



PROTEIN RESEARCH FOUNDATION



2023-2024

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 be globally competitive and to meet the growing demand for protein for animal production purposes as well as optimal utilisation thereof within an integrated value chain, which will lead to a sustainable 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.
- * Facilitating and finding solutions for value chain optimisation.



PROTEIN RESEARCH FOUNDATION RESEARCH REPORT 2023-2024

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1. INTRODUCTION

During the 2023-2024 financial year, the Board of Trustees once again succeeded in their efforts to achieve the objectives of the Trust 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 2023-2024 year the Board comprised of 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
Prof P Swanepoel	-	Expert	:	Discipline - Plant Production

(i) General Overview

During the reporting period 1 March 2023 to 29 February 2024, the Trust met seven (7) times. Three (3) of the meetings were combined with those of the Technology Committee.

During the period under review, R 5 668 635 was approved in respect of research projects, technology transfer and bursaries.

The trust fulfilled the duties of funding and managing research projects and technology transfer, which form part of the core business of the PRF as set out as objectives in the Trust Deed. Furthermore, the facilitation of the Soybean Value chain discussions continued, which made an important contribution to the Soybean Industry.



(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 is monitored and reviewed constantly. Apart from regular discussions, the Fund Managers are requested to deliver a presentation to the Board of Trustees at least once annually.

(b) Audit

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

As in the past, the auditors once again 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 2023 to 29 February 2024, 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 2023 to 29 February 2024, the Technology Committee met five (5) times. Three (3) 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
- Prof FH Meyer
- Prof P Swanepoel
- 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 related 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 2023 to 29 February 2024, the Soybean Working Group met four (4) 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 2023 to 29 February 2024, 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 2023 to 29 February 2024, the Canola Planning Committee met four (4) times.

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.

1.7 Soybean Value Chain

During the reporting period 1 March 2023 to 29 February 2024, the Soybean Value Chain met four (4) times.

The PRF is responsible for the facilitation of these discussions. Various actions were identified that were to the benefit of the Soybean Industry.

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 2022-2023

Three (3) projects were finalised during the year.

- 3.1 **Mr WF van Wyk** - “Research on soybeans to study new preliminary treatments with different biological leaf applications as well as chemical applications and a demonstration trial in a wagon wheel design”, Protein Research Foundation.
- 3.2 **Mr WF van Wyk** - “Research on sclerotinia with emphasis on cultivation practices and treatment with biological products to reduce its occurrence in Soybean”, Protein Research Foundation.
- 3.3 **Mr GP de Beer** - “Cultivar evaluation of soybeans in the western dry land production area of South Africa



4. PROJECTS FINANCED 2023-2024

4.1 CANOLA Agricultural Economists; BFAP, Protein Research Foundation

The Canola Agricultural Economists and BFAP discussions regarding the Income and Cost Budgets for the winter rainfall area are scheduled every second year.

4.2 EVALUATION OF SHORTENED CANOLA PRODUCTION PERIODS AND THE USE OF ALTERNATIVE CROPS ON THE SUSTAINABILITY OF WINTER GRAIN PRODUCTION UNDER CONSERVATION AGRICULTURAL PRACTICES IN THE RIVERSDALE FLATS; Prof JA Strauss and W Langenhoven, Western Cape Department of Agriculture

Objective

The aim of this study is to determine the short- and long-term effects of six of the most feasible crop rotation systems identified for the high potential soil of the Riversdale area on:

- Crop yields
- Weed control
- Disease suppression
- Soil production potential
- Economically sustainable land-use in the Riversdale area

Motivation and project description

- Reduced input costs for wheat production
- Increased protein and oil seed production
- Increased diversification of the farming system for greater financial stability
- Increased production potential of soils due to increased organic matter content, and micro-and macro-organism activity
- Less compaction of high potential soil from animal movement



The new Riversdale project will use the existing 15 large plots being used in the current trial that is part of the previous extended southern Cape crop rotation trial. The 15 plots will be split into 4 to provide a total of 60 plots to provide enough small plots to plant the different rotations, which will be replicated 3 times with all crops present each season.

New systems tested

- Legume crop – Wheat - Canola - Wheat (4 year system as control) - 50% smallgrain, 25 % canola, 25% legume crop
- Canola - Wheat - Canola - Wheat (2 year repeating system) - 50% smallgrain, 50 % canola
- Canola - Barley - Legume crop - Wheat - Wheat (5 year system) - 60% smallgrain, 20% canola, 20% legume crop
- Wheat - Barley - Canola (3 year repeating system) - 67% smallgrain, 33 % canola
- Wheat - Wheat - Green manure cover crop (3 year pure grain system) - 100% grain (oats can be used as smother crop/green manure if needed)
- Green manure cover crop - Wheat - Canola (3 year system with an alternative broadleaf cash crop - 33% grain, 67% broadleaf

Funding institutions

This application will be sent to both the Protein Research Foundation (PRF) and SAWCIT. The budget will be split: 50% PRF & 50% SAWCIT.

The Western Cape Department of Agriculture provides all manpower and facilities required for successful implementation of the trial.

This long-term project will be entering its 12th year in 2023 and has a 12 year planning horizon.



Motivation

Problem

Lack of knowledge on the biological and economic sustainability of crop rotation systems for use on high yielding soil in the Riversdale area.

Nature and extent

The economic viability of long-rotation crop/pasture systems has been shown through two 5 year crop rotation trials following lucerne pasture in the Riversdale area (see previous technical reports presented by the Hardy & Strauss on: ***“Economic sustainability of short- and long-rotation crop/pasture production systems in the southern Cape”***). Increased input costs and lower product price as well as variable rainfall have resulted in high economic risk to wheat farmers. Alternative crops and cropping systems have been identified as potentially financially viable alternatives to the traditional wheat monoculture (Smit & van Zyl 1998). The value of these alternative crops including canola (Arkcoll 1998) and lupins (Agenbach undated) has been shown over the past 10 years in numerous reports and talks by the authors.

In Australia, the introduction of ley pastures since the late 40's in wheat cropping areas has successfully restored fertility and improved soil structure such that grain yields have increased (Donald 1964, White et al 1978, Hardy 2010). The relative success of these crop and crop/pasture rotation systems depends on economic conditions as well as environment and farm size (White et al 1978). However, the relative biological and economic benefits of potential crop rotation systems on high yield-potential improved soils can usually be identified only by long-term studies (Elliott & Jardine 1972). These studies allow for examination of the effects and interactions of, for example, reduced use of fungicides and herbicides due to rotation of a broadleaf crop with the cereal crop (Jordan *et al* 1998).

Of particular importance to emerging farmers and the developing agricultural sectors (but also to commercial farmers) is the concept of reduced input systems (Jordan *et al* 1998) which involve manipulation and integration of husbandry practices within crop management. Crop rotation is a key component in reduced and integrated systems of production, with maximum use made of crops which contribute positively to soil



fertility. Based on data from a five-year "less-intensive strategy" crop rotation experiment, Jordan *et al* (1998) showed reduced overall yields of wheat and oilseed rape of up to 18%. However, production costs were also reduced by 32% and overall profitability of crop production was maintained. There were substantial reductions in applied nitrogen (36%), herbicides (26%), fungicides (79%) and pesticides (78%) where "low-input" was compared to a conventional production strategy.

