PROTEIN RESEARCH FOUNDATION

2019-2020

RESEARCH REPORT

PROTEIN RESEARCH FOUNDATION

Vision

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

Mission

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

The PRF subscribes to…….

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

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PROTEIN RESEARCH FOUNDATION
RESEARCH REPORT 2019-2020

TABLE OF CONTENTS

1. INTRODUCTION 4

2. DISCIPLINES REPRESENTED ON THE BOARD 9

3. LIST OF PROJECTS FINALISED DURING 2018-2019 10

4. PROJECTS FINANCED 2019-2020 11

6. ACHIEVEMENT AWARDS TO PROMOTE THE PRF VISION AND MISSION 46

7. CONCLUSION 47

ANNEXURES 48

I LIST OF APPROVED PROJECTS IN 2019-2020 48

II PRF STRUCTURES 48

III LIST OF BURSARY APPLICATIONS: 1995 - 2020 48

IV LIST OF RESEARCH PROJECTS: 1976 - 2020 48

1. INTRODUCTION

During the 2019-2020 financial year the Board of Trustees once again succeeded in their efforts to achieve the Trust's objectives as set out in the Trust Deed.

- Objectives of the Trust

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

(a) Protein Research

Research on protein sources destined for animal feed either of animal origin or from oilseeds and other protein rich plants.

(b) Oilcake Research

Research related specifically to the oilseed protein value chain.

1.1 Board of Trustees

The Trust is administered and managed by a Board of Trustees convened from various disciplines. During the 2019-2020 year the Board comprised the following Trustees:

Mr AP Theron	-	Expert	:	Representative - Organised Agriculture - Producer of Protein Crops (Chairperson)
Dr E Briedenhann	-	Expert	:	Representative - Oilseeds Processors and Representative - Animal Feed Manufacturers (Vice-Chairperson)
Prof RM Gous	-	Expert	:	Discipline - Protein Consumers
Mr GT du T Keun	-	Expert at the discretion of the Board		
Prof FH Meyer	-	Expert	:	Discipline - Agricultural Economics

(i) General Overview

During the reporting period 1 March 2019 to 28 February 2020, the Trust met six (6) times. Two (2) of the meetings were combined with those of the Technology Committee.

During the period under review, R6 288 581 was approved in respect of research projects, technology transfer and bursaries.

Apart from funding and management of research projects and technology transfer, which form part of the core business of the PRF as set out as objectives in the Trust Deed, the final reorganising was done in order to streamline its work and to introduce measures to limit unnecessary expenditure on allowances, remuneration and administration.

The most important initiative taken was the introduction of discussions on the Soybean Value Chain.

(ii) Financial Overview

(a) Investment and Management of Trust Funds

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

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

(b) Audit

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

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

Together with the auditors, the financial and administrative systems and specifically the financial reporting systems are reviewed and upgraded in order to ensure financial stability and corporate governance.

1.2 Executive Committee

During the reporting period 1 March 2019 to 29 February 2020, the Executive Committee met six (6) times.

The Executive Committee may be considered an extension of the Board and provides recommendations relating to policy matters. The committee is also responsible for financial and marketing matters.

The Executive Committee consisted of the following members:

Mr AP Theron	-	Chairperson, Chairperson of the Board
Dr E Briedenhann	-	Vice-Chairperson of the Board and Chairperson of the Technology Committee
Prof FH Meyer	-	Board Member

1.3 Technology Committee

During the reporting period 1 March 2019 to 29 February 2020, the Technology Committee met four (4) times. Two (2) of the meetings were combined meetings with those of the PRF Board.

The Technology Committee consisted of the following members:

- Dr E Briedenhann (Chairperson)
- Mr AP Theron
- Prof RM Gous
- Dr J Dreyer (Co-opted Member)

The functions of the Technology Committee are as follows:

- The Technology Committee is one of four Board standing committees and reports directly to the Board.

- The Technology Committee is responsible for evaluating and selecting all research projects, promoting technology transfer, visiting researchers and research projects, identifying gaps and new topics relating to research projects and identifying new sources of supply and utilisation of protein for animal feeds.

1.4 Soybean Working Group

During the reporting period 1 March 2019 to 28 February 2020, the Soybean Working Group met three (3) times.

The functions of the Soybean Working Group involve the following:

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

1.5 Canola Working Group

During the reporting period 1 March 2019 to 29 February 2020, the Canola Working Group met three (3) times.

The functions of the Canola Working Group involve the following:

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

1.6 Canola Planning Committee

During the reporting period 1 March 2019 to 29 February 2020, the Canola Planning Committee met four (4) times.

The Canola Planning Committee consisted of the following members:

- Mr AP Theron (Chairman)
- Dr E Briedenhann
- Mr C Cumming
- Mr F le Roux

The functions of the Canola Planning Committee involve the following:

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

2. DISCIPLINES REPRESENTED ON THE BOARD

In the Trust Deed provision is made for representatives from various disciplines which may include the following:

- Animal feed manufacturers' industry
- Oilseed crushing industry
- Fish meal manufacturers' industry and marine research
- Plant Production
- Organised Agriculture
- Agricultural Economics

3. LIST OF PROJECTS FINALISED DURING 2018-2019

Five (5) projects were finalised during the year, but the final reports are expected only in the first half of 2019.

3.1 **Dr PA Swanepoel** "Performance of a dual disc and tine planter, soil quality, residue management and rate of nitrogen placement with seed for canola production", University of Stellenbosch.

3.2 **Mr C Cumming** "Determination of canola harvest yield losses", Protein Research Foundation

4. PROJECTS FINANCED 2019-2020

4.1 GRAIN YIELD COMPETITION FOR CANOLA 2018; C Cumming, Contractor, Protein Research Foundation

The format of the competition was changed for this year from a single land being submitted to a whole farm/farming unit measurement. The main reason for the change was that Agribusiness technical personnel, who had played a major role in monitoring the harvest process, were finding it increasingly difficult to be present at harvesting in one of their busiest times. By moving to a whole farm format, the need for on-farm monitoring was greatly reduced. Producers generally welcomed the change as overall production management, and not a limited area which could be treated differently, was being evaluated.

The climatic conditions, however, were not conducive to optimum production in either of the regions. The Southern Cape experienced good early rains in March which were ideal for planting, but very little rain in the vegetative and early flowering stages resulted in only one contestant entering the competition from the region. A decision was taken to cancel the competition for the region for the year.

In the Swartland conditions were generally unfavourable early (March and April) with the first good rainfall in late May. June and July measured rainfall equal to the long term average, but from August on very little rain fell and high temperatures (up to 5°C above average) persisted. Despite these climatic conditions canola showed it's resilience by producing yields close to the long term average.

Seven producers entered the under 150 ha section of the Swartland competition and five producers for the over 150 ha section.

The under 150 ha section was won by Dirk Lesch, Elim Boerdery in the Malmesbury district with a yield of 2,52 ton/ha over 57 hectares planted. Two other producers averaged over 2 tons/ha in this section.

In the over 150 ha section Eduard Loubser of P.E.Loubser Boerdery, Klipheuwel won with an average yield of 2,23 ton/ha on 383 hectares, just shading out Koos Blanckenberg who averaged 2,10 ton/ha over 551 ha.

Because of the success and general acceptance by producers, it is envisaged that the 2020 competition will follow the same format.

4.2 CANOLA TECHNOLOGY TRANSFER 2018; C Cumming, Contractor, Protein Research Foundation

The Protein Research Foundation (PRF) identified the transfer of technology as one of its key strategies in promoting the advancement of canola production, as set out in the mission statement. As the Agricultural Chemical industry has evolved as one of the key bodies involved in providing producers with technical support, they were targeted for training in the key aspects of canola production. Other role players in technology transfer to producers, such as Agri-business technical personnel, seed company representatives, Department of Agriculture employees and others were welcome to attend. Chemical agents were also encouraged to invite producers, with the emphasis on first time entrants to canola production.

The 2020 PRF Information Day was held on the 12th February 2020 at the Swellendam Agricultural Showgrounds. Attendance on the day totalled 95 persons of which 23 were canola producers and 8 Agricultural students from Stellenbosch University. The agenda covered topics on planter technology, cultivar characteristics and guidelines for cultivar choices, avoiding herbicide damage, latest findings in *Sclerotinia* management and the SOILL canola passport requirements. A panel discussion closed proceedings.

