on those protein sources that have the potential to make a quantitative difference and progress in the local market. Subsequently, the protein sources that currently receive funding are limited to soybeans and canola. Although fish meal and sunflower remain important to the PRF, no research funding was made available for these sources in the past year, mainly because they do not conform to the expansion possibilities as detailed above.

The generic marketing campaign which has already been approved with regard to soybeans and referred to above, should make a significant contribution to the execution of the vision and mission of the PRF. More results will be seen in 2009/2010, whilst canola will follow in 2010/2011.

6.2 Soybeans

The PRF is optimistic that soybeans are poised for strong growth in the immediate future. This is confirmed by the strong display of soya prices throughout the year, and soybeans have indeed become a strong competitor for maize. International proof of the advantages of rotational crop systems of maize and soybeans in a system of minimum tillage prompted the PRF Board to investigate the possibility of mounting a massive generic marketing campaign for soya and to implement this as soon as possible, as mentioned in paragraph 3.

For large parts of the year, soybeans traded above R4 000 per ton on Safex and continuously increased the gap with maize prices. Compared to 2006/2007 the hectare margin declined from 183 000 to 174 000 for

2007/2008 (substantially lower than the record of 243 000 hectares in 2005/2006, but the expected yield has increased from 205 000 to 328 000 ton). In contrast, the crop estimate for 2008/2009 is 224 000 hectares and 405 000 ton, the second highest numbers ever.

As mentioned already in this report certain policy amendments have placed the PRF in a position actively to promote soybeans. Ties specifically with Brazil and Argentina look promising and more detail will be supplied in the next research report.

The most important action, apart from identifying the correct cultivars, still remains technology transfer. Cooperation with Grain South Africa to publish articles in their publication, SA Grain, works well and the PRF would like to acknowledge their support. Great appreciation is often expressed by producers for the information distributed in this manner.

A soya think tank was planned during 2008/2009, but due to logistical reasons it had to be postponed to 2009/2010.

The Super Soya competition still continues and 19 years later remains successful (see paragraph 5.10 above). Cooperation with the No-till Club from KwaZulu-Natal was made possible thanks to Mr Johann du Plessis and indications are that great advantages are in store for even more successful cultivation of soybeans in the future.

Problems of a greater- and lesser extent were experienced this year. Seed companies threatened to withhold new cultivars from the industry should producers continue the practise of holding back grain for seed. Considerable attention was paid to this issue during the PRF Soya work-group meetings, and Grain South Africa (GSA) is currently attending to this issue.

Several soya work-group meetings were held again this year, with great success. The same is true for the annual PRF Soya rust working group and also the PRF Sclerotinia working group meetings. The PRF would like to acknowledge the National Crop Estimates Committee (NCEC) for their assistance with the questionnaires aimed at determining the incidence of sclerotinia. In addition, the PRF acknowledges all the co-workers who make these meetings the success that they are. Projects in this respect, as discussed above, are already receiving attention.

On the same topic, it has been decided to review and update the soybean rust pamphlet, and the PRF would like to thank Dr Pat Caldwell under whose guidance this has been achieved. This is still available in pamphlet format and also on the PRF website.

6.3 Canola

The PRF believes that there is still a future for canola in South Africa, especially in the light of the tremendous growth of canola in the rest of the world where more than 50 million tons is now being produced. It remains an oilseed that is in high demand and has also proven to be a useful rotational crop especially with wheat in the Western Cape. Yield is not yet what it could be and a small push is required to bring the profit margins of this oilseed in line with that of wheat, which would make it more competitive also.

As discussed earlier in this report, a substantial amount of canola research is still being funded, and there has also been a large investment in technology transfer in the past year. The PRF decided to pay considerably more attention to the promotion of canola in the coming year. One of the projects that will receive special attention will be the so-called Canola competition, discussed in more detail in paragraphs 5.16(a) and (b).

A highlight for the local canola industry was the publication 'Canola Production Guidelines' compiled by Prof. André Agenbag being the outcome of a THRIP project. This publication is a valuable addition to the 'Canola Production Manual' previously published by Dr Jos de Kock, a Board member of the PRF. Both documents are available on the PRF website, whilst 'Canola Production Guidelines' is also available from the PRF in hard copy and on CD.