Crops such as canola and lupins are ideally suited to rotation with wheat as it is important (from a disease prevention point of view) that neither canola nor lupins are planted on the same land more frequently than every third or fourth year. Not only do they provide suitable broad-leaf "break" crops in which grass weeds may be effectively controlled in wheat production systems, but they also have the potential to improve soil structure (Arkcoll 1998) and, in the case of lupins, provide nitrogen to the following wheat crop.

Summary

Aim

The aim of this study is to determine the short- and long-term effects of six of the most feasible crop rotation systems identified for the high potential soil of the Riversdale area on:

- Crop yields
- Weed control
- Disease suppression
- Soil production potential
- Economically sustainable land-use in the Riversdale area

Motivation

- Reduced input costs for wheat production
- Increased protein and oil seed production
- Increased diversification of the farming system for greater financial stability
- Increased production potential of soils due to increased organic matter content, and micro-and macro-organism activity
- Less compaction of high potential soil from animal movement



Key questions

Short - term

- Production. What is the production potential of wheat, canola and lupins in a specific season when applying the crop production protocols recommended for the area concerned?
- Alternative crops. What are the effects of incorporating crops such as “koljander” on cereal production in the traditional cereal production systems practiced in the southern Cape?
- What is the effect of previous season's crops (wheat, canola, lupins, barley, oats and “koljander”) on the quantity and quality of crop production in the following season? How do these effects change over time?
- Economics. Are there any short-term differences in the gross margins attained among the rotation systems being tested?
- Production. Does increased frequency in canola production have an effect on sustainability in terms of disease pressure and economic sustainability?

Potential short-term component studies (*Should additional research capacity and funding become available*)

- Are there differences in soil-borne disease infestations in the same crop among rotation systems?
- Are there differences in soil micro-organism populations among rotation systems?
- How do soil nitrogen dynamics differ among crop rotation treatments?
- What is the effect of crop rotation system on the baking quality characteristics of wheat?
- What is the effect of nematodes on the production of the different crops?



Long-term

- Economics. What is the long-term effect of crop rotations on farm income in the Riversdale “vlaktes”?
- Sustainable production. How do rotation systems influence crop yield and quality over time?
- Alternative crops. What are the long-term effects of incorporating green manure cover crops in crop rotation systems?
- Weed control. How does rotation system influence weed seed-banks over time?
- Sustainability of soils. What influence does crop rotation system have on the maintenance and improvement of the organic carbon content of soils?
- Disease suppression. The occurrence and intensity of diseases over time?
- Reducing inputs. How do input requirements for optimal crop and pasture production change over time for the different rotation systems?

Potential long-term component studies (*Should additional research capacity and funding become available*)

- What are the long-term effects of crop rotation on soil-borne diseases?
- What are the long-term effects of crop rotation on soil micro-organisms?
- What are the long-term effects of crop rotation on soil nitrogen dynamics?

The following nul hypotheses will be tested:

Long-term (in four year cycles)

- ***There is no long-term economic benefit to the farming enterprise from applying various crop rotation systems without incorporating pastures on the high potential soil.***
- Crop rotation has no significant effect on the quantity, quality or consistency of wheat production in the Riversdale area.



- Crop rotation systems will not improve soil organic matter content when compared to a crop/pasture system.
- Crop rotation systems will not reduce the input (nitrogen fertilizer, herbicides, insecticides and fungicides) requirements for wheat production.

Short-term (annual)

- The previous season's crop has no effect on the quantity, quality or consistency of wheat production.
- The previous season's crop has no effect on the nitrogen requirements for wheat production.

Summary of experimental design and treatments

The new Riversdale project will use the existing 15 large plots being used in the current trial that is part of the previous extended southern Cape crop rotation trial. The 15 plots will be split into 4 to provide a total of 60 plots to provide enough small plots to plant the different rotations, which will be replicated 3 times with all crops present each season.

New systems tested:

- Legume crop - Wheat - Canola - Wheat (4 year system as control) - 50% smallgrain, 25 % canola, 25% legume crop
- Canola - Wheat - Canola - Wheat (2 year repeating system) - 50% smallgrain, 50 % canola
- Canola - Barley - Legume crop - Wheat - Wheat (5 year system) - 60% smallgrain, 20% canola, 20% legume crop
- Wheat - Barley - Canola (3 year repeating system) - 67% smallgrain, 33 % canola
- Wheat - Wheat - Green manure cover crop (3 year pure grain system) - 100% grain (oats can be used as smother crop/green manure crop)



- Green manure cover crop - Wheat - Canola (3 year system with an alternative broadleaf crop - 33% grain, 67% broadleaf)

Treatments: 6 rotation treatments, fully represented each year and replicated 3 times, in a randomised blocks design.

Camp areas: 0.11 ha

Total area involved: 9 hectares

Number of camps planted to various crops each year: 60

Annual plan of operation

Soils and fertilisation	
Month	Operation
January	Analyse 60 soil samples (collected in November/December) for micro- and macro-elements and determine the fertilisation requirements of each camp. Analyse 60 soils samples to determine organic carbon content of soils in each camp.
March to November	Take additional soil samples and analyse as necessary to deal with specific soil problems as they become evident during the season
March/April	Correct any problems associated with soils e.g. drainage and "brak" patches, as necessary.
April/ May	Prepare soils for cropping (minimum tillage procedures) and apply P, K and lime were necessary. Apply N & P (band placement) as basal dressing at planting.
July/	Apply N top-dressings as required
November/ December	Collect 60 soil samples for fertility analyses (1 composite sample from each camp). Collect 60 soil samples for organic carbon determinations.
Weed seed bank studies	
Month	Operation
End March	Collect 60 composite top-soil samples - two from each of the camps in the trial. Prepare samples in seedling trays and place in germination facility.
April to September	Monitor medic, clover and weeds species germination and emergence at monthly intervals in all 60 seedling trays.
October to March	Capture data, summarise, analyse and report on findings.



Crop management and data collection	
Month	Operation
March	Determine TKW of seed of all crops to be planted. Determine germination % of seed. Use above to ensure correct seeding rate.
May	Plant all crops, timing depends on climatic conditions.
June to October	Control weeds, diseases and pests according to requirements and management protocols. Fertilise according to requirements and management protocols Monitor diseases in each camp.
June/July	Do plant counts in each camp to determine plant densities. (10 samples per camp - 600 samples in total).
November	Do plant counts in stubble of camp after harvesting to obtain estimates of plant survival through season.
October	Harvest crops using combine harvester, individual camps harvested each season. Weigh total harvest from each camp in portable weighing bin on each camp (> 60 tons in total depending on the season). Take samples of grain from each camp for quality determinations
	(%CP, HLM, "sifsel" %, and baking quality measures)
Component research projects (from 2012)	
Month	Operation
January to December	ECONOMIC ANALYSIS Record all inputs and output for each camp e.g. time taken for operation, amount of input used, costs of inputs, crop yield and quality, price for product etc. Enter all data into Gross Margin Analysis program for economic analyses. Finalise economic analyses for previous year by June and produce hard copy of the results.
January to December	Rainfall and temperature data: collected continuously using a data logger that is located within the experimental area. Data are summarised and reported on annually.
General management of experiment and reporting	
Month	Operation
February	Organise and hold meetings of the Riversdale Crop Rotation Technical Committee to develop management protocols for the crops in each treatment, to solve problems and present results to extension staff, and to view development of the crops each season
March/ April	Hold planning meetings with co-workers on their component experiments to be conducted within the experimental area.
January to December	Meet with potential co-workers to design research projects to be conducted within the experimental area aimed at answering specific questions arising as the project progresses.