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

2019 was the 8th year of production on the new trial. Six cash crop systems are tested including shortened canola rotations and cover crops. A total of 60 plots were planted. The 6 systems tested are replicated 3 times and all crops within each system are represented on the field each year.

Riversdale received very little summer rainfall which resulted again in a dry start to the 2019 production season. Only 72 mm fell from January to the end of April. In 2017 a new weather station was installed at the research site which is managed by the Department of Agriculture. A total of 100 mm was received from April to the end of September.

Wheat production - SST0127 was planted at Riversdale at 60 kg/ha. Wheat yields at Riversdale averaged 2772 kg/ha. This was 887 kg/ha more than in 2018 (also a dry year).

Canola production - Alpha was planted at Riversdale at 3 kg/ha. Canola yields at Riversdale averaged 1897 kg/ha which was 235 kg/ha more than 2018.

Barley production - Hessekwa was planted at Riversdale at 52 kg/ha. Barley yields at Riversdale averaged 3287 kg/ha. This average yield was 772 kg/ha more than in 2018. Yields varied between 2888 kg/ha and 3604 kg/ha. All but one plot was classified as malting grade.

Lupin production - Peas was planted at a rate of 80 kg/ha. No plots were harvested due to poor germination and weed problems in the very low rainfall year.

Cover crops - Saia oats and field peas were planted at Riversdale at 25 kg/ha and 80kg/ha, respectively. No other input cost was incurred during the season except the herbicide cost to kill the cover crop following the information day.

Economics - Although 2019 proved to be a low rainfall year all systems tested showed a positive gross margin above direct allocated production costs.

Technology transfer - Various presentations, reports and publications based on the crop production trials being conducted in the Swartland and the Southern Cape during 2019 have been made available.

4.4 PROJECTED PROTEIN REQUIREMENTS FOR ANIMAL COMSUMPTION IN SOUTH AFRICA: D Strydom and W de Jager, University of the Free State, E Briedenhann, Protein Research Foundation

Introduction

The Protein Research Foundation (PRF) has as its main objective the replacement of imported protein with domestically produced protein. After many years of investigating numerous alternatives, the focus has been narrowed to those crops that would make the largest impact, namely soybeans and canola.

The growth in the domestic availability of oilcake is a good measure by which the PRF could ascertain whether its objectives were being achieved, by way of supporting the industry with research, new technology and technology transfer. The targets that will need to be met in the future for the PRF to continue to emulate the great progress that has been made thus requires projections of future oilcake demands and what will be required to obtain self-sufficiency, as well as when this goal is likely to be met.

To measure this progress accurately, various models have been developed and used over the years. These models consider changes in per capita consumption of meat, milk and eggs as projected by BFAP, as well as population growth. The amounts of meat, milk and eggs predicted to be imported and exported are also considered. Projected future prices of major raw materials are incorporated as well as the

availability of raw materials, mainly those that are derived as by-products from various agricultural processing industries.

The genetic improvement of animals has a substantial impact on productivity, and this is an important factor that the model considers. The model calculates the quantity of feed required as well as the raw material breakdown for these feeds.

A substantial amount of feed is consumed by several domestic animal species that are not producers of meat, milk and eggs, and their intake of protein is also taken into consideration.

The model makes use of least cost linear programming to formulate the feed required by all the above animals in South Africa, taking account of the quantity of each raw material available domestically as well as the transport costs of these raw materials across various regions in the country. The result is an accurate prediction of present protein requirements and a projection of these requirements both domestically and imported.

PRF support of the industry is via research, new technology and technology transfer, and growth in the domestic availability of oilcake is a good measure of the rate at which the PRF is achieving its objectives. Projections of future oilcake demands and the amounts that will be required to obtain self-sufficiency, as well as when this goal is likely to be met, set the targets for the PRF in the future. The APR model in collaboration with BFAP data is used to calculate these projections.

Results

Current scenario

On the local market, South Africa progressed in terms of substituting imported soya oilcake with local oilcake. South Africa produced 67% of the total soya requirement in 2019 compared with only 16% in 2009. The projection for 2022 is 89% and this will increase to 98% in 2028. In terms of total oilcake demand the local share in consumption increased from 34% in 2009 to 76% in 2019. It is projected that the local share will increase to 84% in 2022 and 88% in 2028.

Table 1: Historical usages of Total oilcake (Local and imported oilcake)

Year	Local Oilcake (ton)	Total Oilcake (ton)	Local %
2001	454 192	1 021 862	*44*
2002	482 448	1 149 224	*42*
2003	472 312	1 210 396	*39*
2004	489 413	1 121 460	*44*
2005	416 736	1 212 593	*34*
2006	572 231	1 414 338	*40*
2007	608 370	1 635 525	*37*
2008	494 557	1 758 185	*28*
2009	565 181	1 664 927	*34*
2010	701 030	1 743 137	*49*
2011	624 912	1 857 391	*34*
2012	766 927	1 856 360	*41*
2013	760 321	1 877 671	*40*
2014	913 356	1 889 979	*48*
2015	1 197 604	1 914 330	*63*
2016	1 238 120	1 965 291	*63*
2017	1 300 865	1 798 372	*72*
2018	1 441 527	1 649 498	*87*
2019	1 434 660	**1 875 738**	*76*

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

Table 2: Local vs imported soya oilcake

	Local Soya Oilcake (From local soybeans) ton	Local Soybean Production (required) ton	Total Soya Oilcake Requirements ton	Local Soya Production (required) ton self-sufficiency	% Local
2019	820 000	1 025 000	1 218 000	1 522 500	67
2022	929 788	1 162 235	1 255 323	1 569 154	74
2028	1 048 230	1 310 288	1 298 528	1 623 160	81

Oilcake requirements in South Africa are estimated at 1 875 738 tons in 2019 versus a local production of 1 434 660 tons, or 76% of requirements (Table 1). The soybean requirement of 1,2 million tons excludes 124 000 tons of full fat soybeans and 30 000 tons for human consumption.

Soya oilcake produced in South Africa in 2019 provided 67% of the countries soya oilcake requirements (Table 2). This is forecast to increase to 81% in 2028 which is due mainly to imports of oilcake to coastal regions. Logistics remain a challenge to be competitive against imports.

According to the model, feed requirements will increase to 13 426 384 tons in 2028 and 12 321 771 tons in 2022. Soya oilcake requirement will be 1 255 323 tons by the year 2022 and 1 298 528 by 2028.

Estimates indicate 74% self-sufficiency by 2022 and 81% by 2028 in terms of soybeans which can be attributed to an increase in production of soybeans, estimated by BFAP, and a decrease in imported soybean oilcake.

