Value Added Wheat CRC Ltd Annual Report 2001-2002

THE COOPERATIVE RESEARCH CENTRE FOR VALUE ADDED WHEAT
Established & supported under the Australian Government’s Cooperative Research Centre Program
CORE PARTICIPANTS

Commercial
- Arnott’s Biscuits Ltd.
- C-Qentec Diagnostics Pty Ltd
- Goodman Fielder Ltd
- GrainCorp Operations Ltd
- Grains Research & Development Corporation

Research
- NSW Agriculture
- The Department of Agriculture
- The University of Sydney

SUPPORTING PARTICIPANTS

- Australian Proteome Analysis Facility (APAF)
- BRI Australia Ltd
- Centre for Application of Molecular Biology to International Agriculture, Canberra (CAMBIA)
- Cibus Genetics
- Department of Primary Industries, Qld (DPIQ)
- Food Science Australia (CSIRO)
- Primary Industry and Research South Australia (PIRSA)
- South Australia Research & Development Institute (SARDI)
- United States Department of Agriculture (USDA) Manhattan, Kansas Lab
- University of Adelaide
Vision & Mission

The Vision and Mission of the Value Added Wheat CRC can be summarised in a single sentence: "The pursuit of excellent science to meet commercial needs for a more profitable wheat industry".

Our Goals are:

• to integrate new science with existing knowledge and technologies to develop novel diagnostics, processes and germplasm for wheat;

• to link science to the consumer by integrating the research efforts of several groups into commercially targeted programs and

• to ensure the quickest possible delivery of science to the market place to maximise its contribution to industry and commercial performance.
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGHLIGHTS - MAJOR ACHIEVEMENTS AND OUTCOMES</td>
<td>4</td>
</tr>
<tr>
<td>CENTRE OBJECTIVES</td>
<td>5</td>
</tr>
<tr>
<td>CHAIRMAN’S REPORT</td>
<td>6</td>
</tr>
<tr>
<td>MANAGING DIRECTOR’S REPORT</td>
<td>8</td>
</tr>
<tr>
<td>STRUCTURE AND MANAGEMENT</td>
<td>10</td>
</tr>
<tr>
<td>BOARD OF DIRECTORS</td>
<td>12</td>
</tr>
<tr>
<td>COOPERATIVE LINKAGES</td>
<td>14</td>
</tr>
<tr>
<td>PROGRAM 1: DIAGNOSTICS</td>
<td>16</td>
</tr>
<tr>
<td>PROGRAM 2: PRODUCTS AND PROCESSING</td>
<td>18</td>
</tr>
<tr>
<td>PROGRAM 3: GENOMICS AND PROTEOMICS</td>
<td>24</td>
</tr>
<tr>
<td>PROGRAM 4: GERmplasm, PRODUCTION, AGRONOMY AND STORAGE</td>
<td>26</td>
</tr>
<tr>
<td>PROGRAM 5: EDUCATION AND TECHNOLOGY ADOPTION</td>
<td>30</td>
</tr>
<tr>
<td>UTILISATION, COMMERCIALISATION AND LINKS</td>
<td>35</td>
</tr>
<tr>
<td>STAFFING AND ADMINISTRATION</td>
<td>37</td>
</tr>
<tr>
<td>PUBLICATIONS, PRESENTATIONS, GRANTS AND AWARDS</td>
<td>38</td>
</tr>
<tr>
<td>PATENTS AND TRADE MARKS</td>
<td>43</td>
</tr>
<tr>
<td>PERFORMANCE INDICATORS</td>
<td>44</td>
</tr>
<tr>
<td>FINANCIAL MATTERS</td>
<td>47</td>
</tr>
</tbody>
</table>
Major Achievements & Outcomes

Outputs and outcomes from the new Centre in the last twelve months include:

- WheatRite® and ReadRite® diagnostics in advanced stages of commercial development with C-Qentec Diagnostics Pty Ltd, a Core Participant of the CRC.

- New approaches to immunology-based diagnostics for quality started, new work begun and kits supplied to Australian wheat breeders.

- A new test kit for breeders to screen wheat lines for the presence of the GBSS-null 4A phenotype, resulting in lower amylose starch.

- Capillary electrophoretic methods for varietal identity of Australian soft wheats developed.

- QAL2000 biscuit wheat grown and used commercially and superior successor lines advanced for commercial development through Centre Participants.

- Germplasm with extreme variation in blackpoint, PPO, high amylose content and high milling yield identified.

