



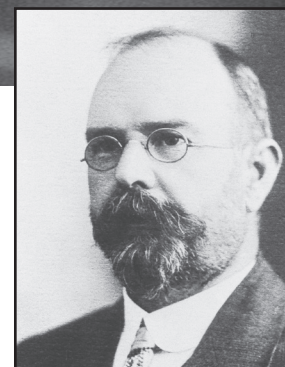
FARRER MEMORIAL TRUST

ANNUAL REPORT
2015

FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND

THE 2015 FARRER MEMORIAL ORATION





FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND

The Farrer Memorial Trust was established in 1911 to perpetuate the memory of William James Farrer and to encourage and inspire agricultural scientists. Initially it awarded scholarships for 'study or research in agricultural problems'. Later it included the delivery of an annual oration and the presentation of the Farrer Memorial Medal to a distinguished agricultural scientist for service rendered in the fields of research, education or administration.

The Director General of the Department of Primary Industries, Mr Scott A Hansen, is the Chairman of the Trust. The other official Trustees are Mr M Bullen, Deputy Director General, Agriculture NSW of the Department of Primary Industries; Prof. Alex McBratney, Professor and Dean of the Faculty of Agriculture, University of Sydney; and Dr J C Radcliffe AM, CSIRO, Unley Park, South Australia. The non official Trustees, representing industry, are: Mr M J R Arnott AM, Boorowa, Ms R Clubb, Araluen, and Mr G Mason, Boorowa.

The 2015 Farrer Memorial Travelling Scholarships were awarded to:

- Mr Kenton Porter, University of Adelaide
- Mr Tim Haskett, Murdoch University
- Ms Hanna Robinson, University of Queensland

The Farrer Memorial Travelling Scholarship is designed to support overseas travel by post-graduates enrolled for a PhD on any aspect of field crop research.

The 2015 Farrer Memorial Medal was awarded to Dr Joe Panozzo at the University of Sydney on Wednesday 19 August 2015. Dr Panozzo delivered the Farrer Oration entitled 'Will current plant breeding for grain-quality traits be applicable in a changing environment?'

The text of the 2015 Farrer Memorial Oration is reproduced on page 19 of this report.



INDEPENDENT AUDITOR'S REPORT

The Trustee for Farrer Memorial Research Scholarship Fund

To Members of the New South Wales Parliament

I have audited the accompanying financial statements of the Trustee for Farrer Memorial Research Fund (the Fund), which comprise the statement of financial position as at 31 December 2015, the statement of comprehensive income, statement of changes in equity and statement of cash flows for the year then ended, notes comprising a summary of significant accounting policies and other explanatory information.

Opinion

In my opinion, the financial statements:

- give a true and fair view of the financial position of the Fund as at 31 December 2015, and of its financial performance and its cash flows for the year then ended in accordance with Australian Accounting Standards
- are in accordance with section 41B of the *Public Finance and Audit Act 1983* (PF&A Act) and the Public Finance and Audit Regulation 2015.

My opinion should be read in conjunction with the rest of this report.

The Trustees' Responsibility for the Financial Statements

The Trustees are responsible for preparing financial statements that give a true and fair view in accordance with Australian Accounting Standards and the PF&A Act and for such internal control as the Trustees determine is necessary to enable the preparation of financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

My responsibility is to express an opinion on the financial statements based on my audit. I conducted my audit in accordance with Australian Auditing Standards. Those Standards require that I comply with relevant ethical requirements relating to audit engagements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including an assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation of the financial statements that give a true and fair view in order to design audit procedures appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

I believe the audit evidence I have obtained is sufficient and appropriate to provide a basis for my audit opinion.

My opinion does *not* provide assurance:

- about the future viability of the Fund
- that it carried out its activities effectively, efficiently and economically
- about the effectiveness of the internal control
- about the security and controls over the electronic publication of the audited financial statements on any website where they may be presented
- about other information which may have been hyperlinked to/from the financial statements.

Independence

In conducting my audit, I have complied with the independence requirements of the Australian Auditing Standards and relevant ethical pronouncements. The PF&A Act further promotes independence by:

- providing that only Parliament, and not the executive government, can remove an Auditor-General
- mandating the Auditor-General as auditor of public sector agencies, but precluding the provision of non-audit services, thus ensuring the Auditor-General and the Audit Office of New South Wales are not compromised in their roles by the possibility of losing clients or income.

C J Giumelli
Director, Financial Audit Services

11 May 2016
SYDNEY

"STATEMENT IN ACCORDANCE WITH SECTION 41C(1B)
OF PUBLIC FINANCE AND AUDIT ACT 1983"

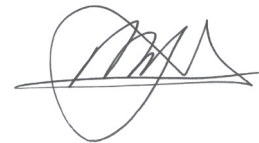
Pursuant to Section 41C (1B) of the Public Finance and Audit Act 1983 and in accordance with a resolution of the Trustees of the Farrer Memorial Research Scholarship Fund, we declare on behalf of the Trust that, in our opinion:

- (a) the accompanying financial statements have been prepared in accordance with applicable Australian Accounting Standards (which include Australian Accounting Interpretations), the provisions of the Public Finance and Audit Act 1983 and the applicable clauses of the Public Finance and Audit Regulation 2015.
- (b) the accompanying financial statements exhibit a true and fair view of the financial position and the financial performance of Farrer Memorial Research Scholarship Fund for the year ended 31 December 2015.
- (c) at the date of signing we are not aware of any circumstances that would render the financial statements misleading or inaccurate.