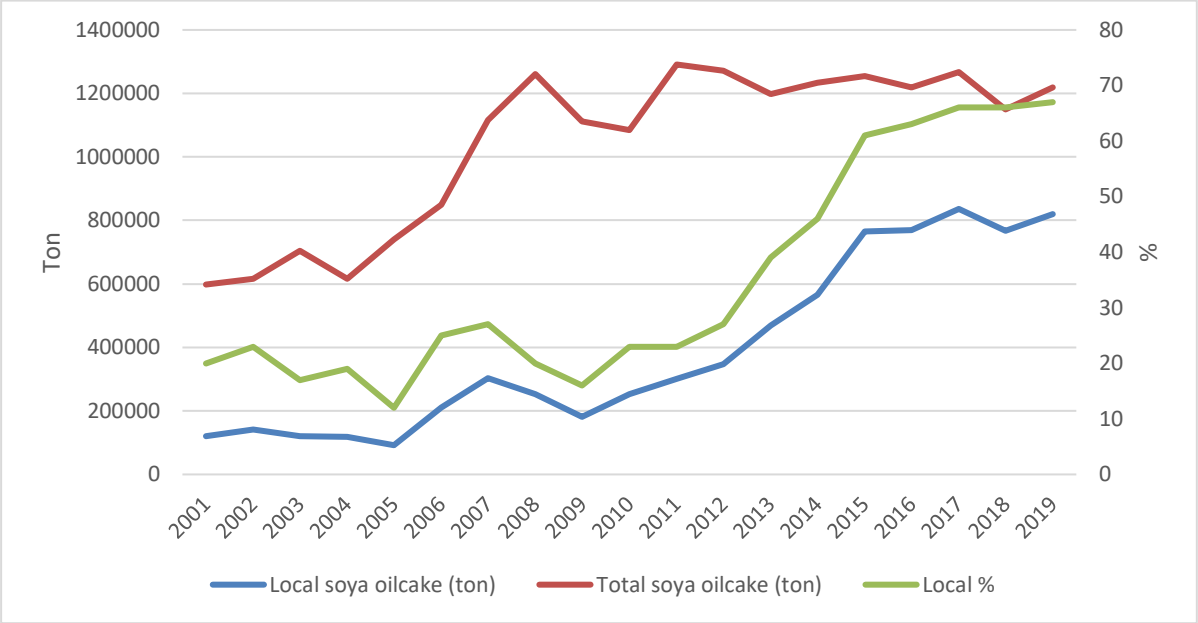

Figure 1: Growth in self-sufficiency in terms of soya oilcake

Conclusion

Seasonality plays an important role in terms of self-sufficiency and usage. In addition, the consumption of animal feed was greatly influenced during the past three seasons by factors such as bird flu and foot and mouth disease which limited exports of beef. The scenarios in this report are based on the assumption that the Poultry Master Plan will stabilise poultry imports. However, if poultry imports continue to increase this will significantly affect the usage of raw materials and the national feed figures.

South Africa is making good progress towards self-sufficiency in terms of oilcakes (Table 3). However, there is still a portion that will be imported and this is a function of both infrastructure and coastal consumption.

Table 3: Self-sufficiency of total oilcake and oilcake

	2019	2022	2028
Total Oilcake	76%	84%	88%
Soya Oilcake	67%	74%	81%

4.5 DEMONSTRATION OF THE USE OF THE REMEDIAL MEASURES TECHNIQUE: RESULTS AND REMEDIAL MEASURES FOR TWO SOYBEAN CULTIVATION LOCATIONS DIFFERING REGARDING CLIMATE, SOIL TYPE AND GROWER PRACTICE; SA Oosthuyse, Hort Research SA

The work was carried out on two soybean stands, one in Rustenburg (farm of Ferdi Meyer) and the other Bothaville (farm of Jan Botma). The primary aim was to identify the key relationships between plant performance and soil conditions indicating fertilization measures leading to the improvement of plant performance. The following was the information deduced in carrying out the technique which involved relating soil analysis variables with plant performance variables. The latest results pertaining to the farm of Ferdi Meyer are reported in this summary.

Target soil analysis values:

a) K sat: 3.2 (from an average of 2.5);

b) Fe conc: 77.5 mg/kg (from an average of 95);

c) Na sat: 0.5 % (from an average of 0.6);

d) P (Bray I) conc: 20 mg/kg (from an average of 14.6).

The following recommendations regarding fertilizer applications were given:

Recommendations (consult your local agronomist):

a) Carry out your agronomist-recommended fertilization program but adjust considering the following;

b) Increase K saturation to 3.2 % in applying potassium chloride;

c) Discontinue any applications of Fe;

d) Consider improving water quality if possible by reducing the quantity of Na particularly;

e) Apply additional phosphate to increase P concentration from 15 to 20 mg/kg.

The following fertilizer quantities to be applied were proposed:

Amounts of fertilizer to apply (kg / ha)

		21% N	Super P	51% K	18.6% Ca
		AS	Granular P	KCl	Gypsum
Quadrant	1	156	52	1201	33104
Quadrant	2	158	139	773	65834
Quadrant	3	164	150	455	58974
Quadrant	4	163	29	1183	38842

.

Spray at every opportunity, i.e., when you apply fungicide, with a TE cocktail.

The soil analysis results prior to application were:

		pH	Resista	N-NO3	N-NH4	P(Bray1	K	Ca	Mg	Na	Fe	Cu	Zn	Mn
		(water)	(Ohms)	(g/MT)	(g/MT)	(g/MT)	(g/MT)	(g/MT)	(g/MT)	(g/MT)	(g/MT)	(g/MT)	(g/MT)	(g/MT)
Quadrant	1	7.77	355	13.85	1.55	9	68	1990	2080	30	17.04	1.36	5.56	46.00
Quadrant	2	7.69	720	12.05	1.45	24	115	678	545	13	11.96	2.20	9.48	59.20
Quadrant	3	7.58	530	12.75	1.20	26	150	953	605	10	10.56	2.36	11.08	79.20
Quadrant	4	7.76	288	17.05	1.25	5	70	1760	2130	30	20.40	1.12	4.44	46.40

		S-(SO4)	Carbon	Ca Sat	Mg Sat	K Sat	Na Sat	Sand	Silt	Clay
		(g/MT)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Quadrant	1	13	1.31	36.3	62.6	0.6	0.5	59	9	32
Quadrant	2	13	0.46	41.1	54.6	3.6	0.7	79	8	13
Quadrant	3	24	0.79	46.7	49.1	3.8	0.4	73	9	18
Quadrant	4	50	1.18	32.9	65.9	0.7	0.5	61	7	32

The soya beans are irrigated with a centre pivot. The area under the pivot is divided into quadrants. The results or each quadrant are shown above.

The soil analysis results after application were:

pH (KCl)	P Mehlich	K	Na	Ca	Mg	% Ca	% Mg	% K	% Na
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%
6.7	65	676	38	1793	1277	42.0	49.1	8.1	0.8

What had noticeably changed was:

a) The soil concentration of K increased from 100 to 676 mg/kg.

b) Correspondingly K saturation was increased from 2.16 % to 8.1 %.

c) Soil Fe concentration increased from 15 to 117 mg/kg.

d) Soil Mn concentration increased from 58 to 135 mg/kg.

e) Soil P concentration increased from 16 to 29 mg/kg.

It would appear that K, P, Fe and Mn applications were made.

Change in plant performance evaluation:

Just prior to harvest, on April 21, 2020, 10 plant-clusters + soil in which the roots were imbedded were removed from the treated quadrant, and also from the adjacent untreated quadrant. The plants had senesced and hence were dry. The 10 samples taken from each quadrant were taken along the same pivit-wheel line. Figs. 1 to 10 provide information regarding stand, sampling and sample evaluation.

After collection, the plants of a sample were separated into stems, roots, pods and beans, the weight of each component determined. 100 bean weight was also determined to obtain an estimate of bean number and solitary weight.

Fig. 1 Centre pivot at the Rustenburg stand.

Fig. 2 Photograph indicating the stage of senescence of the plants when removed for benefit assessment. Leaf drop was generally complete.

Fig. 3 Removal of samples from the treated quadrant. Samples were taken at 10 step intervals (approx. 10 m between samples) along the "same" wheel line in the quadrants in question.

Fig. 4 Removal of samples from the untreated quadrant. Samples were taken at 10 step intervals (approx. 10 m between samples) along the "same" wheel line in the quadrants in question.

Fig. 5 A plant cluster after removal and placement in a large mieliemeal bag. The plant clusters comprised 1 to 5 plants (see the results Table below).

Fig. 6 A plant cluster prior to its removal. A spade was used to dig up the cluster with its root-imbedded soil.

Fig. 7 Placement of labels in the bags taken from the treated quadrant to ensure identification after transit.

Fig. 8 The plants taken from the treated quadrant generally "stuck out" of the bags, whereas those taken from the untreated quadrant did not.

Fig. 9 The stems of a sampled plant-cluster.

Fig. 10 Beans and pods of a sampled cluster.

The following table shows numbers and weights (g) pertaining to the various plant components, the averages for plants removed from the treated quadrant and the average for the plants removed from the untreated quadrant. The percentage increases in number or weight are also shown.