- Waxy wheat lines advanced and evaluated for commercial development by George Weston Foods and by Byron Australia.

- Superior wheat germplasm with multiple quality enhancements (such as rain-damage resistance) identified and licensed to breeders for commercial evaluation.

- Clones suitable for use in the DNA micro-array marker technology of CAMBIA (a Centre Supporting Participant) prepared, and plans laid for making the technology available to wheat breeders for whole-genome use on a worldwide, commercial basis.

- Large numbers of wheat markers capable of high throughput use identified using Centre technology in collaboration with the John Innes Institute, UK.

- Continued six-figure cost-saving improvements to the plant bakery process control system made, and pilot implementation in a Goodman Fielder bakery begun.

- Microbiological food safety risks were evaluated alongside manufacturers.

- Successful completion of two postgraduate projects, three industry and nine grower workshops; training modules and decision aids made available nationally.

http://www.wheat-research.com.au
Value Added Wheat CRC is an incorporated company and operates within the framework of the Commonwealth Cooperative Research Centre program with Participants cash and in-kind contributions being supplemented by financial assistance from the Commonwealth.

Partners in the Centre are from major wheat-based products manufacturers, commercial, agricultural and research bodies:

**Commercial Members**
- Arnott’s Biscuits Ltd
- C-Qentec Diagnostics Ltd
- Goodman Fielder Ltd
- GrainCorp Operations Ltd
- Grains Research & Development Corporation

**Research Members**
- NSW Agriculture
- The Department of Agriculture (WA)
- The University of Sydney

VAWCRC is integrating advanced bioscience, food science, agronomic and genetic investigations, from "research to customer".

- variety improvement;
- wheat production, handling and storage;
- food manufacture and
- nutritional end product and shelf life qualities.

We are using new science in the areas of:
- genomics, proteomics and molecular genetics;
- molecular markers (including microarrays);
- immunology (including engineered antibodies)
  and
- advanced analytical methods.

**Outputs**

- The application of advanced technologies that will permit "on the spot" diagnosis of a range of wheat quality attributes for growers, buyers, handlers and processors of wheat.
- Knowledge, which will provide for enhancement of the processing performance of wheats and for the creation of new, improved and more profitable products.
- Application of plant genetic research to create germplasm for new wheats with specific high added value uses, and improved quality performance when grown in adverse environments.
- Systems to enable growers to achieve more consistent quality of wheat production, and better-trained advisors and agronomists throughout the industry.
- A succession of tertiary and quaternary educated scientists and technicians with practical experience of wheat quality science.
A remarkable feature of Value Added Wheat CRC, as an institution, is that it has already further enhanced the adaptability it inherited from its predecessor, Quality Wheat CRC. It has already responded to changes in its operating environment more quickly and more effectively than many leading corporations and most public sector entities.

A characteristic of the mixed enterprise (public and private sector) Australian wheat and downstream food industry is that while it adapts effectively to embrace new opportunities, and to withstand threats, it does so unevenly and somewhat episodically.

The least institutional rigidity, and arguably the fastest rates of productivity growth, occur in farming. In those parts of the industry characterised by centralised decision making, such as in research or export marketing, change is sometimes effectively resisted for long periods. Amongst the larger corporations involved in storage, handling and food processing, episodic change accompanies mergers, acquisitions and corporate rationalisations.

Given its focus on creating value throughout the industry’s supply chain, the Value Added Wheat CRC must respond very quickly when changes occur anywhere in the industry’s pipeline. Equally importantly, we must adapt to contend with circumstances where needed changes in some parts of the supply chain do not occur – resisting the temptation to blame others for any failure to achieve our own goals.

During the past year, progress with the GRDC’s ambitious plan to commercialise the wheat breeding industry has been mixed, making the consummation of partnership agreements with breeding and seed distribution businesses challenging. Despite this, the CRC has signed some important agreements to commercialise its new biscuit and waxy wheats. It also developed a bold proposal to establish a new enterprise – Commercial Wheat Genes (CWG) – to accelerate the application of molecular methods to wheat breeding.

The remarkable adaptability of VAWCRC is embodied in the CWG proposal. The new service would be made available, on a commercial basis, to all participants in the Australian industry, while at the same time offering a capacity building opportunity to the emerging breeding companies, so that as they develop the know-how to apply the technology themselves, the CWG would move on to applying the next generation of the science.