The Canola Focus which was sponsored by the PRF over the past number of years remains an important resource for conveying the latest information to producers. The PRF would like to acknowledge Messrs. P. Lombard, J. Bruwer and Dr N. Kotze who comprise the editorial team of Canola Focus, as well as all co-workers who continuously make contributions that ensure the success of the publication.

It was noted this year, after long delays, that the concept regulations regarding grading, packaging and marking of canola targeted for sales in South Africa, according to the Law on Agriculture Production Standards, Act 119 of 1990, was accepted by the Department of Agriculture.

Aside from several smaller information days, the Skog- and Riversdal days are still being utilised to introduce canola to increasing numbers of producers. The PRF is one of the principals of Skog and partly funds the project of Dr. Hardy (see 5.19 above) which is conducted in Riversdal on the farm belonging to Mr. Fanie Joubert.

The study tour to Australia, discussed above, was aimed at promoting closer ties and cooperation within the canola industry internationally. This mission was under the leadership of Dr Jos de Kock, a Trustee of the PRF, and included Messrs J. Bruwer and P. Lombard, in accordance with a new policy decision of the PRF discussed above. Progress resulting from this visit will be discussed in the following research report.

In an attempt to identify issues that hamper the progress of the canola industry, the Board has approved a project entitled 'Canola Adoption Decisions in the Overberg'. Unfortunately the project has not yet been initiated and will receive attention in 2009/2010.

All the above mentioned actions are aimed at breaking through the apparent stagnation of the industry and to promote significant annual progress. Following good initial progress, hectares under canola were as follows:

2006 : 32 000
2007 : 33 200 and
2008 : 34 000.

6.4 Lupins

In the research report of 2007/2008 it was mentioned that no further research funds will be made available for lupin research after 31 December 2008 and the necessary reasons were given for taking this decision. The past season yielded only 13 300 tons on 14 000 ha which once again reinforces our decision.

The PRF has however decided to see the lupin issue through to its logical conclusion. Seed from promising cultivars and lines in the possession of the PRF will be made available to interested parties together with the results of the past two years' cultivar trials. In an attempt to make a sufficient quantity of seeds available to such institutions, the process of terminating PRF funded lupin research will only be completed in the 2009/2010 financial year.

In the meantime it has also been agreed with the ARC-IGC that the lupin germplasm in their possession will be transferred to the National germplasm bank for safekeeping.

7. SHORT- AND MEDIUM TERM DEMAND FOR FISH MEAL AND OILCAKE

During the marketing year covering the period 1 April 2007 to 31 March 2008, the demand for fish meal was 55 000 ton and the demand for oilcake 1 758 185 ton. This reflects the amounts consumed largely in the commercial market. For the preceding period of 1 April 2006 to 31 March 2007 the corresponding consumption was 60 000 ton fish meal and 1 635 525 ton oilcake. This shows a decline in the consumption of fish meal in 2007/2008 of 5 000 ton or 8.3 % against the previous marketing year, whilst oilcake consumption increased by 122 660 ton or 7% for the same period.

The substitution of fish meal with oilcake was not of the same magnitude as in previous periods and could still be ascribed to the favourable price relativity of soya oilcake to fish meal. During 2008, the price of fish meal locally as well as

internationally was on the increase due to an increased demand, but production did not keep up with this demand. On average the price in 2008 was R6 500 per ton and at one stage as high as R8 500 per ton. Underlying factors were important drivers – higher soy prices as well as a decline in the value of the Rand. In contrast to this, the world production of fish meal in 2008 was much the same as in 2007, which was noted for low production and a subsequent pressurised supply position.

The international fish meal price freight on board (FOB) Peru was, for example, $820 at the beginning of 2008, then started rising to reach $1 100 in the middle of 2008 after which it declined to $850 at the beginning of 2009. The two main role players in the international arena are Peru on the supply side and China on the consumer side. Any substantial deviation with regard to supply and/or demand of these two role players has a direct impact on the price of fish meal.