Bag No	Treatment	No	Bean	Bean (g)	Pod Wt (g)	Root Wt (g)	Stem Wt (g)	Solitary (g)	Plants (g)
2	Untreated	3	395	57.6	26.5	8.4	31.7	0.146	124.2
8	Untreated	4	572	84.1	33.3	11	49.8	0.147	178.2
9	Untreated	2	380	50.6	24.1	7.2	29.9	0.133	111.8
10	Untreated	3	119	19.8	9.7	10.2	41.7	0.166	81.4
12	Untreated	1	362	56.1	25.6	3.4	19.8	0.155	104.9
13	Untreated	4	567	81.6	31.3	10.3	47.4	0.144	170.6
14	Untreated	3	447	60.8	27.7	9.3	43	0.136	140.8
15	Untreated	5	464	67.8	29.7	10.3	45.7	0.146	153.5
19	Untreated	5	447	70.7	30.8	16.3	43.6	0.158	161.4
20	Untreated	4	454	65.9	32.3	5.2	56.3	0.145	159.7
	Average	**3.4**	**420.7**	**61.5**	**27.1**	**9.16**	**40.89**	**0.1476**	**138.65**
1	Treated	3	475	71.8	28.2	8	41.1	0.151	149.1
3	Treated	3	517	92.6	37.2	17.6	60.8	0.179	208.2
4	Treated	4	522	85.1	34.3	13.5	46.6	0.163	179.5
5	Treated	2	505	84.8	34.2	7.9	47.1	0.168	174
6	Treated	1	355	65.3	27.3	9.5	31.7	0.184	133.8
7	Treated	5	557	88.5	35.6	11.8	56.6	0.159	192.5
11	Treated	4	698	117.3	56.1	17.2	67.9	0.168	258.5
16	Treated	1	458	86.1	37.3	7.2	44.7	0.188	175.3
17	Treated	2	775	129.5	52.1	19.7	73.3	0.167	274.6
18	Treated	4	431	78.8	33.9	15.4	67.6	0.183	195.7
	Average	**2.9**	**529.3**	**89.98**	**37.62**	**12.78**	**53.74**	**0.171**	**194.12**
	% Increase		**26**	**46**	**39**	**40**	**31**	**16**	**40**

The plants from the treated quadrant were 40 % heavier (were larger generally) and yielded 46% more in terms of bean weight. Solitary bean weight was 16 % greater.

Individual values of bean and plant weight are shown in Figs. 11 and 12.

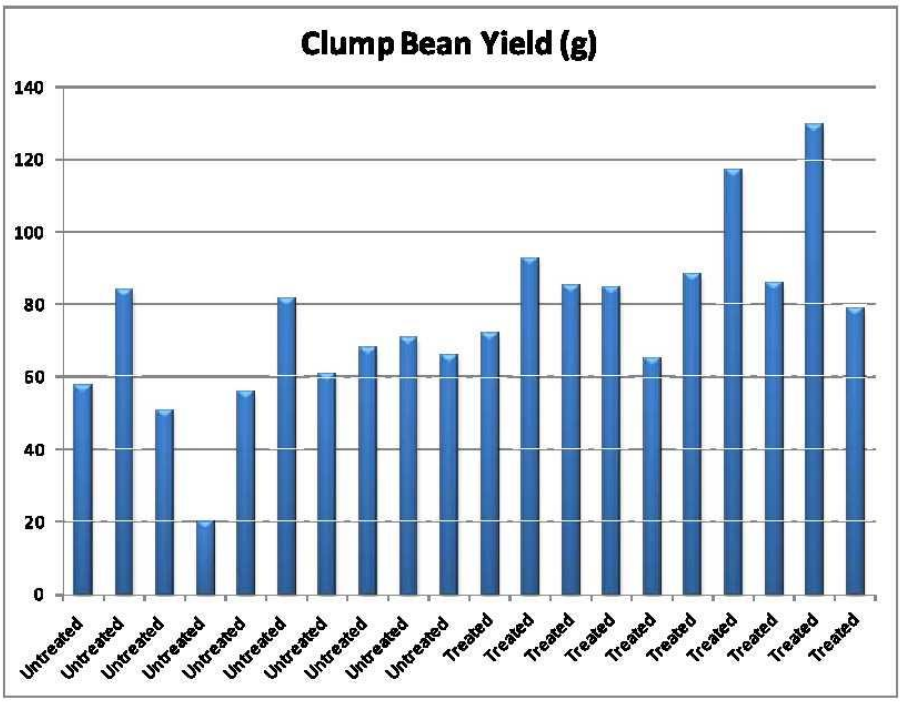

Fig 11. Cluster bean-yield of each of the samples

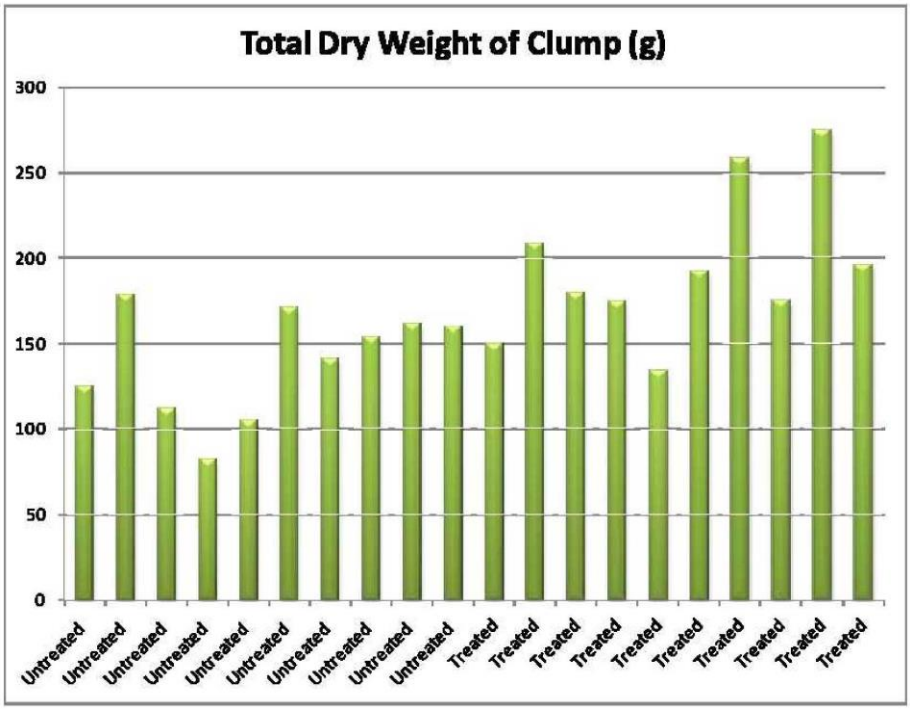

Fig. 12 Total dry weight of each of the plant clusters sampled.

The foregoing benefits may be expected in view of the strong positive relationships found with respect to soil K concentration or saturation, in particular.

The power of the Remedial Measures Technique to determine soil conditions favorably or unfavorably affecting plant performance has been demonstrated. In revealing relationships, measures to improve productivity can be recognized. The application is entirely empirical, not relying on assumption. Analysis is carried out on collected data and relationships are determined in carrying out multivariate statistical analysis. In some instances, measures to improve productivity are obvious. In others, the knowledge of the interpreter may be significant in recognizing remedial measures. Cases will exist where changes cannot practically be implemented or implemented in the short term. Irrespective, an understanding of favorable and unfavorable factors is gained. Actual target (goal) levels are indicated by the analysis as well as how significant the effect of a factor is in a particular situation. The Coefficient of Multiple Determination (R^2) indicates the percentage by which the data variation is accounted for by the variation of the independent variables designated as being significant. Interactions in soils relating to nutrient uptake are generally complex and difficult to understand. The Remedial Measures Technique, in being entirely empirical, provides an instrument to effect measures without assumption. The technique is unique since performance variables are a component of the analysis. The basis of the technique is not complex, the divergence from other methods being the revelation of relationships existing between plant performance and soil variables. That variation always exists between locations in a cultivation block affords relationship determination. The absence of any relationships indicates that, of the independent variable used in the analysis, none of them has a bearing on performance.

4.6 THE INFLUENCE OF PLANTING DATE AND ROW WIDTH ON RECOMMENDED PLANTING DENSITY AND YIELD OF SOYBEANS IN THE NORTH EASTERN FREE STATE; JP van Zyl, Department of Agricultural Development, VKB

In South Africa soya beans are mainly produced in the Mpumalanga and Free State provinces, while within the Free State, production is concentrated in the North Eastern Free State. It is widely known that soya bean yield is influenced by agronomic inputs such as, maturity group, plant density, row width as well as planting date. Extensive research was done globally on these agronomic inputs. However, very little, if any research was done in South Africa, especially in the North Eastern Free State.