January to December	Daily management and inspection of experimental area by field manager. Maintain experimental infrastructure (information boards, roads, fences, gates and watering points) and equipment (data loggers, boom sprayers, tractors and implements). Bi-monthly visits to Riversdale by project leader to view progress, to develop and adjust monitoring procedures, assist with data collection and for quality control. Accept ad-hoc invitations to present results of crop rotation experiment to local study groups and farmer's association meetings Attend study group and farmer's association meetings to be updated on latest technology relating to crop production in the southern Cape Present results as they become available at scientific symposia and congresses of professional societies.
March and September	Present management requirements and results of experiment at the Riversdale information day in September.
April to June	Summarise and analyse all data collected from the previous season. Prepare and submit a detailed annual report on the activities and results.
June and July	Prepare annual progress reports for funders (SAWCIT & PRF) and apply for continuation of funding.
January to December	Prepare talks, as well as popular and scientific publications on the results and implications of the crop rotations being tested.

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

The report submitted is under consideration.



4.4 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), founded in 2004, serves the agro-food, fibre and beverage sectors in South Africa and Africa. Our purpose is to inform better decision-making by providing unique insights gained through rigorous analyses, supported by credible databases, a combination of integrated models and considerable experience. Over more than 15 years, the Bureau has developed a very distinct value proposition to deliver a holistic solution to public sector and private clients active in the agricultural sector and related value chains. This offering is complemented through BFAP's investment in the Integrated Value Information System (IVIS), a geo-spatial platform which further enhances BFAP's product offering by providing enhanced systems solutions to the integration of data and insights visualisation to support strategic decision-making along multi-dimensional value chains.

The BFAP Group consist of a team of experienced private and public sector experts with a range of multi-disciplinary skills including agricultural economics, food science, mathematics and data science, engineering, supply chain management, socio-economic impact assessment, systems technology, and geo-informatics. In addition, we fundamentally believe that a competitive and thriving agricultural sector with its related value chains is built on long-run partnerships. Hence, BFAP has developed a well-established network of local and international collaborators and partners in the public and private sectors. This includes long-standing partnerships with private sector clients for more than a decade, research partners like the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri in the USA and the Food and Agricultural Organization of the United Nations (FAO). BFAP is also one of the founding members and partners of the Regional Network of Agricultural Policy Research Institutes (ReNAPRI) in Eastern and Southern Africa. As a team and as a network, we pool our knowledge and experience to offer the best possible insights and access to a unique high value network.



The BFAP Group utilises globally recognised techniques and modelling systems to analyse the food, fibre and beverage sectors.

The current BFAP modelling system covers more than 50 commodities each supported by:

- in-depth study of agro-resources and input-output markets, production systems and farming business operations, offering the ability to evaluate the competitiveness and sustainability of farming systems.
- end-to-end value chains analysis, tracking product flow, efficiencies, and margins along the chain.
- commodity markets scenario modelling and forecasting to quantify future outcomes, evaluate risk, identify growth opportunities and assess impacts of changes in the macro-economic, business and policy environment.
- analysis of the consumer and retail space to provide insights on food price impacts and food security.
- credible analysis, monitoring and evaluation of rural and socio-economic development related to the food, fibre and beverage industries

The extensive integrated database and modelling frameworks enable BFAP to analyse and generate long-run projections and unpack alternative future scenarios for agricultural commodity markets and within the main sub-sectors (grains, livestock, and horticulture).

The BFAP Farm & Production Analytics Division

The program: The BFAP Farm & Production Analytics 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 Farm & Production Analytics Division



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 presented in **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 projection based on the BFAP sector model output.



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 Development 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 & Cotton		KwaZulu-Natal: Midlands	KwaZulu-Natal: Seed	Citrus	North West integrated farm
Northern Cape: maize	Northern Cape: Barley	North West: Sunflower & Cotton		Mpumalanga: Irrigation	Sandveld: Irrigation	Western Cape: Table grapes	
Mpumalanga: maize (budgets)	Swartland: Wheat, barley & canola: 2019	Mpumalanga: Soybeans (budgets)		KwaZulu-Natal: Northern Coastal Dryland (small-scale)			
North West: maize		Overberg: Canola					
		Northern Cape: cotton					
		Limpopo: cotton					

➤ Agri benchmark

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.

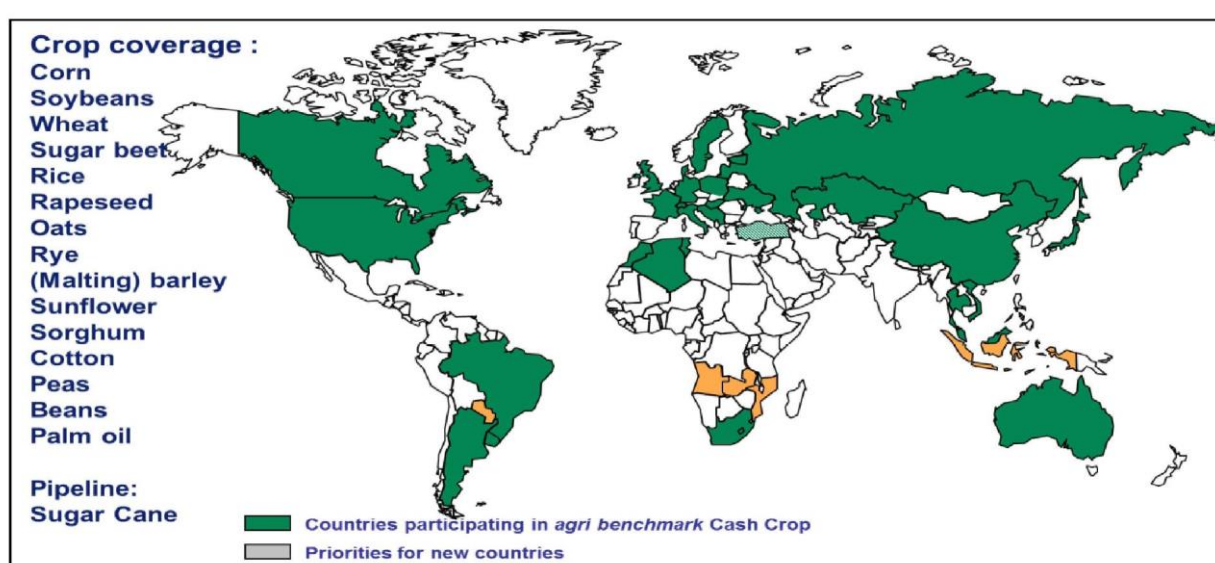


Figure 1: agri benchmark cash crop network

Objectives & key deliverables

The Protein Research Foundation (PRF), Grain South Africa (GSA) and the Bureau for Food and Agricultural Policy (BFAP) historically had their own cost of production efforts which focussed on key summer- and winter crops produced in South Africa's key agro-ecological zones. Given on-going activities associated within the organisations and the extent of the coverage of South African agricultural production, the PRF, GSA and BFAP together with agri businesses agreed to collaborate on the compilation of enterprise budgets.