The price ratio of fish meal with a protein content of 65 % to soy meal with a protein content of 47 % also fluctuated substantially over the past five years, specifically from around 3:1 in January 2003 to approximately 7:1 in July 2006 and to 5:1 at the start of 2009. The favourable movement in the fish meal/soya oilcake price relationship also brought about the expectation that there would be a substantial increase in the local consumption of fish meal in the 2008/2009 marketing year (81 000 ton) against the current marketing year of 55 000 ton.

The local production of fish meal, which included Namibia, ended at 92 000 ton for the 2007/2008 marketing year. The estimated production for the 2008/2009 marketing year is expected to be around the same number.

Production of fish meal in South Africa over the past 5 years could have been much higher if the industry were able to catch the Total Permitted Catch (TPC). Regarding anchovies, 250 000 ton of the allocated 517 000 ton could not be caught in 2008, which represents 60 000 ton of fish meal. This can be ascribed to a variety of factors such as climatic conditions, a decline in catch and a lack of processing capacity.

The higher oilcake consumption in the marketing year 2007/2008 was brought about especially by an increase in the consumption of soya oilcake. If the consumption of AFMA members can be used as a yardstick, then there was a substantial increase in the consumption of soya oilcake from 2006/2007 to 2007/2008 whilst there was a marked decline in the consumption of full fat soya, cottonseed oilcake and canola oilcake. Sunflower oilcake is also an important commodity and the consumption by AFMA members was around 170 000 tons for both 2006/2007 and 2007/2008.

The consumption by AFMA members of the total oilcake was 62.3 % for the marketing year 2007/2008 against the 65 % in the marketing year 2006/2007. The soya oilcake consumption of AFMA members, which includes full fat soya (expressed in oilcake equivalent) is 80.6 % of their total oilcake consumption.

On international markets, oilseed and oilseed products experienced a volatile period in solidarity with the financial markets. Prices of oilseeds and vegetable oils saw

dramatic price declines from the beginning of July 2008 to the beginning of December 2008. The price declines were preceded by a dramatic rise in the prices of the same products from the start of 2008 to July 2008. During the second half of 2008, the prices of soy on the Rotterdam market plummeted by 49 %, that of Canola by 51 % and that of the already overvalued sunflower by 60 %. Bear factors such as a greater than expected USA soybean crop, a decline in demand and good harvests with regard to other seeds such as sunflower added to these price declines. Against this backdrop, worsening harvesting conditions in South America as well as a surge in demand from China caused a strengthening in the price of soy during the last 3 weeks of 2008.

The worldwide economic crisis also led to a decline in demand of livestock products. This then caused a lower demand for oilcake which, together with an increase in feed grain supply and large supplies of oilcake supply, caused a lowering in the price of oilcake. During November 2008 the expectation was that 117.2 million tons of soybeans would be produced in the Southern Hemisphere. Brazil would deliver 59 million ton, Argentina 50 million ton, Paraguay 6 million ton, Bolivia 1.2 million ton and Uruguay 1 million ton. Production in the Northern Hemisphere was estimated at 79,5 million ton for the USA, 10.1 million ton for India, 16,6 million ton for China, 0,98 million ton for the EU, 3,24 million for Canada and 5,74 million ton for the other soy producing countries in this Hemisphere. This brings the total world soybean production to an expected 234 million ton which is 12 million ton more than the 2007/2008 production season. The opening supplies however are 8.7 million tons less than the opening supplies of the previous season. The consumption of 236.8 million tons during 2008/2009 will however lead to the decline in end stock of 2.4 million ton. World production of canola increased by 9 million tons to reach 57.7 million tons in 2008/2009. International exports of canola are expected to increase by 28 % to 10.9 million tons. Despite the increase in prices of certain commodities at the end of December 2008 the worldwide economic crisis must still be seen as the largest contributing bear factor.

The total local consumption of oilcake for the 2007/2008 marketing year was 1 758 185 ton, of which the local market could only supply 494 557 ton. This led to the import of 1 263 628 ton or approximately 72 % of the local consumption. During the 2006/2007 marketing year, 1 027 156 ton or 63 % of local consumption was imported. According to expectations, the 2008/2009 season will again see imports of over 1 million ton of oilcake.