In an attempt to evaluate the yield response to different maturity groups, plant densities, row widths and planting dates, three trials were conducted on farmer's fields over two seasons (2016/17 and 2017/18) in the North Eastern Free State at three agro-ecologically different experimental sites. The same maturity groups (MG 4.5, MG 5 and MG 6) was planted at different plant densities, row widths and planting dates at each trial. Phenological development, plant height, pod height, number of pods per plant, number of seeds per pod, hundred-seed weight and grain yield were measured.

At trial 1 the three maturity groups were planted at four plant densities (200 000, 300 000, 400 000 and 500 000 plants ha^{-1}), one row width (0.76 m) and one planting date. Maturity group had the greatest effect on phenological development, plant height, pod height, hundred-seed weight, and grain yield. Plant density had the greatest effect on plant height, number of pods per plant, while also affecting yield only during the 2016/17 season.

At trial 2 the three maturity groups were planted at four plant densities (150 000, 200 000, 300 000 and 400 000 plants ha^{-1}), two row widths (0.38 m and 0.76 m) and one planting date. Similar to trial 1, maturity group had the greatest effect on phenological development, plant height, pod height, hundred-seed weight and grain yield. Plant density had the greatest effect on plant height and number of pods per plant, while also affecting grain yield slightly during the 2017/18 season. Row width had the greatest effect on hundred-seed weight and grain yield.

At trail 3 the three maturity groups were planted at four plant densities (150 000, 300 000, 400 000 and 600 000 plants ha^{-1}), two row widths (0.30 m and 0.60 m) and at two planting dates (early/normal and late). Similar to trial 1 and 2 only, maturity group had an effect on phenological development for both planting dates. Plant height was affected by maturity group, plant density and row width at both planting dates. Plant heights for the late planting date were shorter compared to the early/normal planting date. Pod height was affected most by maturity group, while the effect of plant density and row width was not as profound. Between planting dates, pod height was slightly higher during the early/normal planting date, but this was negligible. Number of pods per plant was only affected by plant density for the early/normal planting date, while for the late planting date maturity group and row width also produced an effect. Between planting dates there were no significant difference in number of pods per plant. Hundred-seed weight was affected by both maturity group and plant density for both planting dates, while row width only had an effect during the late planting date. Hundred-seed weight was considerably higher during the early/normal planting date compared to the late planting date. Grain yield was mostly affected by maturity group during the early/normal planting date, while row width also had an effect. During the late planting date grain yield was affected by maturity group, plant density and row width. Grain yield was considerably higher during the early/normal planting date compared to the late planting date.

It can therefore be concluded that maturity group and planting dates have a great effect on grain yield. The grain yield of a late planting date is considerably lower compared to early/normal planting dates. Plant density also affects grain yield, but the effect is not as profound for an early/normal planting date, while for a late planting date the effect is greater with grain yield increasing slightly with increased plant density. Grain yield is also affected by row width with narrower rows producing greater grain yields compared to wider rows.

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

Background

The Bureau for Food and Agricultural Policy (BFAP) was founded in 2004 with the purpose of informing decision-making by stakeholders in the agro-food, fibre and beverage complex through independent, research-based policy and market analyses. BFAP is a non-profit company with an advisory board consisting of representatives from the affiliated universities as well as the private and public sector. The company is managed by a Board of Directors. BFAP has a distinguished history of partnerships in the South African agricultural sector, providing exclusive advanced analysis and insights of both primary and secondary agricultural markets to public and private sector. In addition to publication of the annual baseline outlook, its integrated analytical framework has been applied in a number of research projects supporting the agricultural sector at large. Such projects include an evaluation of the possible contribution of the agro-industrial complex to employment creation for the National Planning Commission, an analysis of the long term impact of mining on food security in South Africa and an assessment of the impact of proposed minimum wages for farm workers in South Africa. Furthermore, the training of individuals in specialized strategic decision-making and analytical techniques remains a key priority, ensuring the provision of high quality human capital to support the greater South African agricultural industry.

Over the past decade BFAP has developed into a well-positioned global virtual network linking individuals with multi-disciplinary backgrounds to a coordinated research system that informs decision making within the Food and Beverage sector. The core analytical team consists of independent analysts and researchers who are affiliated with the Department of Agricultural Economics, Extension and Rural Development at the University of Pretoria, the Department of Agricultural Economics at the University of Stellenbosch, or the Directorate of Agricultural Economics at the Provincial Department of Agriculture, Western Cape. Recently, BFAP also signed a Memorandum of Understanding to increase collaborative research with the University of Fort Hare.

This proposal motivates a partnership that will enable the PRF to benefit not only from the expertise and information systems of a diverse local group, but also gain access to a much broader international network including institutions such as the Food and Agricultural Policy Research Institute (FAPRI), the Food and Agricultural Organization (FAO) of the United Nations, the Organisation for Economic Cooperation and Development (OECD), the agri benchmark group at the Thünen Institute in Germany and the Regional Network of Agricultural Policy Research Institutes (ReNAPRI) in Eastern and Southern Africa.

The BFAP Farming Systems Analysis Program

The program: The BFAP farming systems analysis program was established with the main objective to assist agribusinesses and farm businesses with strategic decision-making under changing and uncertain market conditions. This is done by means of advanced quantitative analyses of how different policy options, macroeconomic variables, and volatile commodity market conditions could impact upon farm businesses in selected production regions in South Africa. The BFAP Farming Systems Analysis Program includes economic analysis of the production of grain, oilseed, livestock, wine, fruit, sugar and vegetables. Proto-type farms across South Africa's key producing regions are constructed according to a standard operating procedure (SOP) defined by the agri benchmark methodology and are present in the Table 1.

The models & methodology: The farm-level activity of BFAP consists of two key components on which services to individual clients are based. These include the system of linked models between the sector and the FinSim farm-level models and the agri benchmark international network.

Farm-level modelling

The BFAP farm-level model (FinSim) is a total budgeting model capable of simulating a (representative) farm comprising various enterprises, e.g. grain, oilseeds, and livestock. Apart from the enterprise specifics, the model captures business specifics, such as the asset structure and financing method(s).

The output of the farm-level model is presented through various financial performance indicators. The BFAP FinSim model is utilised in various ways, which include whole-farm planning (capital and operational expenditure), financial and economic feasibility on farm-level, risk analysis via stochastic simulation, impact of policy decisions, input- and market-related shocks on farm-level, and the intermediate and long-term projections based on the BFAP sector model output.

Table 1: BFAP existing network of prototype farms

Table 1: BFAP existing network of prototype farms

Summer Grains	Winter Grains	Oilseeds	Small-scale	Sugarcane	Potatoes	Horticulture	Pig Network
Western Free State: maize	Overberg: Wheat	Eastern Free State: Soybeans	KwaZulu-Natal: Traditional producers	KwaZulu-Natal: Northern Coastal Dryland	Eastern Free State: Dryland	Western Cape: Apples	Western Cape integrated farm
Northern Free State: maize	Overberg: Barley	Eastern Free State: Sunflower	KwaZulu-Natal: Grain Developmen t Program	KwaZulu-Natal: Southern Coastal Dryland	Limpopo: Irrigation	Western Cape: Pears	KwaZulu-Natal integrated farm
Eastern Free State: maize	Northern Cape: Wheat	Northern Free State: Sunflower		KwaZulu-Natal: Midlands	KwaZulu-Natal: Seed		North West integrated farm
Northern Cape: maize	Northern Cape: Barley	North West: Sunflower		Mpumalanga: Irrigation	Sandveld: Irrigation		
Mpumalang a: maize (budgets)	Swartland: Wheat, barley & canola: 2019	Mpumalang a: Soybeans (budgets)		KwaZulu-Natal: Northern Coastal Dryland (small-scale)			
North West: maize		Overberg: Canola					

Agri benchmeark

The agri benchmark network is an international network of agricultural research and advisory economists aiming to create a better understanding of global cash crop farming and the economics thereof. The objective of the agri benchmark initiative is to create a national and international database on farm information through collaboration between the public sector, agribusinesses and producer organisations. The link between the local and international network provides the means to benchmark South African agriculture with worldwide farming systems. More specifically, the national farm information database that is linked to the international information system provides decision makers and stakeholders in South African agriculture with a useful tool to obtain business intelligence information, to obtain updates on local and international agriculture, to make financial and managerial strategies for profitable and sustainable farming, and finally, it provides a platform to compare farming businesses and production systems of 16 cash crop enterprises all over the world. The map below illustrates the major countries and crops in the agri benchmark network.