The main objective of this collaboration and project is to consolidate these efforts and to generate comprehensive crop income and cost budgets for key summer- and winter growing regions and to generate sensitivity analysis for these crops. The compilation of these enterprise budgets are underpinned by the latest macroeconomic trends, BFAP sector model underlying assumptions and international- & domestic market updates. BFAP together with the PRF, Grain SA, agri businesses and industry experts will continue to engage with the objective to refine model assumptions and to ensure alignment.

Please refer to annexure of this proposal for detailed regions and proposed crops.

Specific objectives:

- Generate crop income- and cost budgets for key summer grains- and oilseeds in selective regions in South Africa: Dryland: Mpumalanga / Eastern Highveld, Eastern Free State, Northern-and Western Free State, North West and KwaZulu-Natal. Irrigation: Northern Cape, Brits, Limpopo & Bergville.
- Generate crop income- and cost budgets for key winter grains- and oilseeds in selective regions in South Africa: Dryland: Eastern Free State, Southern Cape and Western Cape. Irrigation: Northern Cape, Brits, Limpopo and Bergville.
- Generate sensitivity analysis for the above identified crops based on the latest market trends and projections. The identified regions and proposed crop coverage is presented in the annexure of this proposal.
- Generate a bi-annual report on crop budgets for the subsequent season.

Proposed schedule of reports

- February/March - Planning & analysis for subsequent winter crop
- August/September - Planning & analysis for subsequent summer crop



Annexure: Regions & crops covered:

Figures 2 - 11 illustrate the existing coverage between the GSA, BFAP and agri businesses. It is proposed to continue with the below listed regions and crops covered by GSA and BFAP.

Levels definitions:

- Level 1: Commodity enterprise budgets: updated annually
- Level 2: Actual cost of production (historic)
- Level 3: Projections / Quarterly Updates

CROP CATEGORY	PROVINCE / REGION		CROP TYPE	PNS		GSA		BFAP	
				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

CROP CATEGORY	PROVINCE / REGION		CROP TYPE	PNS		GSA		BFAP	
				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



CROP CATEGORY	PROVINCE / REGION		CROP TYPE	PNS		GSA		BFAP	
				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

CROP CATEGORY	PROVINCE / REGION		CROP TYPE	PNS		GSA		BFAP	
				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	Moorivier: 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			Loskop & Britz/Koedoeskop/Makoppa: Level 1	x	Winter irrigation: Level 1		
			Wheat	x		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 Ruëns Level 1		
			Wheat minimum tillage	x	Bredasdorp / Caledon Level 1	x	Western Ruëns Level 1	x	Bredasdorp / Caledon Level 1-3
			Barley	x	Bredasdorp / Caledon Level 1	x	Western Ruëns Level 1		
			Canola	x	Bredasdorp / Caledon Level 1	x	Western Ruëns Level 1	x	Bredasdorp / Caledon Level 1-3
			Oats	x	Bredasdorp / Caledon Level 1	x	Western Ruëns Level 1	x	Bredasdorp / Caledon Level 1-3
			Lupines			x	Western Ruëns Level 1		
			Medics					x	Bredasdorp / Caledon Level 1-3
			Lucerne					x	Bredasdorp / Caledon Level 1-3
			Wheat	x	Swellendam Level 1				
			Barley	x	Swellendam Level 1				
			Canola	x	Swellendam Level 1				
			Oats	x	Swellendam Level 1				
		Swellendam							

Figure 10: Southern Cape – Winter

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

Figure 11: Western Cape – Winter

4.5 DATA-INTENSIVE FARM MANAGEMENT (DIFM) PROJECT IN SOUTH AFRICA; M Delpont, BFAP

Introduction

The latest season (2023/24) has just been concluded in the summer region featuring 3 x Soybean trials and 6 x Maize trials on 5 farms, these farmers have been cooperating with this project since 2019.

In addition, 3 farms in the Western Cape (winter production region) have been cooperating with this project since 2022, featuring 3x wheat and 1x canola trial fields in 2023 and 4x wheat and 3x canola that have been planted across the Southern Cape and Swartland production regions (to be harvested towards the end of the 2024 calendar year).

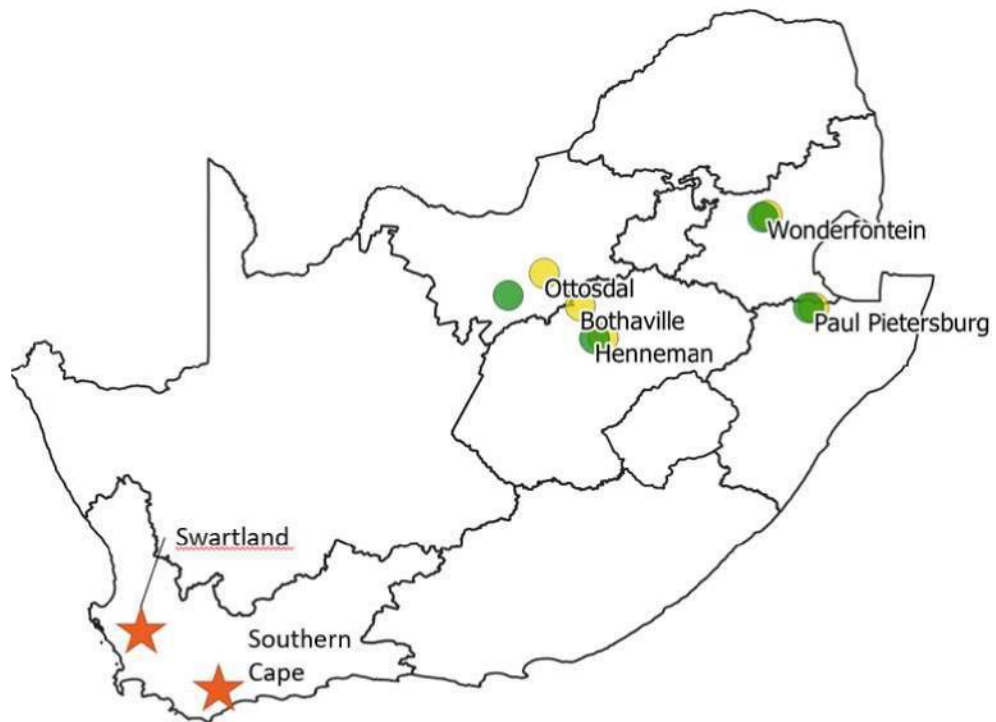


Figure 1: DIFM trial locations

Progress Summary

Most trial data for the summer production region has been gathered however data processing and cleaning has not commenced yet. The online platform (<https://difm.farm/>) developed by the DIFM US project is to be used to process the majority of trial data and some final errors are being solved (related to metric vs imperial unit conversions). Indicative timelines were that data processing could commence from mid-August onwards.

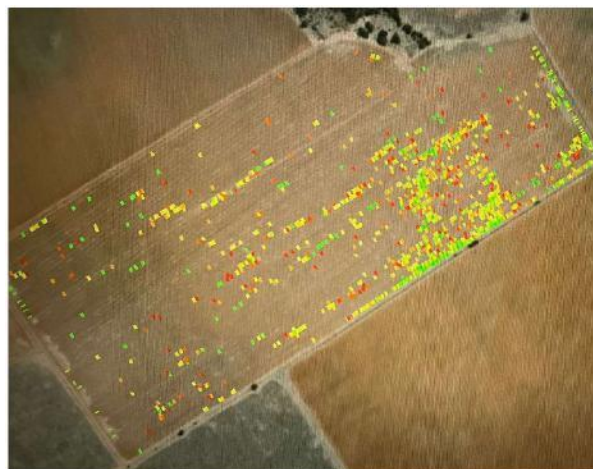


Figure 2: Schweizer-Reineke, soybean harvest map 2024



The soybean trial near Schweizer-Reneke in the North West province was a failure: due to the prolonged dry and hot weather conditions (mid-January - end of March), the yields were mostly below 680kg/ha, which the harvester failed to record. Given the sparsity of the harvest data (illustrated in Figure 2), the trial data cannot be meaningfully processed and analysed.