Projections of oilcake requirements for 2010 and 2020 which were made in March 2008, were discussed in the 2007 Research Report. The projections were 1 918 763 ton for 2010 and 2 681 414 ton for 2020, respectively. More up-to-date projections are not yet available due to the fact that we await more accurate projections from the BFAP model of the University of Pretoria. From these projections it is clear that the backlog is great and that we have to make special attempts to close the gap between total demand and local production.

In this regard the PRF has already commenced with a special marketing program for soy and canola which will be launched in the next report year. The planned

production of bio-diesel by RNRF in Coega also has the ability to contribute greatly in increasing the local production of oilcake.

8. STUDY BURSARIES

The Bursary Committee of the PRF received seven applications for bursaries for the 2008 academic year. Five bursaries were awarded to those applicants who complied with the criteria set out by the PRF.

The aim of these study bursaries is to provide deserving candidates with the opportunity to obtain a Master's or Ph D degree by conducting high quality scientific research involving protein production and/or its efficient usage in animal feed.

In the case of a Master's degree the subject of study by the prospective candidate must fall within the broad guidelines of the vision, mission and goals of the PRF, whereas a study bursary for a Ph D will only be considered if the subject of study is regarded as being of a high priority to the PRF.

Students are encouraged, in cooperation with their supervisors, to promote their research through the publication of scientific and/or popular articles in recognised journals or magazines once their studies have been completed.

It is the aim of the PRF to grant a maximum of eight bursaries per annum, of which at least two should be new bursaries. Of the five bursaries granted for the 2008 academic year, two were new applications.

The applicants listed below received a bursary to the value of R30 000 per annum. Bursaries for Master's and Doctoral studies are granted for a period of two and three years respectively. Bursaries for the ensuing years are granted only if a progress report is submitted and a recommendation is made by the supervisor that satisfactory progress has been made in the preceding year.

M Sc Studies

1. Ms M. Strydom (Second application): "Dierevoeding ten opsigte van die monogastriese dier (Enkelmaagdier)". University of Stellenbosch.

2. Mr D.B. Strydom (Second Application): "Die ekonomiese impak van hernubare brandstof produksie op die Suid-Afrikaanse veevoer bedryf". University of the Free State.

3. Mr T.L. Khetani (First application): "An evaluation of the effects of feed restriction on protein intake and its consequences on egg composition and incubation success in broiler breeder hens". University of KwaZulu-Natal.

4. Ms P.T. Mabulwana (First application): "Determination of drought stress tolerance among soybean varieties by morphological and physiological characteristics". University of Limpopo.

Ph D Studies

1. Ms B.K. Theeruth (Second application): “Evaluation and optimisation routine for the profitable feeding of growing pigs”, University of KwaZulu-Natal (This application has been held over to 2009, due to international obligations of the student)

Completed Theses and Dissertations received

During this report year, the following dissertations were received from bursary holders who have completed their studies:

1. Mr H. Nienaber: “The effect of roughage to concentrates ratio on ruminal fermentation and protein degradability in dairy cows”. University of Pretoria.

2. Ms E.R. Malleson: “Fishmeal supplementation to high producing Jersey cows grazing on rye grass and kikuyu pasture”.

9. ACHIEVEMENT AWARDS IN SUPPORT OF THE VISION AND MISSION OF THE PRF

In order to support the vision and mission in the achievement of its goals, the PRF makes provision for achievement awards to individuals in the following categories:

- Best Doctoral thesis;
- Best Master’s dissertation;
- Best scientific article;
- A person who has made an outstanding contribution in order to promote the vision and mission of the PRF;
- A Board Member who has, over time, played a significant role in the promotion of the activities of the PRF.

The goal of the first two categories is to encourage post graduate students to focus on high quality subjects of study which will promote the goals of the PRF, whilst the third category is aimed at encouraging researchers to publish their research in recognised scientific journals. The aim of the fourth category is to acknowledge those persons who have delivered exceptional contributions, especially in the field of technology transfer. The fifth category is aimed at giving recognition to Board Members who have, over an extended period of time, played a significant role in the activities of the PRF. The following awards were made from a number of nominations received:

1. Best Doctoral thesis: Dr M.K. Nonis, “Modelling nutrient response and performance of broiler breeders after sexual maturity”. University of KwaZulu-Natal.