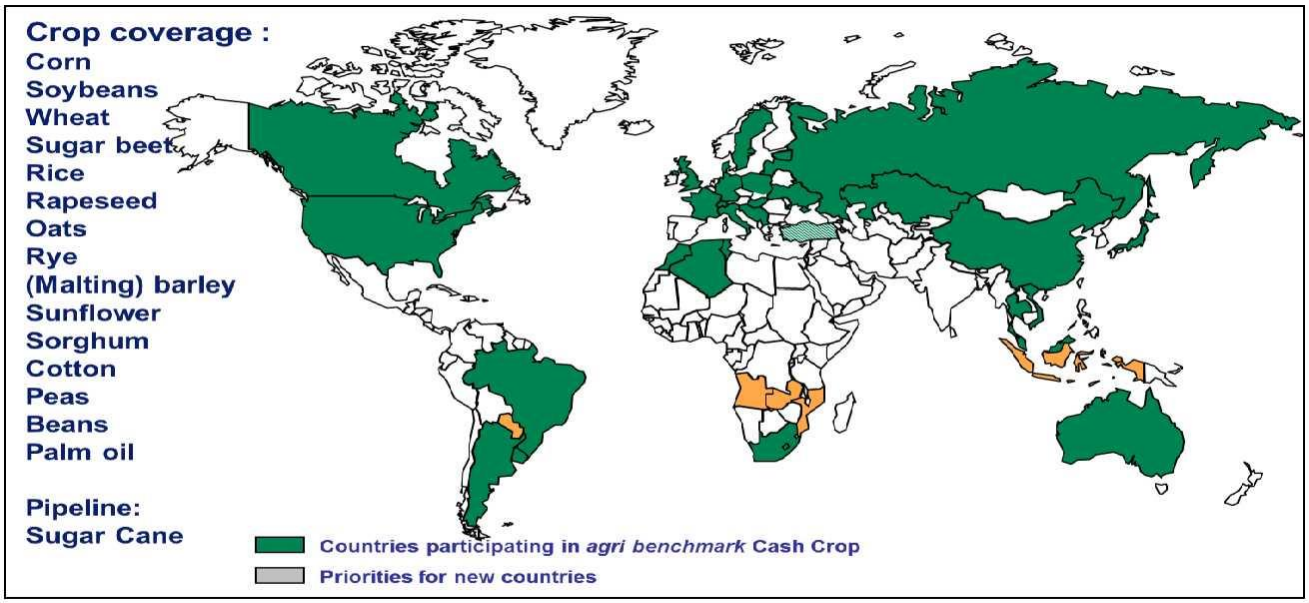

Figure 1: agri benchmark cash crop network

Objectives & key deliverables:

The Protein Research Foundation (PRF), Grain South Africa (GSA) and the Bureau for Food and Agricultural Policy (BFAP) currently have their individual cost of production programs which focusses on the key summer- and winter crops produced in South Africa's key agro-ecological zones. Given the existing activities associated within the organisations and the extent of the coverage of South African agricultural production, it is envisaged that by collaboration and integration of existing activities by PRF, GSA and BFAP will add immense value to the individual organisations' annual output. The main objective is hence to consolidate the three programs, generate comprehensive crop income and cost budgets for the key summer- and winter growing regions and lastly to generate sensitivity analysis for these crops **based on the latest macroeconomic trends, BFAP Baseline underlying assumptions and international- & domestic updates. Please refer to annexure of this proposal for detailed regions and proposed crops.**

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Summer	Mpumalanga	Eastern Highveld	Maize: Conventional			x	Eastern Highveld: Level 1		
			Maize: Round-up	x	Piet Retief & Trichardt: Level 1	x	Eastern Highveld: Level 1	x	Eastern Highveld: Level 1
			Maize: Stack genes			x	Eastern Highveld: Level 1		
			Maize: BT	x	Piet Retief & Trichardt: Level 1				
			Maize: Irrigation			x	Eastern Highveld: Level 1		
			Soybeans: Conventional	x	Piet Retief & Trichardt: Level 1	x	Eastern Highveld: Level 1	x	Eastern Highveld: Level 1
			Soybeans: Minimum tillage	x	Piet Retief & Trichardt: Level 1	x	Eastern Highveld: Level 1		
			Sunflower	x	Piet Retief & Trichardt: Level 1				
			Sugarcane					x	Mpumalanga Irrigation: Level 1-3

Figure 2: Mpumalanga / Eastern Highveld

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Summer	Free State	Eastern Free State	Maize: Conventional			x	Eastern Free State: Level 1	x	Eastern Free State: Studygroup averages: Level 1-3
			Maize: Round-up			x	Eastern Free State: Level 1	x	Eastern Free State: Studygroup averages: Level 1-3
			Maize: Stack genes			x	Eastern Free State: Level 1	x	Eastern Free State: Studygroup averages: Level 1-3
			Maize: BT	x	Reitz/Petrus Steyn/Bethlehem/ Warden: Level 1	x	Eastern Free State: Level 1	x	Eastern Free State: Studygroup averages: Level 1-3
			Sunflower	x	Reitz/Petrus Steyn/Bethlehem/ Warden: Level 1	x	Eastern Free State: Level 1	x	Eastern Free State: Studygroup averages: Level 1-3
			Soybeans RR	x	Reitz/Petrus Steyn/Bethlehem/ Warden: Level 1	x	Eastern Free State: Level 1	x	Eastern Free State: Studygroup averages: Level 1-3
			Potatoes					x	Eastern Free State: Studygroup averages: Level 1-3

Figure 3: Eastern Free State

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Summer	Free State	Northern Free State	Maize: Conventional			x	Parys region: Level 1		
			Maize: Round-up			x	Parys region: Level 1	x	Bothaville / Wesselsbron: Level 1-3
			Maize: Stack genes			x	Parys region: Level 1		
			Maize: BT			x	Parys region: Level 1	x	Bothaville / Wesselsbron: Level 1-3
			Maize: Irrigation			x	Parys region: Level 1		
			Sunflower			x	Parys region: Level 1	x	Bothaville / Wesselsbron: Level 1-3
			Groundnuts			x	Parys region: Level 1		
			Grain Sorghum			x	Parys region: Level 1		
			Soybeans			x	Parys region: Level 1		
Summer	Free State	Western Free State	Maize: Round-up					x	Bultfontein: Level 1-3
			Maize: BT					x	Bultfontein: Level 1-3
			Maize: Irrigation					x	Bultfontein: Level 1-3

Figure 4: Northern- and western Free State

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Summer	North West	North West	Maize: Conventional	x	Koster Hoëveld & Lichtenburg/Ottosdal/Sannieshof/Delareyville: Level 1	x	North West: Level 1	x	Lichtenburg / Delareyville / Koster / North West prototype: Level 1-3
			Maize: Round-up			x	North West: Level 1	x	Lichtenburg / Delareyville / Koster / North West prototype: Level 1-3
			Maize: Stack genes			x	North West: Level 1		
			Maize: BT			x	North West: Level 1		
			Maize: Irrigation			x	North West: Level 1		
			Sunflower	x	Koster Hoëveld & Lichtenburg/Ottosdal/Sannieshof/Delareyville: Level 1	x	North West: Level 1	x	Lichtenburg / Delareyville / Koster / North West prototype: Level 1-3
			Soybeans	x	Koster Hoëveld & Lichtenburg/Ottosdal/Sannieshof/Delareyville: Level 1	x	North West: Level 1		