All other 2024 summer season trials were performed successfully, and results will be included in forthcoming reports.

Mostly, the soybean trials focus on seeding rate treatments with only one farmer adding fertilizer variations to the trial.

Table 1 presents a summary of the soybean trials performed in collaboration with the farmers during the 2024 season. The research team anticipates results to be quite informative in a dryer than usual season (as opposed to relatively wet seasons in the past years).

Table 1: Summary of soybean trials 2023/24

Province	Production region	Planting Date	Seeding rate (plants per ha)		Fertilizer rate (kg/ha)	
			Status quo	Variation applied	Status quo	Variation applied
North West ¹	Schweizer-Reneke	29-11-2023	300 000	200 000 - 450 000	NA	NA
Free State	Henneman	11-11-2023	300 000	150 000 - 450 000	Urea: 0	0 - 100
					Superphosphate: 120	0 - 200
Mpumalanga	Wonderfontein	03-11-2023	280 000	200 000 - 400 000	NA	NA

The maize trials planted and harvested for the 2023/24 season are presented in Table 2. The weather conditions were variable across the country with the Western parts experiencing severe drought conditions and the Eastern parts of the summer production area receiving more rain than in other parts of the country. Harvesting for all trials was completed but trial data processing and analytics will be only included in forthcoming progress reports.



Table 2: Summary of maize trials 2023/24

Province	Production region	Planting Date	Seeding rate (plants per ha)		Fertilizer rate (kg/ha)	
			Status quo	Variation applied	Status	Variation applied
KwaZulu-	Paulpietersburg	24-10-2023	65 000	55 000 – 82 000	Cutlivar varied	5 cultivars used.
KwaZulu-	Paulpietersburg	04-11-2023	65 000	55 000 – 82 000	NPK: 250	100 - 350
Free State	Henneman	08-11-2023	22 000	10 000 – 50 000	Urea: 200	90 - 310
Free State	Bothaville	14-12-2023	25 000	10 000 – 50 000	Urea: 200	90 - 310
Mpumalanga	Wonderfontein	25-10-2023	52 000	42 000 – 70 000	NPK: 265	190 - 350
North West	Ottosdal	21-12-2023	23 000	20 000 – 30 000	NPK: 220	150 - 275

Table 3 presents the canola trial that was harvested in 2023 as well as the new plantings for 2024. Unfortunately, excessive rain and waterlogging prevented the farmer to apply variable rate fertilizer and the trial was deemed a failure. The 2024 season has had a slow start in the Western Cape with overwhelming rainfall since throughout July. A second variable topdress fertilizer is being applied in early August.

Table 3: Summary of canola trial results 2023 and plantings 2024

Province	Production region	Planting Date	Seeding rate (kg/ha)		Fertilizer rate (kg/ha)	
			Status quo	Variation applied	Status quo	Variation applied
Western Cape²	Southern Cape	04-2023	NA	NA	Urea: 80	22 - 102
Western Cape	Southern Cape	04-2024	NA	NA	Urea: 80	22 – 200, with timing differences
Western Cape	Swartland	23-04-2024	2	1 – 3	N: 80	0 – 150, with timing differences
Western Cape	Swartland	22-04-2024	2	1 – 3	N: 80	0 – 150, with timing differences



3x Wheat trials were successfully performed in 2023. The Southern Cape trial is cut into windrows and harvested in a different direction from planting. This implies a need for the trial to be designed in a hexagonal pattern to maximise the amount of clean data that is extracted from it. As a result, however, the amount of observations are a lot less than in the conventional DIFM trial design. Therefore, management zone analyses could not be run for this field yet. By increasing the seeding rate from 68kg/ha up to 96kg/ha, additional profit of R2093/ha can be generated in a season with similar climatic conditions. By increasing the fertiliser rate from 80kg/ha up to 250kg/ha, R8550/ha additional profit could be generated for wheat in a similar season as experienced in 2023.

Both trials in the Swartland region indicated that both yield and profits could have been increased with a higher seeding rate (100kg/ha, maximum treatment) and lower fertiliser rates (75kg/ha, minimum treatment). This finding is perhaps contrary to expectation and typical agronomic recommendations and might also be a function of the rotation system applied on the farm in question (1 year of wheat followed by 2 years' medics). When defining management zones within the field, there seems to have been one zone that has implied a different recommendation: lower seeding (50kg/ha) rate with low fertilisation (100kg/ha).

As mentioned for canola above, the winter production season had a slow start with late onset of rain, followed by an extremely wet July. A second variable top dressing will be applied for the wheat trials in the Swartland as well.



Table 4: Summary of wheat trial results 2023 and plantings 2024

Province	Production region	Planting Date	Seeding rate (kg/ha)		Fertilizer rate (kg/ha)	
			Status quo	Variation applied	Status quo	Variation applied
Western Cape	Southern Cape	04-2023	60	50 - 125	Urea: 80	22 - 122
Western Cape	Swartland	04-05-2023	65	50 - 100	Chicken manure: 150	75 - 200
Western Cape	Swartland	03-05-2023	65	50 - 100	Chicken manure: 150	75 - 200
Western Cape	Southern Cape	04-2024	NA	NA	Urea: 80	22 – 200, with timing differences
Western Cape	Swartland	05-05-2024	65	50 - 100	Chicken manure: 150	75 – 200
Western Cape	Swartland	05-05-2024	65	50 - 100	Chicken manure: 150	75 – 200
Western Cape	Swartland	02-05-2024	100	50 - 150	N: 80	0 – 150 with timing differences



Timeframe for the project: 2023 - 2025

Table 1 represents the proposed timeline for project deliverables.

Table 1: Proposed Project Timeline (Activities for each year: 2022/2023 – 2024/2025)

	Action	Region	Sep - Oct	Nov - Dec	Jan - Feb	Mar - Apr	May - Jun	Jul - Aug
Activity 1: Setting up of field trails	University of Illinois & SA	Summer						
		Winter						
Activity 2: Planting of field trails	SA team	Summer						
		Winter						
Activity 3: In-season monitoring	SA team	Summer						
		Winter						
Activity 4: Capturing and processing of yield data	University of Illinois & SA team	Summer						
		Winter						
Activity 5: Developing and compiling Research	SA team	Summer						
		Winter						
Activity 6: Reporting to farmers and clients	SA team	Summer						
		Winter						

4.6 ESTABLISHING THE CLIMATIC FACTORS FOR MAXIMUM CANOLA YIELD (GENETIC YIELD POTENTIAL) AND MODELLING CANOLA YIELD AND SPATIAL SUITABILITY UNDER PRESENT AND FUTURE CLIMATE CONDITIONS IN THE WESTERN CAPE; SJE Midgley, Western Cape Department of Agriculture

Progress is reported here for 2023, the first official year of the research project. However, project preparation and student enrolment were begun in 2022, and this report covers both years.