Scott Hansen - Chair

Dated 3 May 2016



Michael Bullen - Trustee

Dated 3 May 2016

STATEMENT OF COMPREHENSIVE INCOME
For the year ended 31 December 2015

	Notes	2015 \$	2014 \$
Expenses excluding losses			
Operating expenses			
Employee related	2a	9,366	10,697
Other operating expenses	2b	21,907	26,872
Total expenses excluding losses		31,273	37,569
Revenue			
Investment revenue	3a	34,208	64,748
In kind contribution - Department of Industry, Skills and Regional Development (DISRD)	3b	16,126	17,297
Total revenue		50,334	82,045
Net Result		19,061	44,476
Total Comprehensive Income		19,061	44,476

The accompanying notes form part of these financial statements

STATEMENT OF FINANCIAL POSITION

As at 31 December 2015

	Notes	2015 \$	2014 \$
ASSETS			
Current Assets			
Cash and cash equivalents	4	59,482	56,604
Receivables	5	10,513	3,423
Inventories	6	1,843	2,107
Other financial assets	7	63,437	61,469
Total Current Assets		135,275	123,603
Non-Current Assets			
Financial assets at fair value	8	457,577	450,188
Total Non-Current Assets		457,577	450,188
Total Assets		592,852	573,791
Net Assets			
		592,852	573,791
EQUITY			
Accumulated funds		592,852	573,791
Total Equity		592,852	573,791

The accompanying notes form part of these financial statements

STATEMENT OF CHANGES IN EQUITY

For the year ended 31 December 2015

	Accumulated Funds \$	Total \$
BALANCE AT 1 January 2015	573,791	573,791
Net result for the year	19,061	19,061
BALANCE AT 31 December 2015	592,852	592,852
BALANCE AT 1 January 2014	529,315	529,315
Net result for the year	44,476	44,476
BALANCE AT 31 December 2014	573,791	573,791

The accompanying notes form part of these financial statements

STATEMENT OF CASH FLOWS
For the year ended 31 December 2015

	Notes	2015 \$	2014 \$
CASH FLOWS FROM OPERATING ACTIVITIES			
Payments			
Grants and subsidies		(14,850)	(19,975)
Other		(33)	(33)
Total Payments		(14,883)	(20,008)
Receipts			
Interest received		2,193	5,238
Dividends received		15,003	19,731
Return on investment		565	935
Total Receipts		17,761	25,904
NET CASH FLOWS FROM OPERATING ACTIVITIES	9	2,878	5,896
CASH FLOWS FROM INVESTING ACTIVITIES			
Proceeds on redemption of financial assets		-	16,000
NET CASH FLOWS FROM INVESTING ACTIVITIES		-	16,000
NET INCREASE / (DECREASE) IN CASH		2,878	21,896
Opening Cash and Cash Equivalents		56,604	34,708
CLOSING CASH AND CASH EQUIVALENTS	4	59,482	56,604

The accompanying notes form part of these financial statements

NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS FOR THE YEAR
ENDED IN 31 DECEMBER 2015

1. Summary of Significant Accounting Policies

(a) Reporting Entity

The *Farrer Memorial Research Scholarship Fund Act 1930* permits the Trustees (the Trust) to use its earnings to assist study and research into agricultural problems, meet costs of the Farrer Memorial Oration and may provide an honorarium to the recipient of the Farrer Memorial Medal. The Trust is a not-for-profit entity as profit is not its principal objective and it has no cash generating units.

These financial statements for the year ended 31 December 2015 have been authorised for issue by the Chair of the Trust on the date the accompanying statement by the Chair of the Trust was signed.

(b) Basis of Preparation

The Trust's financial statements are general purpose financial statements which have been prepared on an accrual basis and in accordance with:

- applicable Australian Accounting Standards (which include Australian Accounting Interpretations)
- the requirements of the *Public Finance and Audit Act 1983* and *Public Finance and Audit Regulation 2015*.

Property, plant and equipment, assets (or disposal groups) held for sale and financial assets at 'fair value through profit or loss' and available for sale are measured at fair value. Other financial statement items are prepared in accordance with the historical cost convention.

Judgements, key assumptions and estimations management has made are disclosed in the relevant notes to the financial statements.

All amounts are rounded to the nearest dollar and are expressed in Australian currency.

(c) Statement of Compliance

The financial statements and notes comply with Australian Accounting Standards which include Australian Accounting Interpretations.

(d) Insurance

The Trust's insurance activities are covered by NSW Department of Industry, Skills and Regional Development (DISRD) insurance with the NSW Treasury Managed Fund Scheme of self-insurance for Government agencies.

(e) Income Recognition

Income is measured at the fair value of the consideration or contribution received or receivable. Additional comments regarding the accounting policies for the recognition of income are discussed below.

(i) Contributions

Contributions (including grants and donations) are generally recognised as income when the Trust obtains control over the assets comprising the contributions. Control over the contributions is normally obtained upon receipt of the cash.

(f) Personnel services

The Trust does not have any employees and receives administrative, secretarial support and operational assistance from DISRD. The Trust is not required to reimburse DISRD for personnel services.

1. Summary of Significant Accounting Policies**(g) Assets****(i) Loans and Receivables**

Receivables are non-derivative financial assets with fixed or determinable payments that are not quoted in an active market. These financial assets are recognised initially at fair value, usually based on the transaction cost or face value. Subsequent measurement is at amortised cost using the effective interest method, less an allowance for any impairment of receivables. Any changes are accounted for in the net result for the year when impaired, derecognised or through the amortisation process.