Figure 5: North West

Summer	KwaZulu-Natal	KwaZulu-Natal	Maize	x	Bloedrivier: Level 1			x	Northern-Natal: Level 2
			Maize: Irrigation	x	Bergville: Level 1				
			Soybeans	x	Bloedrivier: Level 1			x	Northern-Natal: Level 2
			Soybeans: Irrigation	x	Bergville: Level 1				
			Sugarcane					x	Coastal Dryland & Midlands: Level 1-3
			Potatoes					x	Mooirivier: Level 1-3
			Small-scale maize					x	Bergville: Level 2

Figure 6: KwaZulu-Natal

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Summer	Irrigation	Northern Cape	Maize	x	GWK region: Level 1	x	Orange River: Level 1	x	Prieska & Douglas: Level 1-3
			Soybeans RR	x	GWK region: Level 1	x	Orange River: Level 1		
			Groundnuts	x	GWK region: Level 1				
		Limpopo / Britz	Maize	x	Loskop & Britz/Koedoeskop/ Makoppa: Level 1	x	Limpopo/Britz: Level 1		
			Soybeans	x	Loskop & Britz/Koedoeskop/ Makoppa: Level 1	x	Limpopo/Britz: Level 1		
			Sorghum			x	Limpopo/Britz: Level 1		
			Sunflower			x	Limpopo/Britz: Level 1		
		Bergville	Maize	x	Bergville: Level 1				
			Soybeans	x	Bergville: Level 1				

Figure 7: Summer Irrigation: Northern Cape, Brits, Limpopo & Bergville

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Winter	Irrigation	Northern Cape	Wheat	x	GWK region: Level 1	x	Northern Cape: Level 1	x	Prieska & Douglas: Level 1-3
			Barley			x	Northern Cape: Level 1	x	Prieska & Douglas: Level 1-3
			Canola	x	GWK region: Level 1				
		Limpopo / Britz	Wheat	x	Loskop & Britz/Koedoeskop/ Makoppa: Level 1	x	Winter irrigation: Level 1		
			Barley			x	Winter irrigation: Level 1		
		Bergville	Wheat	x	Bergville: Level 1				

Figure 8: Winter Irrigation: Northern Cape, Brits, Limpopo & Bergville

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Winter	Free State	Eastern Free State	Wheat conventional	x	Reitz/Petrus Steyn/Bethlehem/ Warden	x	Eastern Free State: Level 1	x	Eastern Free State: Studygroup averages: Level 1-3
			Wheat after fallow			x	Eastern Free State: Level 1		
			Irrigation wheat			x	Eastern Free State: Level 1		
		Central Free State	Wheat conventional			x	Central Free State: Level 1		
			Wheat: minimum tillage			x	Central Free State: Level 1		

Figure 9: Free State – Winter

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Winter	Southern Cape	Overberg / Ruens	Wheat conventional			x	Western Ruêns: Level 1		
			Wheat minimum tillage	x	Bredasdorp / Caledon: Level 1	x	Western Ruêns: Level 1	x	Bredasdorp / Caledon: Level 1-3
			Barley	x	Bredasdorp / Caledon: Level 1	x	Western Ruêns: Level 1		
			Canola	x	Bredasdorp / Caledon: Level 1	x	Western Ruêns: Level 1	x	Bredasdorp / Caledon: Level 1-3
			Oats	x	Bredasdorp / Caledon: Level 1	x	Western Ruêns: Level 1	x	Bredasdorp / Caledon: Level 1-3
			Lupines			x	Western Ruêns: Level 1		
			Medics					x	Bredasdorp / Caledon: Level 1-3
			Lucerne					x	Bredasdorp / Caledon: Level 1-3
		Swellendam	Wheat	x	Swellendam: Level 1				
			Barley	x	Swellendam: Level 1				
			Canola	x	Swellendam: Level 1				
			Oats	x	Swellendam: Level 1				

Figure 10: Southern Cape – Winter

				PNS		GSA		BFAP	
CROP CATEGORY	PROVINCE / REGION		CROP TYPE	Coverage	Description	Coverage	Description	Coverage	Description
Winter	Western Cape	Swartland	Wheat conventional			x	Swartland: Level 1		
			Wheat minimum tillage	x	Swartland: Level 1	x	Swartland: Level 1		
			Canola	x	Swartland: Level 1	x	Swartland: Level 1		
			Lupines			x	Swartland: Level 1		

Figure 11: Western Cape – Winter

4.8 THE INFLUENCE OF WEED AND HERBICIDES ON THE GROWTH AND YIELD OF SOYBEANS; WF van Wyk, Contractor, Protein Research Foundation

Increasing soybean production on the Highveld

2019/2020: Trials conducted on the UP-Experimental farm in Hatfield, Pretoria.

- **Potassium trial**

  Treatments: Four (4) levels of K (0, 100, 200 and 300 kg/ha) were administered and incorporated into the soil pre-planting. Potassium was also applied at 100 kg/ha in the middle of every second pair of rows at a depth of 20 cm concentrated in a band. A sixth treatment was where 100 kg K/ha was applied but the plots were not planted with soybeans. The plots were kept free of weeds throughout the growing season.

The trial was harvested, threshed and all post-harvest data were taken. Where Potassium was applied at 300 kg/ha the yield was 3054 kg/ha, while where no K was applied it was 2609 kg/ha, 2956 kg/ha where 100 kg K/ha was applied and 3263 kg/ha where 200 kg K/ha was applied. At the treatment where K was applied at a depth of 20 cm between rows the yield was 3441 kg/ha.

Potassium-analysis of the soil after harvesting was not done yet due to the Covid 19 pandemic and therefore no comparison with pre-planting analysis is possible.

Seedling diseases like Rhizoctonia and Pythium were found at the trial this year. (It is possible from the heavy rains during in December as well as drainage problems).

All the results will be given in the progress report.

- **Weed control trial**

  Five (5) treatments were applied namely, no weed control, only pre-emerge control with diclosulam and alachlor, pre-emerge control with diclosulam and alachlor followed by a glyphosate application at 3-4 weeks, no pre-emerge control with glyphosate applied at 6 weeks and no pre-emerge control with glyphosate applied at 10 weeks. The yields were 2232, 3370, 3483 and 4322 kg/ha respectively. **[Additional or Demonstration-trials as started in 2018/2019.]**

<u>Additional treatments that were used are</u>:

- 25 cm row spacing with two seeds/position planted every 16.65 cm in the row - gives a density of 240 000 plants/ha.
- 45 cm row spacing with two seeds/position planted every 33.3 cm in the row - gives a density of 265 000 plants/ha.
- Growth points of soybeans removed with slasher at 15 cm height above the soil when plants were 30 cm tall (R1). Plant density of 290 000 pl/ha.
- Application of Spoor en Boor on the leaves of soybeans in 45 cm rows at R2 (only micro-elements).
- Application of Groenwoema on the leaves of soybeans in 45 cm rows at R2 (micro-elements and N, P and K).

- Urea(46) applied at 100 g N, 200 kg N and 300 kg N at R2 - R6.
- LAN(28) applied at 100 g N, 200 kg N and 300 kg N at R2 - R6.
- Controls(2) in 45 cm rows and plant density of 290 000 plants/ha.
- No inoculation.

The treatments were harvested, threshed and post-harvest data were taken. Where LAN was applied at 200 and 300 kg/ha the yield was better than 5 ton/ha. The yields of treatments 1 and 3 were respectively 4989 and 4724 kg/ha. The yields of the other treatments were under 4500 kg/ha with the controls and urea treatments the lowest at 3600 – 3800 kg/ha.

4.9 CULTIVAR EVALUATION OF SOYBEANS IN THE WESTERN DRY LAND PRODUCTION AREA OF SOUTH AFRICA; GP De Beer and WF van Wyk, Contractors, Protein Research Foundation

The past season was certainly one of the best seasons the west ever experienced.

The planning was to plant cultivar trials at Schweizer Reneke, Hoopstad, Leeudoringstad and Bossies (Between Delaryville and Sannieshof). The trials at Schweizer Reneke and Leeudoringstad were planted on the 22 and 23 November 2019. Due to a crust forming on top of the sandy soils the population were poor. These trials were replanted on 12 December. The trial at Hoopstad was planted on 11 December 2019. All these trials were visited the day after planting to break the crust that formed on top for the soybeans to germinate. The trial at Bossies couldn't be planted because it was too wet and then it was too late to plant soybeans in this area.