Another key feature of the CWG proposal is the important role of VAWCRC as a catalyst. The skills developed in managing the CRC itself have been leveraged to bring together an extraordinary array of high-tech partners from across the public and private sectors in Australia and elsewhere, avoiding the cost of replicating facilities and services in bringing leading-edge new technology to the wheat and food industries.

In conducting its own program, good progress has been made in developing a new business model for the CRC, which will see rigorous tests applied, on a rolling basis, to both new and existing projects and programs, to maximise the chances of the commercial success of the business, as Commonwealth funding diminishes. Success with the development and importantly with the application of this initiative will be a key success factor in driving the business of the CRC forward.

Other challenges include adjusting to the planned sale of Goodman Fielder’s milling assets to an entity substantially owned by Graincorp, which is another CRC partner. Similarly, Bayer has acquired a CRC partner, C-Qentec, by virtue of its takeover of Aventis. During its second year, the CRC will meet these challenges, as their implications become clearer, with the same effective adaptability that it has shown in the first year of its life.
A gratifying aspect of serving as Chair of VAWCRC is the quality and cohesiveness of the management team, under the leadership of Bill Rathmell. They do a difficult job exceptionally well. The Board too has been very effective in corporate governance and has persisted in grappling with some of the more intractable challenges until a solution has been forthcoming. Nevertheless, the real achievements of the CRC are, as ever, those of its scientists. They are well documented throughout this Annual Report.

Geoff Miller
In the first year of the Value Added Wheat Cooperative Research Centre, we have kept up the scientific momentum that was built up in the Quality Wheat CRC. We have moved from the old agreements between the Participants and the Commonwealth to the new ones. We have made significant advances in commercialisation of Company outcomes. We have raised the level of collaboration between groups researching in our area around Australia and the world, inside and outside the Centre.

The new high-technology projects have mostly got off to a very fast start, in particular with the Australian Proteome Analysis Facility (APAF) and the Centre for the Application of Molecular Biology to International Agriculture (CAMBIA). The latter collaboration has formed the basis of a successful application for increased industry funds from the Grains Research and Development Corporation (GRDC).

We also made an application for supplementary CRC-scheme funding – "Commercial Wheat Genes". The future use of molecular methods to accelerate wheat breeding, which this is designed to exploit, will be the most significant technology development in an otherwise fairly mature industry. It is a Wheat CRC priority that the new benefits that will flow from the fast uptake of this science be made available to the Australian communities that derive their livelihoods from wheat. We have already advanced our “pipeline” of products coming from this approach. We are continuing our collaborations with leading international groups in this area of technology, both private (Monsanto, Cibus Genetics) and public-sector (John Innes Centre).

The three core research providers in the Centre – the University of Sydney and the NSW and WA State Departments of Agriculture – have been joined by the South Australian Research & Development Institute (SARDI) as significant contributors of "high tech" research resources, in this and in other fields.

To enhance commercialisation, we have created and filled the post of Commercial Director. We have reached agreements with George Weston Foods (a former Participant) and with SunPrime Seeds (an "SME" owned by three Centre Participants, including GrainCorp and GRDC) to fully commercialise our first two speciality wheats, "waxy" and biscuit wheats (sisters of QAL2000(1) ), respectively. Improved or even completely new food products from Participant companies such as Arnott’s and Goodman Fielder, using improved processes and novel recipes devised by themselves or by companies with whom we are also working, like Byron Australia and George Weston Foods, will flow from this work.

In other business areas, our partnership on the WheatRite® & ReadRite® technology with C-Qentec Diagnostics Pty Ltd has flourished. They have moved to a novel product form and are aggressively tackling world-wide markets. Significant sales are expected in the next twelve months.

Our other new high technology science group, the immunologists of NSW Agriculture at the Elizabeth MacArthur Agricultural Institute (EMAI) are vigorously pursuing other possible diagnostic products with C-Qentec Pty Ltd. Meanwhile we continue to provide diagnostic and other research services to Australian wheat breeders on a cost recovery basis. The plan to do this on a large scale for profit is the basis of the Commercial Wheat Genes application referred to earlier.

The projects aimed at improving wheat processing have also continued apace. We have received further industry (GRDC) funds to continue two of them. We have started to focus on the creation of value for the Participants and for the industry at large in the baking process control project. The microbiology work, which also received separate industry funding (MasterFoods), has also delivered the required outcomes. In the Education and Technology Transfer Program, we have recruited new PhD students for a range of projects and have focussed particularly on the technology transfer aspect with the recruitment of a part-time assistant to the Program Manager, whose brief it is to create the necessary materials to facilitate this.