Short term receivables with no stated interest rate are measured at the original invoice amount where the effect of discounting is immaterial.

(ii) Inventories

Inventories held for distribution are stated at cost, adjusted when applicable, for loss of service potential. A loss of service potential is identified and measured based on the existence of a current replacement cost that is lower than the carrying amount.

(iii) Investments

Investments are initially recognised at fair value plus, in the case of investments not at fair value through profit or loss, transaction costs. The Trust determines the classification of its financial assets after initial recognition and, when allowed and appropriate, revalues this at each financial year end.

• **Fair value through profit or loss** - The Trust subsequently measures investments classified as 'held for trading' or designated upon initial recognition 'at fair value through profit or loss' at fair value. Financial assets are classified as 'held for trading' if they are acquired for the purpose of selling in the near term. Derivatives are also classified as 'held for trading'. Gains or losses on these assets are recognised in the net result for the year.

• **Held-to-maturity investments** - Non-derivative financial assets with fixed or determinable payments and fixed maturity that the Trust has the positive intention and ability to hold to maturity are classified as 'held-to-maturity'. These investments are measured at amortised cost using the effective interest method. Changes are recognised in the net result for the year when impaired, derecognised or through amortisation process.

• **Available-for-sale investments** - Any residual investments that do not fall into any other category are accounted for as available-for-sale investments and measured at fair value. Gains or losses on available-for-sale investments are recognised in other comprehensive income until disposed or impaired, at which time the cumulative gain or loss previously recognised in other comprehensive income is recognised in the net result for the year. However, interest calculated using the effective interest method and dividends are recognised in the net result for the year.

Purchases or sales of investments under contract that require delivery of the asset within a timeframe established by convention or regulation are recognised on the trade date; i.e. the date the Trust commits to the purchase or sale of the asset.

The fair value of investments that are traded at fair value in an active market is determined by reference to quoted current bid prices at the close of business on the statement of financial position date.

(h) Fair value hierarchy

A number of the Trust's accounting policies and disclosures require the measurement of fair values, for both financial and non-financial assets and liabilities. When measuring fair value, the valuation technique used maximises the use of relevant observable inputs and minimises the use of unobservable inputs. Under AASB 13: *Fair Value Measurement*, the Trust categorises, for disclosure purposes, the valuation techniques based on the inputs used in the valuation techniques as follows:

- Level 1 - quoted prices in active markets for identical assets/liabilities that the Trust can access at the measurement date.
- Level 2 - inputs other than quoted prices included in Level 1 that are observable, either directly or indirectly.
- Level 3 - inputs that are not based on observable market data (unobservable inputs).

The Trust recognises transfers between levels of the fair value hierarchy at the end of the reporting period during which the change has occurred.

1. Summary of Significant Accounting Policies**(i) Equity****(i) Accumulated Funds**

The category accumulated funds includes all current and prior period retained funds.

(j) Comparative Information

Except when Australian Accounting Standard permits or requires otherwise, comparative information is presented in respect of the previous period for all amounts reported in the financial statements.

(k) Changes in accounting policy, including new or revised Australian Accounting Standards

NSW Public sector entities are not permitted to early adopt new Australian Accounting Standards, unless Treasury determines otherwise.

Accordingly, the Trust has not applied the following Australian Accounting Standards recently issued but not yet implemented:

- AASB 9, AASB 2010-7, AASB 2013-9 (Part C), AASB 2014-1 (Part E), AASB 2014-7 and AASB 2014-8 regarding financial instruments
- AASB 14 and AASB 2014-1 (Part D) regarding Regulatory Deferral Accounts
- AASB 15 and AASB 2014-5 regarding Revenue from Contracts with Customers
- AASB 2015-1 regarding annual improvements to Australian Accounting Standards 2012-2014 cycle
- AASB 2015-2 regarding amendments to AASB 101 disclosure initiatives
- AASB 2015-3 Amendments to Australian Accounting Standards arising from the withdrawal of AASB 1031 Materiality

While the impact of these standards in the period of initial application has not been specifically quantified, they are not expected to materially impact the financial statements.

2. Expenses Excluding Losses

	2015	2014
	\$	\$
(a) Employee related expenses		
Personnel expenses	9,366	10,697
	9,366	10,697
(b) Other operating expenses include the following:		
Auditor's remuneration	6,760	6,600
Bank charges	33	33
Scholarships	14,850	19,975
Other operating expenses	264	264
	21,907	26,872
3. Revenue		
(a) Investment revenue		
Interest	3,715	6,974
Dividends	22,538	19,753
Return on investment	566	935
Net fair value gains on measurement of investments in listed shares designated through profit and loss	7,389	37,086
	34,208	64,748
(b) In kind contribution - DISRD		
Personnel services contribution	9,366	10,697
Audit fee contribution	6,760	6,600
	16,126	17,297

DISRD pays for audit remuneration and personnel service on behalf of the Trust. DISRD provides financial statement preparation services free of charge to the Trust.

4. Cash and Cash Equivalents

	2015	2014
	\$	\$
Cash at bank and on hand	43,454	40,592
At call deposits	16,028	16,012
	59,482	56,604

For the purposes of the financial statement of cash flows, cash and cash equivalents include cash at bank, cash on hand, short-term deposits, at call deposits and bank overdraft.