2. Best Master’s dissertation: Ms D.D. Visser, “Studies on *Sclerotinia sclerotiorum* (sclerotinia stem rot) on soybeans”. University of KwaZulu-Natal.

3. Best article in a scientific magazine: Mr R. Strauss, “The role of low soil temperature in the inhibition of growth and PSH function during dark chilling in soybean genotypes of contrasting tolerance”. North West University.

4. A person who has made an outstanding contribution in promoting the goals of the PRF: Mr C.J. du Plessis. Mr du Plessis, previously a Board Member, is currently farming in KwaZulu-Natal and still continues to make valuable contributions to the success of the Super Soy competition.

5. A Board Member who, over time, made a significant contribution to the activities of the PRF:

   - Dr M. Griessel and
   - Mr J.S.G. Joubert.

All the awards, with the exception of that to Dr Nonis who is currently working abroad, have been presented at appropriate functions.

10. CONCLUSION

Funding and people are the primary requisites for ensuring that research is successful. There are few, if any, areas of research in South Africa in which both these resources are adequate. Yet in spite of several shortcomings already discussed in this document it is with gratitude that the PRF can report that good progress has been made in the past year, due to the cooperation of people and institutions as well as having sufficient funds available to continue with our activities.

Once again, the PRF has received a positive report from its auditors, the Ashton CA (SA) Group, and we thank them for providing the Board with the peace of mind that all the financial requirements with which the PRF has to comply have been fulfilled.

Similarly we would like to emphasise that it is not possible for the PRF to shoulder the entire financial burden for everything that has been discussed in this report. Our most important partners are the ARC, OPDT/OAC, the Winter Grains Trust, Universities and the Provincial Departments of Agriculture, especially in the Western Cape and KwaZulu-Natal.

People, and their contributions, are the source of the PRF’s success. It is impossible to mention everyone by name, but our heartfelt thanks go to all

researchers, contractors, consultants, peer evaluators, the media and the variety of authors, agricultural writers and journalists, radio presenters, co-workers in the PRF work groups, those who have assisted with trials, information days, demonstrations, etc. and literally everyone who has helped, directly or indirectly, to make the activities of the PRF a success.

The PRF Board would especially like to thank our Chief Executive Officer, Mr. G.T. duT Keun and his dedicated staff for the exceptional manner in which they continue to execute their daily tasks. To this core team, who shoulder the total administrative burden of the PRF, no time or trouble is too much to ask when a task needs to be completed, and the success of the PRF depends on them.

In closing, I would like to express my most sincere gratitude to every member of our Board of Trustees who continue, on a daily basis, to deliver even greater contributions to the activities of the PRF, especially in the light of policy changes that have placed greater pressure on Board Members. The combination of all people and institutions mentioned above and the Trustees of the PRF ensures that every person in South Africa reaps the benefits of the actions of the PRF.

GJH SCHOLTEMEIJER
CHAIRMAN

LIST OF APPROVED PROJECTS FOR 2008/09

1.	National soybean cultivar trials Mr JL Erasmus	ARC-Institute for Grain Crops
2.	The increase in soybean production on the Highveld Mr WF van Wyk	Protein Research Foundation
3.	Effect of SO_2 and its interaction with drought, on growth, physiology and biochemistry of soybean (G.max), studied in an OTC system Dr PDR van Heerden	North-West University
4.	Phenotypic markers for nodulation capacity of soybean cultivars Prof K Kunert	University of Pretoria
5.	Establishment of an early warning system for soybean rust Dr M Craven	ARC-Institute for Grain Crops
6.	Determining the epidemiological value of resistance to rust caused by *Phakopsora pachyrhizi* in soybean lines Prof NW McLaren	University of the Free-State
7.	The effect of silicon on the control of soybean rust *(Phakopsora pachyrhizi) on soybeans* Dr PM Caldwell	University of KwaZulu-Natal
8.	Generating management-orientated maps of long-term soybean rust susceptible areas in South Africa Dr PM Caldwell	ARC-Institute for Grain Crops
9.	Study of inoculation and disease evaluation techniques for *Sclerotinia* stem rot of soybean Prof NW McLaren	University of the Free-State
10.	Super Soya Competition, KwaZulu-Natal Mr C Havenga	Protein Research Foundation
11.	Cultivar evaluation of oil and protein crops in the winter rainfall region Mr PJA Lombard	Department of Agriculture, Western Cape