Throughout the year the management team comprising the Board, HQ Staff and the Senior Management Group (SMG) have monitored the work in progress, and adjusted resources and budgets as appropriate. There has been increased attention paid to project outcomes and routes to commercialisation. This was the main theme of the first Value Added Wheat CRC conference held at Avoca Beach in February 2002, a theme reinforced by a workshop with our Chairman and commercial Board members, and an address from the President of the Grains Council of Australia, Keith Perrett.
The Annual Operating Plan for 2002-3 contained for the first time a quantitative analysis of the returns to be expected from particular projects, and a portfolio analysis of the risk/reward matrix. Over the next year we shall be building on this start to create a new business "model" for the company, to assure its revenues in the later years of the Commonwealth contract, and its survival thereafter.

It would be false to say that there have not been some frustrations. It has not proved possible to engage the whole of the research industry in putting in place a fully integrated, commercial infrastructure to assure the most effective implementation of biotechnology in wheat breeding.

Our attempts to launch a fully-certified quality assurance system in the wheat industry likewise appear to have been ahead of their time. Nevertheless, we are continuing to make these activities as all-inclusive as possible, consistently with them retaining their commercial potential, in order to generate the maximum benefit to the industry.

Many people have contributed to the ongoing success of the Wheat CRC. The new Senior Management Group is a very effective team. Although Professor Don Marshall resigned as Program 4 Manager when he left the University of Sydney, he rejoined the SMG as the GRDC representative, replacing Mike Perry. Don was replaced by John Oliver who has stepped back into Program Management for the CRC despite a heavy workload for NSW Agriculture.

Peter Sharp has also contributed greatly to the CRC from the University, despite being Acting Director of the Plant Breeding Institute (following Don’s departure) and Di Miskelly has also given much despite the changes in Goodman Fielder.

Neil Howes has made an extraordinary contribution as Program Manager and in getting together our bid for industry and Commonwealth funds. Andrew Kennett and Felice Driver have brought valuable and energetic guidance from industry. My thanks go to the whole of the SMG team.

I want to thank the HQ team too. Peter Vaughan, who started mid-year as Commercial Director and Deva Jayaretnam who is now our Finance Manager have already added their considerable contributions to those of Clare Johnson (Education and Technology Transfer Manager), Helen Warwick (now Company Secretary as well as Communications and Office Manager) and Mary Foster. Alan Ellis, who made an important contribution as Business Manager over the formative years, left the Company in January.

Next year will see an increasing focus on the commercialisation of outcomes. Our portfolio of products and services is growing and will increase faster from our Commercial Wheat Genes proposal. The momentum of the Centre and of the Company will continue to increase.

W G Rathmell

Rapid breeding technologies are speeding the delivery of germplasm with valuable new characteristics to Australian breeding programs.
VAWCRC links a powerful grouping of commercial and research organisations, with complementary and comprehensive corporate capabilities along the wheat value-added chain.

Established initially in 1995 as Quality Wheat CRC, the new Centre, Value Added Wheat CRC, received a further 7 years funding on July 1st 2001. It is an incorporated company limited by guarantee and a registered not-for-profit organisation.

The Centre operates within the framework of the Commonwealth Cooperative Research Centre program with Participants cash and in-kind contributions being supplemented by financial assistance from the Commonwealth.

The partners in VAWCRC bring an unequalled range of competencies to focus on the Centre’s work including:

- Wheat genetics, breeding, agronomy;
- Wheat chemistry, biochemistry, physiology;
- Wheat quality, processing into bread, noodles, pasta, biscuits and novel products and
- Marketing and trading of wheat, including seed wheat and products from wheat.

These competencies provide an excellent basis for the Centre to address the challenges associated with achieving the integration of the scientific and technical areas with each other and with commercialisation, as described in the next section.

The Participants

Core Participants comprise a strong grouping of companies representing the complete “farm to consumer” supply chain as well as the largest research providers.

The Grains Research and Development Corporation (GRDC) represents growers’ businesses and use the Centre’s research to enhance value at the farm level. Goodman Fielder Milling and Baking (GF) and Arnott’s Biscuits Ltd are using the Centre’s science to enhance the added value in milling (GF only) and in the domestic manufacture (both companies) of wheat based consumer products. C-Qentec Pty Ltd represents a supplier of high technology diagnostics to the wheat industry.