Cash and cash equivalent assets recognised in the statement of financial position are reconciled at the end of the financial year to the statement of cash flows as follows;

Cash and cash equivalents (per statement of financial position)	59,482	56,604
Closing cash and cash equivalents (per statement of cash flows)	59,482	56,604

Refer Note 10 for details regarding credit risk, liquidity risk and market risk arising from financial instruments.

5. Current Assets - Receivables

	2015	2014
	\$	\$
Receivables from investing activities	10,513	3,423
	10,513	3,423

Details regarding credit risk, liquidity risk and market risk, including financial assets that are either past due or impaired, are disclosed in Note 10.

6. Current Assets - Inventories

Medals held for distribution - at cost	1,843	2,107
	1,843	2,107

Inventories consist of Farrer Memorial Medals. Medals are valued at cost which approximates fair value.

7. Current Assets - Other Financial Assets

Macquarie bank term deposit	63,437	61,469
	63,437	61,469

Refer to Note 10 for further information regarding credit risk, liquidity risk and market risk arising from financial instruments.

8. Non-Current Assets - Financial Assets at Fair Value

The following summary shows the market values (Fair value) of all shareholdings as at 31 December 2015.

Company	Market Value	
	2015 \$	2014 \$
Fixed Income Securities		
National Australia Bank (NABHA)	25,545	28,823
Macquarie bank (MBLHB)	24,876	29,160
Suncorp Group (SBKHB)	31,570	31,779
	81,991	89,762
Listed Trusts		
Dexus Property Group (DXS)	15,113	14,045
Goodman Group (GMG)	8,872	8,051
Sydney Airport (SYD)	64,770	48,042
Duet Group DUE)	30,096	31,812
SP AusNet (AST)	21,532	19,285
	140,383	121,235
Growth Securities (Shares)		
National Australia Bank (NAB)	34,730	38,640
Westpac Banking Corporation (WBC)	53,695	53,056
Leighton Holdings (LEI)	41,675	38,587
Wesfarmers (WES)	47,768	47,895
Telstra (TLS)	57,335	61,013
	235,203	239,191
Portfolio Total	457,577	450,188

The movement in the market value of the financial assets at fair value through the income statement in 2015 was a gain of \$7,389 (2014 gain of \$37,086).

Refer to Note 10 for further information regarding fair value measurement, credit risk, liquidity risk and market risk arising from financial instruments.

9. Reconciliation of Cash Flows from Operating Activities to Net Result

	2015 \$	2014 \$
Net cash used on operating activities	2,878	5,896
Increase/(decrease) in inventories	(264)	(264)
Increase/(decrease) in receivables	7,090	(434)
Increase/(decrease) in fair value of financial assets	7,389	37,086
Increase/(decrease) in other financial assets	1,968	2,192
Net result	19,061	44,476

10. Financial Instruments

The Trust's principal financial instruments are outlined below. These financial instruments arise directly from the Trust's operations or are required to finance the Trust's operations. The trust does not enter into or trade financial instruments, including derivative financial instruments, for speculative purposes.

The Trust's main risks arising from financial instruments are outlined below, together with the Trust's objectives, policies and processes for measuring and managing risk. Further quantitative and qualitative disclosures are included throughout this financial statement.

The Trustees have overall responsibility for the establishment and oversight of risk management and reviews and agrees policies for managing each of these risks. Risk management policies are established to identify and analyse the risks faced by the Trust, to set risk limits and controls and to monitor risks.

The Trust's overall risk management program focuses on the risk versus return feature of financial markets and seeks to minimise adverse effects on the Trust's investment returns. The Trust currently does not use derivative instruments such as foreign exchange contracts and interest swaps to hedge its risk exposure. The Trust uses a variety of risk mitigation measures to manage the types of risk to which it is exposed. These methods include sensitivity analysis in the case of interest rates and other price risks.

The Trust maintains a number of investment portfolios to address a variety of objectives:

- A long term growth portfolio representing the Trust's asset reserves and endowments and has a long term investment horizon. This portfolio has an investment profile oriented towards growth assets and is managed by external fund managers.
- A long term debt portfolio used to generate a fixed income stream. This portfolio invests in short to medium term fixed and floating rate securities.

(a) Financial Instrument Categories

Financial Assets	Note	Category	Carrying Amount 2015 \$	Carrying Amount 2014 \$
Class:				
Cash and cash equivalents	4	N/A	59,482	56,604
Financial assets at fair value	8	At fair value through profit or loss - designated as such upon initial recognition	457,577	450,188
Receivables	5	Loans and receivables (at amortised cost)	10,513	3,423
Other financial assets	7	Held to maturity (at amortised cost)	63,437	61,469

(b) Credit Risk

Credit risk arises when there is the possibility that the counter party will default on their contractual obligations, resulting in a financial loss to the Trust. The maximum exposure to credit risk is generally represented by the carrying amount of the financial assets.

Credit risk arises from the financial assets of the Trust, including cash, receivables and other financial assets. No collateral is held by the Trust. The Trust has not granted any financial guarantees.

Credit risk associated with the Trust's financial assets, other than receivables, is managed through the selection of counter parties and establishment of minimum credit rating standards.

Cash

Cash comprises cash on hand and bank balances with St George Bank and Rabobank Australia Limited. St George interest is earned on the daily bank balance at market rates and Rabobank interest is earned at a flat 0.2% rate during 2015 (2014 0.2%).

Receivables - trade debtors

All trade debtors are recognised as amounts receivable at balance date.