The PhD Agric student, Mr AA le Roux, successfully developed and presented his project proposal to Stellenbosch University and the Western Cape Department of Agriculture Research Project Committee. The project is now formally registered at both institutions.

A systematic literature review on the effects of climate change on canola growth, phenology, production and oilseed yield was conducted. A draft review article was written for submission to an international peer-reviewed journal in 2023.



The phytotron at Stellenbosch University was prepared for the first controlled environment canola pot trial. Systems for irrigation/fertigation, lighting and automated climate and soil water content monitoring were installed. The first trial was initiated in July 2023, studying six cultivars representing three cultivar types and two growing season lengths. Constant factors are day/night light regime and current temperature regime at Langgewens Research Farm, and current atmospheric CO₂ concentration.

Langgewens canola trial production and weather data for 2011-2022 were collected and sorted, ready for statistical analysis.

Mr le Roux attended an online course on “Introduction to APSIM” (Agricultural Production Systems Simulator Model) which he will use for the crop-climate modelling.

Outputs included one poster presentation at a national scientific conference, two oral presentations at industry days, and participation in a panel discussion at a climate change and agriculture youth convention. One media article showcased the project and student.

4.7 IS ADDITIONAL NITROGEN BENEFICIAL TO SOYBEANS (*GLYCINE MAX. L*) IN DIFFERENT AGRO-ECOLOGIES OF THE EASTERN HIGHVELD?; Mr B Nkutha, University of the Free State

Problem description

Soybeans are commonly known for their ability to fix nitrogen, and this results in the application of nitrogen fertilizer being relatively small in this summer grain crop compared to other non-leguminous grain crops. One of many other reasons for small amounts of inorganic nitrogen being applied in soybeans is the negative effect it arguably has on biological nitrogen fixation. However, it remains an essential nutrient element because it plays two essential roles in plants.

Firstly, it is an essential constituent of reserve proteins and secondly, it is part of the enzymatic systems responsible for the growth and development of plants. Therefore, it is highly essential to ensure nitrogen levels are always sufficient in crop production.



Even though minimal nitrogen is applied in soybeans, most producers still apply supplemental nitrogen with the aim of obtaining higher yields of great quality (high protein and oil content). However, the rate at which they apply this nitrogen is either too high, too low, or unnecessary (in situations where the obtained yield is comparatively high without any nitrogen application). This research project seeks to test the effectiveness of various levels of nitrogen application and eventually determine the optimum level that will effectively enhance the growth, yield and quality of the crop while ensuring a substantial return on investment.

Aim and methodology

The aim is to test effectiveness of various levels of nitrogen application on the growth, yield and quality of soybeans in different agro-ecologies and to statistically identify the optimum level of nitrogen application that will enhance the amount and quality of production. This is carried out by planting field trials at various locations using complete randomised block design plots with four replicates per treatment. The treatments are 0 (Control), 10, 20, 30 and 40 kg N/ha. The fertiliser is band placed 5 cm below and 5 cm away from the seeds. This application takes place before the plant enters peak nitrogen demands, at grain filling (R3).

Soil samples are collected for analysis prior to planting and after harvesting; among other measurements obtained from their analysis, they are also taken to measure the nitrogen status of the soil. The trials are monitored weekly and raw data is collected from emergence to harvest. The effect of nitrogen on nodulation will be monitored from the time of administration until maturity. The primary parameters that will be measured are growth-related parameters of the plant, the yield, yield components, as well as protein and oil content.

Motivation

This research project is a very important ‘farm level’ trial that will assist farmers in taking sound decisions that will help them realize substantial returns on investment. It constitutes a best management practice trial to ensure high yields with higher protein and oil contents are obtained by altering controllable aspects in soybean production. It is also highly significant to agronomists and other crop related research scientists and consultants, particularly when making recommendations to farmers.



Farmers also need this information because optimum levels of nitrogen application remain questionable. The importance of the project to dryland producers is significantly high because of the adverse climatic conditions, a large variety of soil types and ever-changing rainfall patterns in summer rainfall regions. Outcomes from this project will assist in the mitigation of risks and taking informed decisions.

The area estimates and first production forecast of summer field crops shows that soybeans will be planted on a total of 915 300 ha for the 2022 production year, which is an increment of more than 10% from the 2021 production year. This simply means more and more farmers in the summer rainfall regions are expanding their soybean production.

Possibility of technology transfer and application

The results obtained from the project will be published by a registered institution as a master's degree thesis. They will further be provided to various industry stakeholders and role players, voluntarily and upon request. They will also be presented at farmer's days and/or conferences.

Does your institution have the necessary infrastructure and resources?

The institution does have the necessary infrastructure and resources to ensure that this research project is executed the best way possible. In cases where extra equipment or external evaluations and analysis are required then the researcher will make use of Agricultural Research Council (ARC) facilities as and when required.

Relevance and impact of proposed outcomes

The production of soybeans in South Africa at large is increasing, particularly now that fertilizer costs have tremendously increased. The total area planted increased from 705 000 ha in 2020 to 827 100 ha in 2021, which is a 17,3% increase. The expansion comes with a strong desire to achieve high yields using minimal nitrogen fertilizer. The outcome of the project will be very helpful to farmers because the amount of money they save from applying enough nitrogen will give enough returns compared to applying a lot of nitrogen and still obtaining the same yield.



Chances for success

The chances for success are very high because the trials will be planted at three different locations, and this will ensure that should any of the trials at a specific location face any environmental challenges then there are two more trials still active. The treatments will be replicated four times; this also minimizes the risk of failure.

Added to that, the trials are planted on lands of commercial farmers and there is a great guarantee that they will produce every season. The necessary equipment: implements, planters, sprayers, tractors, and combines are available, highly maintained and kept in sound conditions. Furthermore, my advisory committee is very experienced and has good credentials. My supervisors, Dr GM Ceronio and Dr E van der Watt (University of the Free State) have more than 20 years of research experience in agronomy and plant physiology respectively.

Mr JGT Prinsloo who is a farmer, agriculturalist and mentor contribute a great deal of support and knowledge towards planting, monitoring, harvesting, and interpreting different laboratory analyses, thus ensuring the project becomes successful. My colleague, Mr R Senekal is very supportive and always available for data collection and making remarks. VKB Landbou, particularly the agricultural management department is also playing an important role in ensuring this project becomes successful.

Economic justification

Fertilizer is relatively expensive, and it is not financially viable to spend a lot of money on large quantities of nitrogen fertilizer, and to also apply it in high quantities but not really make a good return from it. Regardless of whether supplemental nitrogen application is too high or not, the costs involved need to be evaluated and sound decisions should be taken to ensure that the money spent on fertilizer secures higher yields. Fertilizer prices have been increasing by more than 5% year on year. After the Russia Ukraine War, they increased even more and this is becoming a problem for most South African farmers, particularly those producing under dryland conditions. For example, Greensulf 35 retail price on the 3rd of March was R11 825.00/ton and on the 14th of March the cost price was R12 978.00/ton, this is a 9.7% increase within a period of days. This shows how expensive fertilizer has become.



This project seeks to help farmers use their fertilizer wisely and save substantial amounts of money on fertilizer.