Each commercial Core Participant is positioned in a different part of the value added chain. Each one is able to take up enhanced benefits in that part of the chain, but also integrate vertically with other commercial Participants.

Overall, the commercial Participants bring expertise in the introduction and marketing of novel wheats to growers, millers and consumers. They provide channels of trade for marketing of the harvested product at home and abroad, expertise in the profitable and efficient processing of wheat into flour and processing into conventional and novel food products. The three largest research providers are also Core Participants. Each Core Participant is represented on the Board of the Centre.

Supporting Participants comprise research providers and commercial companies with interests in a subset of the scientific programs of the CRC. The Centre has the support of a balanced group of supporting participants.

These participants bring a wide range of capabilities to the Centre enabling a complete range of projects in each program to be delivered at the highest professional standards.

Supporting Participants include:

- Australian Proteome Analysis Facility (APAF)
- BRI Australia Ltd
- Centre for Application of Molecular Biology to International Agriculture, Canberra (CAMBIA)
- Cibus Genetics
- Department of Primary Industries, Qld (DPIQ)
- Food Science Australia (CSIRO)
- Primary Industry and Resources South Australia (PIRSA)
- South Australian Research & Development Institute (SARDI)
- United States Department of Agriculture (USDA) Manhattan, Kansas Lab
- University of Adelaide
VAWCRC Governing Board

The Board of the Company has a commercial orientation and has a majority of Core research users representatives. This is to ensure that the CRC’s research is driven commercially, by the requirements of the users of that research. The three largest (Core) research providers hold seats on the Board. The Board has a broad balance of skills including people from business and science backgrounds. It establishes the strategic direction of the Centre, sets performance benchmarks for scientific, commercial and operational activities and monitors performance against these benchmarks. Board membership, headed by an independent Chairman is as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr G Miller</td>
<td>Independent Chairman</td>
</tr>
<tr>
<td>Prof W Rathmell</td>
<td>Managing Director</td>
</tr>
<tr>
<td>Mr P Bennett</td>
<td>Arnott’s Biscuits Ltd</td>
</tr>
<tr>
<td>Mr B Howie</td>
<td>C-Qentec Diagnostics Pty Ltd</td>
</tr>
<tr>
<td>Mr N Stenvert</td>
<td>Goodman Fielder Milling &amp; Baking</td>
</tr>
<tr>
<td>Mr A Single</td>
<td>GrainCorp Operations</td>
</tr>
<tr>
<td>Dr R Gilmour</td>
<td>Grains Research &amp; Development Corporation</td>
</tr>
<tr>
<td>Dr L Cook</td>
<td>NSW Agriculture</td>
</tr>
<tr>
<td>Dr G Robertson</td>
<td>The Department of Agriculture (WA)</td>
</tr>
<tr>
<td>Prof L Copeland</td>
<td>The University of Sydney</td>
</tr>
</tbody>
</table>

The Managing Director:
- Provides leadership to the Centre;
- Ensures that Centre funds are used in accordance with the budget in the Annual Operating Plan;
- Monitors and keeps the Board informed of the Centre’s performance;
- Supervises the program managers and
- Identifies new research opportunities

Commercial Director

The Commercial Director is responsible for commercialisation of all outcomes from VAWCRC Projects. In addition, he is charged with the task of developing a new business model for the company to enable it to become self sustaining at the end of the Commonwealth Support.

Senior Management Group

The Senior Management Group (SMG) consisting of five Program Managers, other representatives of Core Participants and the Commercial Director assists the Managing Director.

The Program Managers, who have appropriate technical/commercial qualifications, manage the research and education programs. The group routinely meets monthly and are responsible for the timely and effective management of all projects allocated to their Program and report to the Managing Director.

Audit Committee

The Audit Committee reviews the quarterly and annual financial reports of the company and the results of the annual audit. It reports its findings to the Board.
Dr Geoff Miller AO, Chairman, Value Added Wheat CRC Ltd

Dr Geoff Miller is a company director and corporate adviser, specialising in agribusiness. He is Chairman of Farmshed Ventures Pty Ltd; Beeline Technologies Inc (USA); Value Added Wheat CRC Ltd; and the International Food Policy Research Institute (Washington DC) and Deputy Chairman of Gresham Rabo Management Ltd (Manager of the Food & Agribusiness Investment Fund). He is a Director of Agsystems Pty Ltd; Agrilink Pty Ltd; and GCM Strategic Services Pty Ltd.