Other financial assets

The Trust has placed funds on deposit with Macquarie Bank Limited for a fixed term. The interest rate payable is fixed for the term of the deposit. The deposits at balance date were earning an average interest rate of 3.00% (2014: 3.45%)

(c) Liquidity risk

Liquidity risk is the risk that the Trust will be unable to meet its payment obligations when they fall due. The Trust continuously manages risk through monitoring future cash flows and maturities planning to ensure adequate holding of high quality liquid assets. The trust has no loans payable and no assets have been pledged as collateral. The Trust's exposure to liquidity risk is deemed insignificant based on prior periods' data and current assessment of risk. The trust has no liabilities and the majority of the assets are cash, cash equivalents or tradable shares and securities.

(d) Market risk

Market risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market prices. The Trust's exposure to market risk are primarily through price risk and cash flow and fair interest rate risk.

The effect on profit and equity due to a reasonably possible change in risk variable is outlined in the information below, for interest rate risk and other price risk.

Interest rate risk

The Trust's interest rate risk arises from the cash kept in the bank account subject to interest bearing at variable average rate of 2.5%. At 31 December 2015, if interest rates decreased/increased by 1.00% with all other variables held constant, equity would have been \$595 lower/higher (2014: \$566 lower/higher) as a result of an increase/decrease in fair value of debt security.

Other price risk

The Trust has exposure to equity securities price risk. This arises from investments held by the Trust and classified on the balance sheet as Assets held at fair value through the income statement, such that the impact of a change in value of the securities would be reflected as either an increase or decrease in fair value of the security through the income statement.

To manage its price risk from investments in equity securities, the Trust has contracted out the management of the portfolio to external fund managers, Macquarie Equities Limited. These fund managers are mandated to diversify the investments of the portfolio under their management. The quantum of funds under management per external fund manager and the investment objectives of each external fund manager are in accordance with policies set by the Trustees.

A majority of the Trust's equity investments managed by external fund managers are denominated in AUD, are publicly traded and included in the ASX 300 Index. The impact of increases/decreases on the ASX 300 Index on the Trust's equity would be increase/decrease of \$45,757 (2014: \$45,019). The analysis is based on the assumption that the ASX 300 Index increased/decreased by 10%, with all other variables held constant and the Trust's equity portfolio moves according to the historical correlation with the index.

**Market risk
(d) (continued)**

	Carrying Amount \$	Interest rate risk				Other price risk			
		-1.00%		1.00%		-10.00%		10.00%	
		Profit	Equity	Profit	Equity	Profit	Equity	Profit	Equity
31 December 2015									
Financial Assets									
Cash & cash equivalents	59,482	(595)	(595)	595	595	-	-	-	-
Financial Assets held to Maturity ⁽¹⁾	63,437	-	-	-	-	-	-	-	-
Receivables ⁽²⁾	10,513	-	-	-	-	-	-	-	-
Fixed Income Securities ⁽³⁾	81,991	-	-	-	-	(8,199)	(8,199)	8,199	8,199
Listed Trusts	140,383	-	-	-	-	(14,038)	(14,038)	14,038	14,038
Growth Securities	235,203	-	-	-	-	(23,520)	(23,520)	23,520	23,520
Total increase/(decrease)		(595)	(595)	595	595	(45,757)	(45,757)	45,757	45,757
31 December 2014									
Financial Assets									
Cash & cash equivalents	56,604	(566)	(566)	566	566	-	-	-	-
Financial Assets held to Maturity ⁽¹⁾	61,469	-	-	-	-	-	-	-	-
Receivables ⁽²⁾	3,423	-	-	-	-	-	-	-	-
Fixed Income Securities ⁽³⁾	89,762	-	-	-	-	(8,976)	(8,976)	8,976	8,976
Listed Trusts	121,235	-	-	-	-	(12,124)	(12,124)	12,124	12,124
Growth Securities	239,191	-	-	-	-	(23,919)	(23,919)	23,919	23,919
Total increase/(decrease)		(566)	(566)	566	566	(45,019)	(45,019)	45,019	45,019

Notes:

1. Held to Maturity Term Deposits are not traded and are not subject to interest rate variation during the term.
2. Receivables include interest due on Fixed Interest Securities and Term Deposits and dividends receivable. The value of these receivables will not change due to changes in market interest rates.
3. Fixed Income Securities are composed of Listed Fixed Interest Securities which are not subject to changes in market interest rates.

(e) Fair value measurement

(i) Fair value compared to carrying amount

Financial instruments are generally recognised at cost, with the exception of investments, which are measured at fair value.

The carrying amount of the financial instruments recognised in the financial statements approximates the fair value.

10. Financial Instruments (continued)

(e) Fair value measurement (continued)

(ii) Fair value recognised in the statement of financial position

	Level 1	Level 2	Level 3	2015
	\$	\$	\$	Total
				\$
Financial assets at fair value				
Fixed Income Securities	81,991	-	-	81,991
Listed Trusts	140,383	-	-	140,383
Growth Securities	235,203	-	-	235,203
	457,577	-	-	457,577

	Level 1	Level 2	Level 3	2014
	\$	\$	\$	Total
				\$
Financial assets at fair value				
Fixed Income Securities	89,762	-	-	89,762
Listed Trusts	121,235	-	-	121,235
Growth Securities	239,191	-	-	239,191
	450,188	-	-	450,188

There were no transfers between Level 1 or 2 during the period.

11. Commitments for Expenditure

The Trust has no commitments for expenditure as at 31 December 2015.

12. Contingent Assets and Liabilities

The Trust has no contingent assets or liabilities as at 31 December 2015.