12.	An investigation into the production dynamics of eight crop rotation systems, including wheat, canola, lupins and pasture species in the Swartland, Western Cape Dr MB Hardy	Department of Agriculture, Western Cape
13.	Economic sustainability of short- and long rotation crop/pasture production system in the southern Cape Dr MB Hardy	Department of Agriculture, Western Cape
14.	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 Dr J Labuschagne (New Application)	Department of Agriculture, Western Cape
15.	Assessing Canola seed losses during seed ripening and harvesting in the Western Cape Province Dr J Strauss (New Application)	Department of Agriculture, Western Cape
16.	The promotion of canola as a rotational crop within a conservation farming system in the dry land planting region of the Swartland and southern Cape, through the use of a producer competition Mr IF Slabbert en Mr CL van Rooyen	Department of Agriculture, Western Cape
17.	N-fertilization of canola based on N-mineralisation and leaching Prof GA Agenbag	University of Stellenbosch
18.	Optimal soil tillage methods to be used in a wheat/canola/wheat lupin crop rotation system in the Swartland production area Prof GA Agenbag (New Application)	University of Stellenbosch
19.	Management of herbicide resistance in the Western Cape Dr PJ Pieterse (New Application)	University of Stellenbosch

20.	Characterization and management of *Rhizoctonia* on canola and lupin in cropping systems in the Western Cape Dr SC Lamprecht	ARC-Plant Protection Research Institute
21.	Insects and other pests of canola Dr G Tribe	ARC-Plant Protection Research Institute
22.	Calibration of near infrared spectrometry for amino acid analysis in animal feed Dr M Ciacciariello	University of KwaZulu-Natal
23.	The effect of lighting on the efficiency of utilisation of dietary protein by Cobb and Ross broiler strains used in South Africa Prof RM Gous	University of KwaZulu-Natal
24.	The evaluation of raw soybeans in diets of growing ostriches Prof TS Brand (New Application)	Department of Agriculture, Western Cape
25.	Income- and cost Budgets Mr JSG Joubert	Protein Research Foundation
26.	Models: APR- and Nieuwoudt/McGuigan model	University of KwaZulu-Natal
27.	PRF website	Protein Research Foundation

LIST OF PROJECTS COMPLETED IN 2008

	TITLE OF RESEARCHERS	INSTITUTION
1.	An evaluation of crop rotation with canola under irrigation Dr AA Nel	ARC-Institute for Grain Crops
2.	Evaluation of canola cultivars under irrigation Dr AA Nel	ARC-Institute for Grain Crops
3.	Lupin seed production Mnr JW Lodewyckx	ARC-Institute for Grain Crops
4.	A comparison of the response to dietary protein by the Cobb and Ross broiler strains used in South Africa Prof RM Gous	University of KwaZulu-Natal
5.	Salt tolerance of canola Prof GA Agenbag	University of Stellenbosch
6.	A comparative study on the growth and yield response of soybean to treatment with different bio-products Prof JC Pretorius	University of the Free-State
7.	Calibration of near infrared spectrometry for amino acid analysis in animal feed Dr M Ciacciariello	University of KwaZulu-Natal
8.	The evaluation of Distillers Dried Grains and solubles (DDGS) as a protein source for poultry and pigs Prof RM Gous	University of KwaZulu-Natal

SHORT- AND MEDIUM TERM REQUIREMENTS AND USAGE OF FISH MEAL AND OILCAKE

(Updated January 2009)

TABLE 1: FISH MEAL AND OIL CAKE BALANCE SHEET (2006/2007 - 2008/2009) (APRIL - MARCH)