In the past, Dr Miller has served on the boards of major Australian agribusiness organisations marketing and processing wheat, wool, cotton and sugar. He also spent almost two decades as chief executive of national agencies in Canberra. He was, inter alia, Secretary of the Department of Primary Industries & Energy; Associate Secretary of the Department of Foreign Affairs & Trade; Director of the Economic Planning Advisory Council; and Director of the Bureau of Agricultural Economics.

Dr Miller graduated with first class honours in Agricultural economics from the University of New England, Australia, and holds Masters and PhD degrees in Applied Economics from Stanford University, USA. He is a Fellow of the Australian Institute of Company Directors.

Professor Bill Rathmell, Managing Director, Value Added Wheat CRC Ltd

Between 1991 and 1995 Bill was Research & Development Director of SES Europe, a supplier and breeder of agricultural seeds based in Belgium. Prior to that, he was Exploratory Plant Science Manager at ICI’s Agricultural Research Station in the UK. In this post, he managed research programs in fields as diverse as entomology and plant molecular genetics. He has also held a number of academic posts in the USA and Europe. Professor Rathmell was appointed Managing Director of Quality Wheat CRC Ltd in 1995 and when the Centre was re-funded and became Value Added Wheat CRC in July 2001 he became Managing Director of the new Centre. He is also adjunct Professor in the Faculty of Agriculture in the University of Sydney.

Professor Rathmell holds a degree and doctorate in Natural Sciences from Cambridge University (UK) and also studied at the University of Wisconsin (USA).

Dr Lindsay Cook, Chief, Division of Plant Industry, NSW Agriculture

Lindsay Cook obtained a B.Ag Science from Melbourne and a PhD from New England. He spent a post doctoral year at Oregan State University (USA). He researched pasture seed production problems in the Victorian Department of Agriculture before moving to New South Wales to lead the seeds section for NSW Agriculture. In this position he was responsible for seed certification and registration schemes and the seeds laboratory. Subsequently, he was appointed Principal Agronomist (Cereals) and Director of Plant Production Research. He currently holds the position of Chief, Division of Plant Industries. This division undertakes NSW Agriculture’s research and extension programs for all field crops, pastures and rangelands, annual and perennial horticulture, and in soil management, irrigation water management and land use planning.

Mr Nick Stenvert, Research Director, Goodman Fielder, Milling and Baking

Nick Stenvert has worked with Goodman Fielder Milling and Baking for 13 years in various capacities. He was appointed Research Director in 1999 following the merger with Bunge Defiance. Prior to this he had extensive experience in the cereal industry both in Australia and overseas.

He worked with BRI Australia for a period of 15 years and has been involved in all aspects of cereals ranging from research, wheat breeding, testing, processing, product development and end product application, including working in Asia and the Middle East.

Dr Graeme Robertson, Chief Executive Officer, Agriculture Western Australia (WA)

Graeme Robertson, CEO The Dept. of Agriculture (WA) since August 1995. His career has involved a wide range of research, development and management activities in agriculture, including a period as officer in charge of the Kimberley region, Director of Resource Management and Commissioner of Soil Conservation, before being appointed Deputy Director General of the Department in 1990. He has been involved in a number of national and state activities involving agriculture and resource management, including 6 years as the inaugural chair of Land and Water Resources Research and Development Corporation. He is currently on a number of boards and advisory committees. Dr Robertson followed his honours degree in agricultural science at the University of Western Australia with a PhD in plant physiology at Oxford. He was elected as a Fellow of the Australian Institute of Agriculture, Science and Technology in 1996.
Professor Les Copeland, Dean, Faculty of Agriculture, University of Sydney

Les Copeland took up an academic appointment in the University of Sydney in 1974, after postdoctoral research at Yale University, New Haven and the State University of New York, Buffalo in the USA. He was Head of the Department of Agricultural Chemistry and Soil Science from 1993 to 2000 and is currently Dean of the Faculty of Agriculture, Food and Natural Resources. His research and teaching are in the areas of agricultural, food and environmental chemistry and biochemistry, and he has published extensively on chemistry and biochemistry of starch and proteins in foods, biological nitrogen fixation, and soil microbial diversity. Les was a Fulbright Fellow in the University of California in Davis, USA in 1979-80, and a Visiting Fellow in the Australian National University in 1986 and 1992. He is a Fellow of the Royal Australian Chemical Institute, and a member of the Editorial Board of Plant Science.