13. After Balance Date Events

The Trust is unaware of any significant events after balance date that would impact the financial statements and the notes to the financial statements.

END OF AUDITED FINANCIAL STATEMENTS



The 2015 FARRER MEMORIAL ORATION

Will current plant breeding for grain-quality traits
be applicable in a changing environment?

Dr Joe Panozzo



Farrer and grain – quality traits

Dr Joe Panozzo

I am honoured to receive the William Farrer award and thank the Farrer trust and the NSW Department of Primary Industries for this very prestigious award. In accepting this award, I acknowledge my fellow grains chemists and plant breeders with whom I’ve had the privilege of working during my career in crop improvement.

I would also like to thank the joint Charles Perkins Centre and Marie Bashir Institute (CPC/MBI), particularly the project node on “Food systems and Nutrition: Security, Safety, Quality”; the Sydney Environment Institute Food, People, Planet Research Node; the Food Systems Innovations Network; the Australian Centre for International Agricultural Research and the Crawford Fund for the opportunity to present my oration today.

During my career in plant breeding, I have been fortunate to have worked on five main broad-acre crops: wheat, barley, canola, lentils and field peas which are all grown in south-eastern Australia. Each of these crops have a unique role in agriculture and play an important part in food manufacture and human nutrition.

In my oration, I will outline improvements in grain quality and discuss the main drivers in plant breeding for each crop. I am mindful the audience at this symposium have an interest in food security and nutrition and so I will discuss where the current gaps in plant breeding are in relation to this field of science.

Historically, plant breeding in Australia was undertaken by state departments of agriculture, universities and CSIRO. The emphasis has been on developing varieties that are best for the Australian grains industry using the principles first used in Australia by William Farrer. In the past 10 years, state governments have withdrawn from directly breeding the major cereal crops, as this role has been taken over by the private sector. However, state governments still invest in breeding minor crops such as pulses.

Nonetheless, the aims remain the same, to develop new varieties which are adapted to a specific growing region, soil-type and set of environmental conditions. Each new variety is, in theory, better than the previous variety as plant breeders introduced new germplasm with a combination of genes for improved resistance or tolerance to plant diseases resulting in increased grain yields. Similarly, the chemist has identified through extensive screening of the new germplasm, a new line with improved quality traits.

The development of a new variety is the culmination of between eight and 12 years of extensive testing, and during the course of testing, thousands of germplasm lines are discarded because they fail a particular test. What may not be apparent to those not directly associated with plant improvement is that there is a need to look into the future to foresee issues which may arise in 10 years’ time. These issues may be related to the emergence of a new plant disease, issues related to climate, specific requirements of new markets or a change in food trends.

The development of successful varieties is becoming increasingly more difficult. Scientists try to combine genes which confer increased grain yields, improved agronomic traits for adaptability in a changing environment and resistance to pests and diseases as well as ensuring the grain meets market specifications. I will now outline the major quality traits in broad terms for these five crops, identify which industry sectors are the drivers for improving grain quality and identify any gaps.

Wheat

Wheat is the major broad-acre crop grown in Australia. Approximately 23 million tonnes are produced annually. The majority of the wheat is exported to South East Asia, Japan, South Korea and the Middle-East. Domestically, wheat is milled into flour and used predominantly by the baking industry. The primary quality targets are; large grain size, protein percentage between 10 and 14% to align with a particular market class, high flour yield and white flour colour and dough rheology which optimises bread quality and processing characteristics within the bakery.

Table 1: Wheat

Industry Sector	Macro quality traits	Drivers	Resources allocated for improving quality traits
Grain	Grain size	Industry	Large
Flour milling	Milling yield, colour	Industry	
Automated bakeries	Dough mixing properties	Industry	
Starch and gluten	Starch gelatinisation	Industry	
Retailers	Baked quality	Industry	
Health	• Reduced allergy to gluten • Increased resistant starch* • Increased amino acids, vitamins, micronutrients	Consumers	Small

*Commercial bread available with high RS

Underlying these broad traits are the contributions of proteins and carbohydrates which are the major components of the grain; their composition controlled by multiple genes located on different chromosomes; and their expression altered by the effects of environmental conditions during grain development. This may appear to be relatively easy task to simultaneously improve grain yields and disease resistance and quality traits. However pleiotropic effects can often alter the desired outcome.

In a highly competitive commercial environment, gaining or maintaining market share is important for profitability and therefore breeding programs target quality traits to align with the largest markets.

Wheat is also the grain which receives the greatest public scrutiny in terms of allergies and intolerances and whilst there have been attempts to address these issues, the task has proven to be complex without compromising mainstream quality targets. A case in point is a wheat that is suitable for coeliac patients. To address this issue would require down-regulating coeliac-toxic proteins such as gliadins without compromising the gluten structure and baking quality.

Similarly, the development of a wheat variety with increased resistant starch is generally not compatible for grain yield and grain size with most commercial cultivars as increasing the resistant starch, involves a shift in the starch biosynthesis pathways altering the relative synthesis of amylose and amylopectin. The result is often smaller or partially-filled grains.

Barley

Barley is a high value grain, particularly if the variety meets the industry grain and malting specifications for beer production. These specifications are defined by large grains, specific protein percentage window and optimal levels of starch-degrading enzymes which are synthesised during the germination or malting process. For malting barley, the β-glucan levels which are components of cell walls must be very low as their presence creates filtration problems during the production of beer.