4.8 CANOLA (*BRASSICA NAPUS L.*) PLANT POPULATION AND CULTIVAR EFFECTS ON WEEDS IN THE WESTERN CAPE, SOUTH AFRICA; Ms C Viljoen, University of Stellenbosch

Problem description

Canola growth, yield components and final yield are all directly affected by the plant population. Overall, optimal canola plant populations of 60 to 70 plants m^{-2} have been recommended for the hybrid cultivars in Europe (Rathke et al. 2006), while the standard plant populations for China is roughly 30 plants m^{-2} . Optimal canola plant populations for dry climates such as South Africa and Australia are recommended to be in the range of 40 to 80 plants m^{-2} (Canola Council of Canada, 2011; PRF, 2018). As plant populations decrease, there are fewer plants per unit area which then compensates by increasing productivity of each plant as a result of higher leaf area index, more branching and a higher number of pods per individual plant (Leach et al. 1999). Due to canola compensating to lower plant populations and less intra-row competition, producers have the flexibility to decrease seeding rates to reduce input costs, while still achieving maximum yields.

There have been unofficial reports (so-as low as five plants m^{-2} , which yielded similar yields to called “farmer trials”) in the Southern Cape of Canola plant population within the recommended range. Five plants m^{-2} is, however, a high-risk approach, particularly as yield might be limited by insufficient yield components in years with good rainfall. However, successes of such low plant populations point to the possibility of reducing seeding rates significantly and subsequently lead savings in seed cost, and therefore increased profitability. Preliminary results from a current study by Prof Pieter Swanepoel and Rory Blok in the Western Cape shows that plant populations can be reduced to as low as 10 plants per m^{-2} , without significant yield reductions. The premise for reducing seeding rates is based on seed costs. Canola seed costs are a substantial amount of cost to producers. The input cost associated with growing canola has seen a major push for better knowledge on optimal plant population for all the new canola varieties that are currently available on the market to date.



Due to the high canola seed prices, considerable research and development investments on investigating the correct plant populations for specific varieties across different climatic zones has been done. By reducing the plant populations, intraspecific plant competition is minimised resulting in reduced seed costs and potentially sustain or improve the current seed yields farmers are obtaining.

However, contrary to reducing seeding rates, the chances of weed problems increase. Effective weed control globally and also in South Africa have been hampered by reduced efficacy of chemical weed control methods (Tharayil-Santhakumar 2003). This is due to the increasing occurrence of herbicide resistant weeds that cannot be controlled effectively by means of the normal selective herbicides registered on crops (Heap 2021). *Lolium* spp. and *Raphanus raphanistrum* are of particular concern in Canola in the Western Cape.

Higher seeding rates, in combination with a competitive cultivar and early weed control can lead to better weed suppression (Harker et al. 2003). Cultivar selection for high yields and weed suppression might be an important strategy in integrated weed management (IWM) (Mwendwa et al. 2020). Cultivars that grow vigorously early in the season will suppress weed establishment and survival (Lemerle et al. 2014).

Lemerle et al. (2014) reported that triazine tolerant (TT) cultivars were least suppressive due to lower biomass production compared to other herbicide tolerant groups. The lower biomass production and less weed suppression by TT cultivars are a common observation in the Western Cape. Studies in Australia by Lemerle et al. (2016) also proved that different cultivars differed in the ability to suppress ryegrass and volunteer wheat in canola crops.

The lack of efficient weed control by means of herbicides necessitated the implementation of IWM systems. Amongst others control methods included in IWM are higher seeding rates and cultivar choice. In some cases, higher seeding rates contributed to better weed control and higher yields (Harker et al. 2003, Lemerle et al. 2011, Asaduzzaman et al. 2020). Lemerle et al. (2016) however found no significant effect of seeding rate on weed suppression in canola. Lower seeding rates however resulted in significantly higher weed seed production that will lead to major future problems.



Pieterse (2015) also found that seeding density of canola had a very small, however significant effect on the dry matter production of weeds 90 days after sowing in 2012 but none at harvest, as well as no effect on yield at both Langgewens and Roodebloem. In 2013 canola seeding density had no effect on weed dry matter production at 90 days after planting but did have a positive effect on canola yield. The influence of cultivar choice in combination with seeding density was not investigated at that stage.

It appears therefore that the combination of seeding rate and cultivar choice will influence weed populations. Locality and climate will influence these interactions and site specific research is needed to develop strategies to reduce weed populations in canola crops. Although the trend is for better weed control with higher seeding rates and cultivar choice, it needs to be tested under local conditions. With the high incidence of herbicide resistant ryegrass and wild radish in the canola cropping areas, all tactics that could add to effective IWM should be investigated.

Aim (measurable and coupled to time schedule)

The aim of this study is to evaluate weed pressure in canola as affected by canola plant population, and cultivar choice through evaluating:

- Weed abundance, weed composition, and weed seed production (2023 and 2024);
- Canola growth, development, yield and seed quality (2023 and 2024); and
- To disseminate information to producers and advisors (2024 and 2025).

The Gantt chart below shows the time schedule for 2023 (first season planting 2023 already planted); 2024 (second season planting); 2025 only dissemination.



Fieldwork activity	2023 and 2024											
	J	F	M	A	M	J	J	A	S	O	N	D
Soils and fertilisation												
Soil sampling and analysis			x	x								
Prepare soil/experimental area for seeding				x	x							
Fertiliser applications						x	x					
Crop management												
Plant crops (take climate in consideration)				x	x							
Monitor and control weeds, diseases, pests					x	x	x	x	x	x		
Plant population determination						x	x					
Hand thinning					x	x						
Canola Biomass determination					x	x	x	x	x			
Weed abundance, composition determination						x	x	x	x			
Harvest crops										x		
Yield and quality determination										x	x	
Climatic data	x	x	x	x	x	x	x	x	x	x	x	x

Dissemination of information	2024		2025		
	Mar	Aug	Mar	Aug	Sep
Farmers day	x	x	x	x	x
Popular article		x	x		
Scientific article					x
Radio talk		x		x	
Congress contribution: Poster		x			
Congress contribution: Paper					x

Motivation

- The development of herbicide resistant weeds makes chemical weed control in canola increasingly difficult;
- While there are still effective chemical control options available, this needs to be augmented by sound integrated weed management systems to keep them sustainable;
- Investigating the interaction between cultivar choice and plant population to evaluate weed suppression success without compromising canola yield can result in developing effective management strategies to reduce weed competition in canola;
- Canola is an expensive crop to grow but new varieties with high seedling vigour and increased plant competition could help reduce plant populations, thereby reducing seed costs while maintaining or improving yields; and



- Determining the agronomic and economic benefits of reducing plant populations will inform growers whether it is an option to consider.

Possibility of technology transfer and application

Results will be communicated on annual national conferences and field walk-and-talks (informal practical days). Findings will be popularised in the farmers' magazines (for example Landbouweekblad, Farmer's Weekly etc) and also extended to farmers through farmer's days annually in various regions (e.g. Annual Research Farm Information Days: "Voorsaaidae" etc.)

Addressing market demands

Weed management has become an increasingly important aspect of crop production because of the difficulty of controlling weeds in crops, and canola is no exception. Apart from the environmental pollution that herbicides may cause, there is a growing public opposition to many herbicides. The development of herbicide resistant weeds exacerbates the problem further. The development of alternative, environmentally friendly weed management systems is therefore important to address both these problems. Chemical control of weeds should be scaled down and at the same time augmented with IWM systems to decrease environmental pollution and to keep crop production viable and sustainable.