There were 28 cultivars planted at the different localities. Each localities cultivars were randomised different than the other localities.

The trial at Leeudoringstad had a mean yield of 2571.9 kg/ha. The cultivar with the highest yield was LDC5.9 (MG 5.9) with 3589.6 kg/ha and the cultivar with the lowest yield was P48T48 R (MG 4.8) with 1042.6 kg/ha.

The trial at Schweizer Reneke had a mean yield of 2057 kg/ha. The cultivar with the highest yield was P64T39 (MG 6.4) with 2912 kg/ha and the cultivar with the lowest yield was P48T48 R (MG 4.8) with 1062 kg/ha.

The trial at Hoopstad had a mean yield of 3160 kg/ha. The cultivar with the highest yield was P64T39 R (MG 6.4) with 4147 kg/ha and the cultivar with the lowest yield was SSS5449 (tuc) (MG 4.8) with 2385 kg/ha.

4.10 THE USE OF CULTIVATION PRACTICES IN SOYBEAN TO AVOID *SCLEROTINIA* INFECTION; WF van Wyk, Contractor, Protein Research Foundation

Planting of 2 cultivars (DM 5953 - short season grower and PAN 1623 - long season grower) with 3 different planting dates at Wonderfontein and Stoffberg.

Trial at Mr Piet Prinsloo from Stoffberg

Three (3) planting dates namely 22 October 2019, 15 November 2019 and 13 December 2019 were used. Planting was done with an Apache no-till planter in no-till conditions under irrigation. Sclerotinia was observed on the long grower at different degrees of severity and the data will be included in a follow-up report. Rainfall data and temperatures were taken as well as the dates on which the different planting dates were in the different reproductive stages (R - values). These values still have to be incorporated into graphs and all the other data will also be included in a follow-up report.

Trial at Mr Gerrit Roos from Wonderfontein

Two (2) planting dates namely 23 November 2019 and 17 December 2019 were used. Planting was done with a John-Deere minimum-till planter in minimum-till conditions under dryland. Sclerotinia developed in February and infections appeared at the long season grower (PAN 1623 R) at different degrees of severity. The short season grower (DM 5953) showed no infections at all the different planting dates. Rainfall data and temperatures were taken as well as the dates on which the different planting dates were in the different reproductive stages (R - values). These values still have to be

incorporated into graphs and all the other data will also be included in a follow-up report.

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

As usual, most of the time was dedicated to normal page content updates and additions across the 17 sections and on 29 February 2020 the Protein Research Foundation website hosted a total of 1,121 HTML pages (excluding dynamically created pages).

During January 2020 the home page was updated to a more contemporary look and content groups on the page were reorganised to make it more user friendly.

PHP 7.2

The server on which the PRF's website is hosted has been upgraded to PHP 7.2 **** during September 2019. Since this was a major upgrade, the website framework and content were validated earlier in the year to ensure that there would be no errors on the website after the upgrade.

*** PHP is the base programming language that is used to output website content to the browser.*

Visitor statistics

Reporting Year	Unique Visitors *Raw values**	Unique Visitors *Google values**		
-	-	***Visitors***	***Pages***	***Pages per visit***
2004	1 691			
2005	3 285			
2006	4 552			
2007	5 404	3 041	10 838	2.79
2008	11 104	5 274	18 829	2.82
2009	10 194	6 610	27 341	3.18
2010	11 812	6 054	23 347	2.98
2011	12 357	5 511	24 258	3.29
2012	16 306	6 909	28 206	3.12
2013	54 739	8 767	34 284	2.97
2014	54 590	10 189	39 363	3.03
2015	35 653	12 519	45078	3.60
2016	31 674	8 733	53 811	4.47
2017	47 373	6 901	20 514	2.18
2018	38 049	10 041	24 873	1.90
2019	**45 787**	**10 444**	**23 628**	**1.78**

Google values shows an increase in page views and a significant increase in unique visitors. Pages per visit decreased slightly. The most pageviews came from the following pages in order of percentage share:

- Homepage, 15.66 %
- Soy oilcake price average, 6.3 %
- Guidelines for executive summaries, 3.54 %
- Biofuels government policy, 2.55 %
- Biobrandstof inleiding, 1.85 %

ICB Mobile App

In its capacity as a provider of valuable information to both producers and researchers via the web, the Protein Research Foundation is in the perfect position to offer more interactive functionalities to visitors.

With this in mind, a mobile application has been commissioned for the Income and Cost Budgets (ICB) where producers can use the ICB Calculator App on their mobile devices, in an internet browser or as a downloadable application on their computers. The beta app has been released during February 2020 with an official launch date set for later in 2020.

5. STUDY GRANTS AND BURSARIES

The PRF bursary scheme was approved in 1994 and the first bursary for postgraduate studies was awarded for the 1995 academic year. We are proud to look back on a period of 24 years during which 78 bursaries were awarded to deserving candidates for Masters' and Doctorate studies. The aim of the bursary scheme is to train deserving candidates in the scientific method to allow them to contribute to high quality scientific research after completing their studies. This includes, in particular, research aimed at promoting the production of protein for animal consumption.

Students are also encouraged to publish their research results in scientific journals, popular magazines or both. Management summaries of theses and manuscripts are published on the PRF website and database.

Bursaries for Masters' studies are awarded for a period of two years and three years in the case of Doctorate studies. Bursaries awarded for the current year were approved by the Technology Committe and were the following:

5.1 MSc Studies

5.1.1 **Mr JP van Zyl** (Second application). "Effect of plant population, maturity group and row width on soybean yield in the North East Free State", University of the Free State;

5.1.2 **Mr A Liebenberg** (First application). "Consideration for liming soil for canola production: Soil tillage, placement, form and fineness of lime", Stellenbosch University.

5.2 PhD Studies

5.2.1 **Ms IR Crouse** (First application). “Die ontwikkeling van stikstof bestuurstrategieë onder bewaringslandboupraktyke in die Wes-Kaap”, Stellenbosch University;

5.3 Completed theses received

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

5.3.1 **Mr E du Toit**, “Developing nitrogen fertiliser management strategies for canola under conservation agriculture practices in the Western Cape”, MSc, Stellenbosch University;

5.3.2 **Ms J van der Merwe**, “Evaluation of canola oilcake as alternative locally produced protein source for slaughter ostriches”, MSc, Stellenbosch University;

5.3.3 **Ms TC Maluke**, “Plant cystatins and insect resistance: Inhibition of insect midgut cysteine proteases by plant cystatins and their role in plant insect resistance”, MSc, University of Pretoria;

5.3.4 **Ms P Mbedzi**, “Initial screening of soybeans for simple sequence repeats conferring resistance to *Sclerotinia sclerotiorum*”, MSc, University of Pretoria.

6. ACHIEVEMENT AWARDS TO PROMOTE THE PRF VISION AND MISSION

Each year the PRF recognises individuals for their special contributions in support of the vision and mission of the PRF.

Awards are categorised as follows:

- Best Doctoral thesis;
- Best Masters thesis;
- Best article published in a scientific journal;
- An individual or organisation that has made an exceptional contribution in promoting the vision and mission of the PRF;
- A Board Member who has contributed significantly in promoting, over a period of time the activities of the PRF;

During the year under review, awards will be presented to Ms Caitlin de Vos and Ms Marlese Meiring in the category Best Masters thesis. The awards will be presented at an appropriate event during the year under review.

No other awards were made during the year.

7. CONCLUSION

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

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

ANDRIES P THERON
CHAIRPERSON

ANNEXURES

I LIST OF APPROVED PROJECTS IN 2019-2020

https://www.proteinresearch.net/index.php?page=last-years-approved-projects

II PRF STRUCTURES

https://www.proteinresearch.net/index.php?page=about-us

III LIST OF BURSARY APPLICATIONS: 1995 - 2020

https://www.proteinresearch.net/index.php?page=last-years-approved-projects

IV LIST OF RESEARCH PROJECTS: 1976 - 2020

https://www.proteinresearch.net/index.php?page=projects-awarded-archive