However, from a human-wellbeing perspective, we know that β-glucans have an important role in preventing the absorption of cholesterol, and so there is a conflicting issue of what the industry requires to produce a high-value beer and what the consumer requires to reduce LDL cholesterol. To this end, the CSIRO developed BARLEYmax which is higher in dietary fibre and resistant starch than commercial malting barley varieties.

Table 2: Barley

Industry Sector	Macro quality traits	Drivers	Resources allocated for improving quality traits
Malt production	Optimum enzyme development	Malting industry	Large
Beer production	Low β-glucan Optimum starch and protein degrading enzymes Low beer haze proteins	Brewing companies	
Feed w/barley	Grain size Protein Metabolisable energy	Grains Industry	
Food For example, (BARLEYmax*)	High β-glucan High resistant starch	Health-conscious consumers	-

*Developed by CSIRO and partners

Canola

Oilseed crops such as canola are either exported or processed within Australia into a range of oil products. Of all broad-acre crops, canola breeders have been able to target a range of industry sectors to produce oil for diverse end-uses and also for human health. This wasn't always the case as the predecessor to canola in the 1960s was rapeseed. The oil from rapeseed contained high levels of the erucic acid and the seed meal was high in glucosinolates. It was found that erucic acid was deleterious to human health and glucosinolates were unpalatable for live-stock. With the introduction of canola, an acronym for Canadian Oil Low Acid, the

presence of these compounds was reduced to very low concentrations. The emphasis of the canola industry was to improve the quality by selecting fatty acids with enhanced or decreased fatty acid concentrations for use as an edible oil for cooking. The aim was to make the oil more healthy by increasing the oleic acid levels or to improve the frying stability by decreasing linolenic acid levels.

Table 3: Canola

Industry Sector	Macro quality traits	Drivers	Resources allocated for improving quality traits
Oil (Human use)	Increased oleic (C18:1)	Industry	Large
Oil (Frying stability)	Lower linolenic (C18:3)	Industry	
Meal (stockfeed)	Low glucosinolates	Stockfeed Industry	
Health	Long chain omega-3 fatty acids. Increased DHA	Consumers	-

As Australia embraced the value of olive oil, the canola industry realised an opportunity to develop an oil with health-giving benefits similar to olive oil. The aim was to increase oleic acid levels and reduce the level of saturated fatty acids. Recently, there have been reports on the development of germplasm with an increase in omega-3 fatty acids with DHA levels similar to those found in fish to directly target the health market (Media bulletin, 2014).

Pulses

Of all the grains consumed by humans, pulses are still an untapped resource for enhanced human nutrition. Pulses, including the two, I referred to earlier; lentils and field peas are widely consumed outside Australia, their consumption by Australian residents is still quite small by comparison. We know that pulses are high in protein, carbohydrates and fibre and phytochemicals with reputed bioactive properties (Rochfort and Panozzo, 2007).

Pulse quality traits and breeding objectives can be segmented into four groups as outlined in Table 4. The segmentation reflects consumption with the majority of pulses used as a whole seed or as a split product. The four sectors also align with resources allocated to the development of a new variety.

We can segment our breeding objectives and testing into four main groups. These are physical seed characteristics, processing characteristics, macro-seed composition such as protein, carbohydrate and fibre; and compounds present in minor concentrations such as isoflavones, saponins oligosaccharides and phytates. To date most of the breeding objectives for pulses have been based on improving seed size, shape and colour, as these traits are the basis for trading within the Indian sub-continent. In addition as the majority of pulses are dehulled and split, the second most important breeding objective centres on dehulling and splitting, hydration and cooking time. The combination of optimising the physical seed traits and improving processing characteristics accounts for the majority of the resources allocated to improve quality traits in a new variety.

Table 4: Pulse Grains

Industry Sector	Macro quality traits	Drivers	Resources allocated for improving quality traits
Physical seed traits	Seed size, shape and colour	Traditional consumers (Indian sub-continent)	Large
Processing traits	Dehulling/splitting Split colour Cooking time	Traditional consumers (Indian sub-continent)	
Seed composition	Starch Protein Fibre	Traditional and non-traditional consumers (Western consumers)	
Bioactive compounds (for example)	Isoflavones Phytosterols Saponins Oligosaccharides Folates Phytates	Non-traditional consumers (Western consumers)	Small

There is no disputing that seed composition such as proteins and carbohydrates will affect cooking traits. However, in most cases, as food is prepared within a household, the cooking process can be adjusted to compensate for any variation in grain composition. Two components of pulse quality as outlined in Table 4, worthy of further investigation and development are associated with seed composition. These are macro-compounds such as protein, carbohydrates and fibre which can be used particularly for non-traditional food products, and, bioactive compounds including isoflavones, oligosaccharides and phytosterols which are of interest for their purported health benefits.

All of the traits I have described for each grain type are controlled by multiple genes and therefore by understanding the plant genome and their biochemistry, researchers are able to make a stepwise improvement in plant breeding or genetic selection. Moreover, we also know there are significant interactions with environmental conditions which alter the expression of a particular trait and this can have a positive or negative effect.

Grain quality and nutrition in a changing environment

There is no disputing that carbon dioxide levels in the atmosphere have steadily increased since the commencement of industrialisation and it has been estimated that levels of carbon dioxide will reach 550 ppm by the year 2050 (IPCC, 2007). To investigate the effect the effect of elevated carbon dioxide in the atmosphere on crop growth, the Australian Grains Free Atmospheric Carbon Enrichment facility was established at Horsham, Victoria with funding from the State Government of Victorian, the Grains Research and Development Corporation, the Commonwealth Government and the University of Melbourne. The infrastructure was designed so that 550ppm of carbon dioxide could be applied throughout the growth stages of the crop and the response to elevated carbon dioxide investigated in a diverse range of experiments (Mollah et al., 2009). The facility undertakes research

projects supported by Melbourne University, the Federal Department of Agriculture, Australian Research Council, the Victorian State Government and the Grains Research and Development Corporation (PICCC, 2015).