These IWM tactics can help to improve and sustain yield across the canola value chains, this allows production to increase and create a market demand. Increased canola production will result in more products being developed from canola. Since 2015, there has been an increase in consumption and that is higher than the supply, thereby creating a net market demand for the product.

Does your institution have the necessary infrastructure and resources?

Stellenbosch University is equipped with infrastructure, equipment, and a technical team to carry out this research.



Stellenbosch University is also equipped to receive and administer any funds awarded to this project. The University has offices and divisions specifically responsible for different levels of project management and financial oversight. This includes a research contract office, with project accountancy and legal services, an intellectual property office, a technology transfer centre, and a Finance Division responsible for the wide range of financial activities expected of a research-intensive higher education institution. Within the office and the Finance Division care is taken that the financial management complies with both institutional, national and funder rules and regulations. Finances of projects at the University are managed through cost centres created for specific projects.

Relevance and impact of proposed outcomes

This study will improve the understanding of how these specific IWM tactics can contribute to effective weed management in canola across different productions zones in the Western Cape. The challenge for producers and the canola industry over the next few years will be to continue to improve production and effectively control weeds to warrant supply of high-quality oils for domestic use. Understanding sustainable weed management systems in canola is important to increase canola growing confidence.

Chances for success

Similar IWM trials on canola as well as other crops have been conducted in Australia and this can be used as a basis to plan these trials. In addition, a similar type of trial (only on sowing density) was carried out by Dr PJ Pieterse from 2012 to 2014 but due to some technical problems, the results were not very clear. The report of that project can also be consulted to prevent similar problems from happening during this trial. This research is proactive and this agronomic practice needs to be investigated to make canola a successful commodity in the South African farming landscape of the future.



Extent of back-up (continuity)

A team of experts involving experienced scientists and technicians provides a good backup and memory of the e project's business plan to continue with the project in case any of the team members not being able to continue.

Economic justification

Financial analyses done on the competitiveness of different crops grown in the Western Cape showed that small increases in canola yield may have a large impact on profit margins of canola. Higher profit margins will help to convince farmers to plant more canola. Increased farming efficiency because of refined management operations (precision farming: plant population, cultivar choice) should lead to increased profitability when the results are applied on farms.

Annual savings from the lower canola seed costs will become clear from this study.



4.9 PRF WEBSITE; M du Preez and Y Papadimitropoulos, Protein Research

Period: 1 March 2023 to 29 February 2024

2023/2024 was uneventful regarding major updates to services and programming languages that form the basis of the website framework. Consequently, the focus during 2023/2024 was primarily to update existing page content and add new website content. On 29 February 2024 the Protein Research Foundation website hosted a total of 1,399 static pages. This number excludes dynamically created pages, such as the Research Database section.

Google analytics 4

As mentioned in last year's report, Google's Universal Analytics (UA) stopped processing data on 1 July 2023. It was replaced with Google's next generation Analytics 4 (or GA4 for short). Google Analytics collects visitor data from websites and apps and returns this information by means of graphs, which makes it easier to understand visitors' journeys.

The changeover was relatively smooth, owing to the fact that the PRF's new GA4 property has been running alongside the existing UA property since December 2022.

ICB Calculator App

Unable to determine an accurate figure for the number of times the online ICB App was launched. Google Play Store statistics show approximately 11 active installations. *(The amount of downloads the desktop received cannot be calculated at this stage)*



Website Visitor Statistics

Reporting Year	Unique Visitors	Unique Visitors		
	Raw values*	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
2020	27 317	9 632	24 169	1.93
2021	25 905	12 096	24 176	1.66
2022	29 278	13 074	22 570	1.52
2023	43 805	10 096 **	±18 000 **	±1.78 **

[NOTE **: It is unclear if the new Google Analytics 4 system had an impact on the results.] Google values show a decrease in page views and a decrease in active visitors. Visitors decreased by approximately 3000 and Page views increased by approximately 104 for the period: 1 March 2023 to 29 February 2024. The most page views came from the following pages in order of percentage share:

Figure based on User engagement > Page Title

1. Home page: Most amount of views
2. Bursary Requirements
3. Bursary Application Form
4. Soy Oilcake Price Average: Longest engagement time
5. ICB Calculator App



YouTube visitor statistics

Reporting Year	YouTube statistics		
	Views	Watch time (hours)	Subscriber gain
2014	611	28	+2
2015	1 900	74	+4
2016	8 400	256	+21
2017	23 000	568	+78
2018	35 000	716	+195
2019	27 900	660	+151
2020	27 600	670	+163
2021	19 400	570	+161
2022	29 200	916	+247
2023	6,200	188.6	+37
LIFETIME	±163,100	±4200 Hours	+916

The Protein Research Foundation's YouTube channel has grown to almost 916 subscribers by the end of 29 Feb 2024.

The most watched video:

1. Soybean Cultivation: 01 Introduction - Wessel van Wyk: ±3,301 Views;
2. Soybean Cultivation: Soybean Cultivation: Full Video 54 minutes - Wessel van Wyk: ±498 Views



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 27 years during which 89 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 Master's 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 Committee and were the following:

5.1 MSc Studies

- 5.1.1 **Ms RL Riet** (first application). "The effects of canola cultivar, planting density and herbicide use on weed suppression".
- 5.1.2 **Ms MV Mabitsela** (first application). "Effect of strategic tillage on soil nutrients stratification and productivity of wheat and canola in the Swartland region".
- 5.1.3 **Ms M Deventer** (first application). "Modelling the effect of environmental conditions and inoculum load on the development of *Sclerotinia* stem rot of canola in the Western Cape".
- 5.1.4 **Mr L Matthews** (Second application). "Effects of livestock integration into cropping systems on productivity of canola and the cropping system's global warming potential", University of Stellenbosch.
- 5.1.5 **Ms M Du Plessis** (Second application). "The effect of gypsum from on soil amelioration", University of Stellenbosch.



5.1.6 **Mr AB Folscher** (Second application) “Investigating pathways of infection of *Leptosphaeria* spp. causing blackleg of canola in the Western Cape”, University of Stellenbosch.

5.2 PhD Studies

5.2.1 **Mr AA Le Roux** (first application). “The effect of current and future climate on canola production in the Swartland region of South Africa”.

5.2.2 **Ms HM Screuder** (Third application). “Characterisation and management of *Leptosphaeria* spp. causing blackleg of canola in the Western Cape”, University of Stellenbosch.

5.2.3 **Mr LD Du Preez** (Second Application) The effect of tillage and crop rotation on soil health and plant production in the Western Cape Province, South Africa”, University of Stellenbosch.

5.3 Completed theses received

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

5.3.1 **Ms L Matthews** - “Effects of livestock integration into cropping systems on productivity of canola and the cropping system’s global warming potential”.



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; and
- A Board Member who has contributed significantly in promoting, over a period of time, the activities of the PRF.

No 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 webmasters. 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 2020-2023

[Latest approved new and continued research projects \(proteinresearch.net\)](https://www.proteinresearch.net/)

II PRF STRUCTURES

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

III LIST OF BURSARY APPLICATIONS: 1995 - 2023

[Bursaries awarded from 1995](#)

IV LIST OF RESEARCH PROJECTS: 1976 - 2023

[Research projects since 1976-2023](#)