	FISH MEAL (TON)			OIL CAKE (TON)		
Year	**2006/2007**	**2007/2008**	**2008/2009**	**2006/2007**	**2007/2008**	**2008/2009**
Requirements/Sales	60 000	55 000	100 000	1 635 526	1 758 185	1 700 000
Available/Produced	87 000	91 700	91 000	608 370	494 557	695 291
Shortage/Imports	***-27 000***	***-36 700***	***9 000***	***1 027 156***	***1 263 628***	***1 004 709***

2007/2008 - Estimate

Source: Fishing industry; AFMA Chairman's Report 2007/2008

TABLE 2: FISH MEAL AND OIL CAKE USAGE (2006/2007 - 2008/2009) (APRIL - MARCH)

	FISH MEAL (TON)			OIL CAKE (TON)		
Year	**2006/2007**	**2007/2008**	**2008/2009**	**2006/2007**	**2007/2008**	**2008/2009**
AFMA Members	37 871	48 156	93 247	1 063 945	1 094 941	1 087 989
Non-AFMA Members	22 129	6 844	6 753	571 581	663 244	612 011
Total	***60 000***	***55 000***	***100 000***	***1 635 526***	***1 758 185***	***1 700 000***

Source: AFMA Chairmans Report 2007/2008

2008/2009 - Estimate

* Non-AFMA Members figures can also include unused stocks

TABLE 3: THE MAIN RAW MATERIAL USAGE BY AFMA-MEMBERS (APRIL - MARCH) (2006/2007-2008/2009)

RAW MATERIALS	TOTAL (TON) (2006/2007)	INCLUSION RATE (%)	TOTAL (TON) (2007/2008)	INCLUSION RATE (%)	TOTAL (TON) (2008/2009)	INCLUSION RATE (%)
Sunflower oilcake	169 172	3.79	167 836	2.67	248 739	4.84
Groundnuts oilcake	316	0.01	0.00	0.00	2	0.00
Soya oilcake	653 463	14.64	752 073	15.35	720 345	14.01
Ful fat soya	183 047	4.10	130 609	2.67	79 209	1.54
Cotton oilcake	35 590	0.80	19 068 -	0.39	23 042 -	0.45
Fullfat cotton	10 241	0.23	9 074	0.19	5 330	0.10
Canola oilcake	4 330	0.10	2 963	0.06	2 362	0.05
Ful fat canola	3757	0.08	553	0.01	53	0.00
Copra and Palm Kernel	4029	0.09	7016	0.14	5398	0.10
Maize Germ Oil Cake	2859	0.06	5750	0.12	3509	0.07
Total oilcake	***1 063 945***	***24.67***	***1 094 941***	***22.34***	***1 087 989*** .	***21.16***
Total maize products	***2 428 502***	***54.05***	***2 627 498***	***53.61***	***2 888 653***	***56.18***
Total fish meal	***37 871***	***0.88***	***48 156***	***1.12***	***93 247***	***1.81***

Source: AFMA Chairmans Report 2007/2008

AFMA rawmaterial usage April 2008-March 2009

[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 (2005/2006 - 2007/2008) (APRIL - MARCH)

	LOCAL (RSA + NAMIBIA) FISH MEAL PRODUCTION (TON)			IMPORTED FISH MEAL (TON)		
Year	**2006/2007**	**2007/2008**	**2008/2009**	**2006/2007**	**2007/2008**	**2008/2009**
RSA	75 000	85 000	85 000			
Namibia	12 000	6 700	6 000			
Total	***87 000***	***91 700***	***91 000***	***-27 000***	***-36 700***	***9 000***

Source: AFMA; SA Fishmeal Marketing Company
2008/2009-Estimate.