Based on data from this facility, we have been able to confirm that elevated carbon dioxide conditions increase plant biomass and grain yields of wheat. Of significance for the grains industry, the protein percentage in the grain decreased by five to seven percent relative to the ambient CO₂ treatment. This may necessitate increased use of fertilisers to maintain the protein levels in the future. We have demonstrated that elevated carbon dioxide also alters protein composition and in particular the synthesis of glutenin and gliadin proteins which are important for optimum dough rheology. In addition we have reported on the deleterious effect on baking quality and reduced bread volume (Panozzo et al., 2014).

The implications for human nutrition are also significant. Myers et al. (2014) reported in the journal Nature, using data derived from the Victorian AGFACE facility and elsewhere, that elevated carbon dioxide conditions resulted in a significant decrease of approximately 10% in zinc, and 5% in iron and, phytate in wheat. The implications are significant as further modelling studies undertaken by Myers et al., (2015) suggest that the countries that will be most at risk of zinc deficiency as a result of elevated levels of carbon dioxide will be the African continent as well as the Indian subcontinent and the Middle-East.

Concluding remarks

I have highlighted the important work that is undertaken by plant breeding programs in ensuring that every new variety is adaptable within a constantly changing Australian environment.

It is important that each variety is fit for purpose and extensive testing is undertaken to ensure this is the case for both the domestic market and for highly competitive export markets. It is clear that for macro components of grain, their effect on product

quality, particularly for cereal grains and oilseeds, is clearly understood and with the advancement of new genomic and phenomic technologies, significant gains in tackling more complex traits will be possible in the future.

With the acceleration of lifestyle diseases and the apparent increase in cereal-based allergies, further research in developing new varieties to assist in overcoming these issues will become more important.

The promotion of pulses as a nutritious source of protein, carbohydrates and fibre and other minor components in western diets needs to be ongoing. The initiative by the global pulse community to promote 2016 as the International Year of the Pulse will increase our awareness of this important food source.

With climate change and increasing climate variability ensuring new varieties combine grain quality traits and nutritional composition to feed the world will become paramount particularly as demonstrated in the literature that human nutrition may be compromised.

Much of the research involving food for human nutrition or wellbeing has investigated a particular component of the grain in isolation, and looked at the biochemical response. For example, the effect of β -glucans to reduce plasma LDL cholesterol levels. This reductionist approach is often used in science to investigate cause and effect, however grains should be regarded as a matrix containing a range of bioactive compounds. Each will have a direct or interactive effect on our wellbeing. Future research therefore needs to be holistic and consider the effects of more than one component. Similarly, medical science needs to work more closely with applied sciences such as plant improvement so that we can ensure ongoing food and nutritional security for the world.

References

- Media Bulletin (2014) **Sustainable DHA omega-3 canola closer to reality**. <http://www.nufarm.com/assets/26570/1/Omega-3collaborationupdateJan2014Final.pdf>
- Rochfort, S. and Panozzo, J.F. (2007). Phytochemicals for health, the role of pulses. *Journal of Agriculture and Food Chemistry*, 55: (20), 7981-7994

IPCC Core Writing Team: Pauchauri, R.K. and Reisinger, A. (2007). **Climate Change 2007. Synthesis Report**. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland: IPCC

Primary Industries Climate Challenges Centre: **The Australian Grains Free Air Carbon Dioxide Enrichment Facility (AGFACE)** (2015) <http://www.piccc.org.au/research/project/252>

Mollah, M., Norton, R., Huzzey, J. (2009) Australian Grains Free Air Carbon Enrichment (AGFACE) facility: design and performance. *Crop and Pasture Science* 60: 697-707 <http://dx.doi.org/10.10171.CP08354>

Panozzo J.F., Walker, C.K., Partington, D.L., Neumann, N.C., Tausz, M., Seneweera, S. and Fitzgerald, G.J. (2014) Elevated levels of carbon dioxide changes protein concentration and composition and, compromises baking quality. A FACE study. *Journal of Cereal Science* 60: 461-470 <http://dx.doi.org/10.1016/j.jcs.2014.08.011>

Myers, S.S., Zanobetti, A., Kloog, I., Huybers, P., Leakey, A.D.B., Bloom, A.J., Carlise, E., Dietterich, L.H., Fitzgerald, G., Hasegawa, T., Holbrook, N.M., Nelson, R.L., Ottman, M.J., Raboy, V., Sakai, H., Sartor, K.A., Schwartz, J., Seneweera, S., Tausz, M. and Usui, Y. (2014) Increasing CO₂ threatens human nutrition. *Nature* 510: 139-143, <http://dx.doi.org/10.1038/nature13179>

Myers, S.S., Wessels, K.R., Zanobetti, A. and Schwartz, J. (2015) Effect of increased concentrations of atmospheric carbon dioxide on the global threat of zinc deficiency: a modelling study. *The Lancet*. 1-7. [http://dx.doi.org/10.1016/52214-109x\(15\)00093-5](http://dx.doi.org/10.1016/52214-109x(15)00093-5)