Dr Ross Gilmour, Program Manager, Grains Research and Development Corporation

Ross Gilmour worked first as a wheat breeder, and later as a barley breeder, for the Western Australian Department of Agriculture from 1985 to 1995. He then spent five years in South East Asia developing genetic improvement programs for plantation crops such as oil palm and tropical Acacias. Ross is Program Manager (Winter Cereals Improvement) for the GRDC. That program manages the GRDC investment in breeding, quality, agronomy and breeding technologies for the winter cereals, where the annual investment is approximately $34 million.

Mr Andy Single, Merchandise Manager, GrainCorp Operations Ltd.

Andy has worked for GrainCorp Operations for the past 8 years, becoming a member of the Executive in 1998 with the formation of the Merchandise Division. He has worked in the marketing of farm inputs for the past 12 years. During that time he was seconded from GrainCorp to manage SunPrime Seeds. Andy has been awarded a Bachelor of Business.

Mr Bruce Howie, General Manager, C-Qentec Diagnostics Pty Ltd

Bruce Howie joined the crop protection industry in 1981 with responsibilities for new product development, ultimately moving to the role of Technical Director within Rhone-Poulenc (now Bayer CropScience). In this role he established strong links with Australian research groups leading to direct collaborations between the company and organisations such as CRCs and CSIRO. In 2000 Bruce initiated the formation of C-Qentec Diagnostics Pty Ltd, a subsidiary of Bayer CropScience, with the purpose of commercialising advanced DNA and protein based diagnostic tools for agriculture. The company has successfully launched two products, one of which (WheatRite®) was derived from the program at the VAWCRC.

Mr Paul Bennett, Director, Regional Quality and Supply Chain Development, Arnott’s Biscuits Ltd

During the course of the past 32 years, Paul has held various positions in the manufacturing and production chain of the Arnott’s business, initially joining Arnotts as a Production Trainee in 1970. Following his graduation from the University of NSW Sydney (with Honours) in 1974 he was appointed Production Foreman, at Arnotts, Ashfield following the takeover of Peek Freans in June 1975. In 1976 he was promoted to Production Superintendent responsible for all mixing baking & machining and in 1978 moved to Homebush taking up the position of Mixing Room Superintendent with responsibility for ingredients storage and preparation and dough mixing for 12 high speed ovens. In 1980 he was promoted to Bakehouse Superintendent (Homebush) in charge of 12 high speed ovens. Subsequent promotions followed in 1983 to Packaging Manager (Homebush) responsible for 1300 staff over three shifts, 1991 NSW Supply Manager , 1992 National Procurement Manager, 1994 Production Manager Special Assignment Arnotts, Virginia and 1998 Regional Supply Chain Manager Arnotts NSW. He was appointed Director of Regional Quality and Supply Chain Development in 2001 and currently holds this position.

Mr Paul Bennett

During the course of the past 32 years, Paul has held various positions in the manufacturing and production chain of the Arnott’s business, initially joining Arnotts as a Production Trainee in 1970. Following his graduation from the University of NSW Sydney (with Honours) in 1974 he was appointed Production Foreman, at Arnotts, Ashfield following the takeover of Peek Freans in June 1975. In 1976 he was promoted to Production Superintendent responsible for all mixing baking & machining and in 1978 moved to Homebush taking up the position of Mixing Room Superintendent with responsibility for ingredients storage and preparation and dough mixing for 12 high speed ovens. In 1980 he was promoted to Bakehouse Superintendent (Homebush) in charge of 12 high speed ovens. Subsequent promotions followed in 1983 to Packaging Manager (Homebush) responsible for 1300 staff over three shifts, 1991 NSW Supply Manager , 1992 National Procurement Manager, 1994 Production Manager Special Assignment Arnotts, Virginia and 1998 Regional Supply Chain Manager Arnotts NSW. He was appointed Director of Regional Quality and Supply Chain Development in 2001 and currently holds this position.