TABLE 5: OIL CAKE: LOCAL PRODUCTION AND IMPORTS (2005/2006 - 2007/2008)

	LOCAL OIL CAKE PRODUCTION (TON)			IMPORTED OIL CAKE (TON)		
Year	**2006/2007**	**2007/2008**	**2008/2009**	**2006/2007**	**2007/2008**	**2008/2009**
OIL CAKE:						
Groundnuts oilcake	2 515	54	540		344	
Sunflower oilcake	199 500	138 558	371 935	68 808	103 987	
Soya Cake	113 440	115 200	258 396	808 051	904 214	
- Full fat	189 840	138 000		3 949	104 377	
Beans						
Cotton Cake	32 500	32 500	32 500	99 617	109 988	
- Full fat	35 000	35 000		39 766	33 338	
Other				6 965	7 425	
Canola	21 175	21 945	22 120			
Lupins	14 400	13 300	9 800			
Copra & Palm Kernel						
Total	***608 370***	***494 557***	***695 291***	***1 027 156***	***1 263 673***	***1 004 709***

Source: AFMA Chairman's report 2007/2008 :
Estimate - 2008/09 .The projected local production figures for soja and cotton reflect fullfat and oilcake

TABLE 6: OIL SEED AND GRAIN PRODUCTION IN THE RSA (TON)
TABLE 6: OIL SEED AND GRAIN PRODUCTION IN THE RSA (TON)
(2004/2005 - 2008/2009 - MARKETING SEASON)

CROP	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009
White maize	5 805 000	6 540 700	4 187 400	4 315 000	7 480 000
Yellow maize	3 677 000	4 909 300	2 430 600	2 810 000	5 220 000
Sorghum	373 000	260 000	96 000	176 000	255 000
Groundnuts	115 000	64 000	74 000	58 000	88 800
Sunflower	648 000	620 000	520 000	300 000	872 000
Soya beans	220 000	272 500	424 000	205 000	282 000
Cotton seed	50 169	37 804	25 962	19 525	17 378
Wheat	1 680 000	1 905 000	2 105 000	1 905 000	2 022 000
Sweet Lupines	3 950	14 100	14 400	13 300	14 000
Canola	32 000	44 200	36 500	38 150	34 000

Source: National Crop Estimates Committee ; Fifth forcast for winter crops (18 December 2008) and final crop estimate for summer crops for the 2008/09 marketing year (27 November 2008); Cotton South Africa .

TABLE 7: OIL SEED AND GRAIN SUPPLY IN THE RSA (TON)
(2008/2009 MARKETING SEASON)

CROP	Opening stock	Imports to RSA	Production	Total supply
White maize	618 000	0	7 480 000	8 098 000
Yellow maize	439 000	0	5 220 000	5 659 000
Sorghum	43 000	0	255 000	298 000
Groundnuts	19 000	10 000	88 800	117 800
Sunflower	95 000	3 000	872 000	970 000
Soya beans	97 000	16 000	282 000	395 000
Wheat	509 000	1 130 000	2 022 000	3 661 000
Canola	10 900	0	34 000	44 900

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

TABLE 8: AREA PLANTED TO OIL SEED AND GRAIN CROPS IN THE RSA
(2003/2004-2008/2009 PRODUCTION SEASON)

CROP	Ha planted 2003/04	Ha planted .2004/05	Ha planted .2005/06	Ha planted .2006/07	Ha planted .2007/08	Ha planted .2008/09
White maize	1 842 000	1 700 000	1 033 000	1 624 800	1 737 000	1 600 000
Yellow maize	1 001 300	1 110 000	567 200	927 000	1 062 000	962 000
Sorghum	130 000	86 500	37 150	69 000	86 800	94 900
Groundnuts	71 500	40 000	48 550	40 770	54 200	57 500
Sunflower	530 000	460 000	472 480	316 350	564 300	586 400
Soya beans	135 000	150 000	240 570	183 000	165 400	227 500
Wheat	748 000	830 000	805 000	764 800	632 000	748 000
Sweet Lupines	10 100	7 100	14 100	16 000	14 000	14 000
Canola	44 200	44 250	40 200	32 000	33 260	34 000
Total	4 512 100	4 427 850	3 258 250	3 973 720	4 348 960	4 324 300

Source: National Crop Estimates Committee:Intentions to plant Summer crops 2008/09 Production season (23 October 2008)
Fifth area estimate for winter crops 2008/2009 production season (18 December 2008)

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 STRUCTURE