Mr Paul Bennett

During the course of the past 32 years, Paul has held various positions in the manufacturing and production chain of the Arnott’s business, initially joining Arnotts as a Production Trainee in 1970. Following his graduation from the University of NSW Sydney (with Honours) in 1974 he was appointed Production Foreman, at Arnotts, Ashfield following the takeover of Peek Freans in June 1975. In 1976 he was promoted to Production Superintendent responsible for all mixing baking & machining and in 1978 moved to Homebush taking up the position of Mixing Room Superintendent with responsibility for ingredients storage and preparation and dough mixing for 12 high speed ovens. In 1980 he was promoted to Bakehouse Superintendent (Homebush) in charge of 12 high speed ovens. Subsequent promotions followed in 1983 to Packaging Manager (Homebush) responsible for 1300 staff over three shifts, 1991 NSW Supply Manager , 1992 National Procurement Manager, 1994 Production Manager Special Assignment Arnotts, Virginia and 1998 Regional Supply Chain Manager Arnotts NSW. He was appointed Director of Regional Quality and Supply Chain Development in 2001 and currently holds this position.

Mr Paul Bennett

During the course of the past 32 years, Paul has held various positions in the manufacturing and production chain of the Arnott’s business, initially joining Arnotts as a Production Trainee in 1970. Following his graduation from the University of NSW Sydney (with Honours) in 1974 he was appointed Production Foreman, at Arnotts, Ashfield following the takeover of Peek Freans in June 1975. In 1976 he was promoted to Production Superintendent responsible for all mixing baking & machining and in 1978 moved to Homebush taking up the position of Mixing Room Superintendent with responsibility for ingredients storage and preparation and dough mixing for 12 high speed ovens. In 1980 he was promoted to Bakehouse Superintendent (Homebush) in charge of 12 high speed ovens. Subsequent promotions followed in 1983 to Packaging Manager (Homebush) responsible for 1300 staff over three shifts, 1991 NSW Supply Manager , 1992 National Procurement Manager, 1994 Production Manager Special Assignment Arnotts, Virginia and 1998 Regional Supply Chain Manager Arnotts NSW. He was appointed Director of Regional Quality and Supply Chain Development in 2001 and currently holds this position.

Mr Paul Bennett

During the course of the past 32 years, Paul has held various positions in the manufacturing and production chain of the Arnott’s business, initially joining Arnotts as a Production Trainee in 1970. Following his graduation from the University of NSW Sydney (with Honours) in 1974 he was appointed Production Foreman, at Arnotts, Ashfield following the takeover of Peek Freans in June 1975. In 1976 he was promoted to Production Superintendent responsible for all mixing baking & machining and in 1978 moved to Homebush taking up the position of Mixing Room Superintendent with responsibility for ingredients storage and preparation and dough mixing for 12 high speed ovens. In 1980 he was promoted to Bakehouse Superintendent (Homebush) in charge of 12 high speed ovens. Subsequent promotions followed in 1983 to Packaging Manager (Homebush) responsible for 1300 staff over three shifts, 1991 NSW Supply Manager , 1992 National Procurement Manager, 1994 Production Manager Special Assignment Arnotts, Virginia and 1998 Regional Supply Chain Manager Arnotts NSW. He was appointed Director of Regional Quality and Supply Chain Development in 2001 and currently holds this position.
A n important success criterion for the Centre is that it promotes research linkages and co-operation amongst its own Participants as well as with outsiders (commercial and researchers). The Performance Indicators section later in this Annual Report contains a description in some detail of the progress we have made in developing cooperative linkages.

Most of the projects with cross-site interaction initiated in the earlier years of the CRC have continued through its life. We have added to the earlier years’ momentum by starting and running new projects, some of which will continue into VAWCRC:

- Collaboration with The Department of Agriculture (WA), also involving fertiliser suppliers, designed to determine environmental effects, especially micronutrient deficiency, on quality and permit management and extension strategies to be further improved in that state.
- A project, which has industry involvement, to study novel approaches to increasing conditioning efficiency and thereby mill performance.
- The CRC/GRDC project on strategies to replace cake flour chlorination also has commercial commitment.
- Building on the success of, and strong industry support for, the flour mill microbiology project, the new project to assess the microbiological safety of end products from Australian wheat and flour also involves Commercial Participants, and has attracted investment from a non-participating commercial organisation.

Other projects within the Centre that involve people from non-participant organisations have continued this year. The list now includes:

- Another CRC/GRDC project to identify key quality characteristics required by bread manufacturers using the sponge and dough process involves extensive collaboration with the Leslie Research Institute, Queensland DPI.
- The provision of diagnostic kits to wheat breeders around Australia and in Mexico.
- We have signed a contract for the world-wide commercial development of the WheatRite® kit with C-Qentec Diagnostics Pty Ltd, and we have continued to work with Real Time Engineering on the design of a prototype ReadRite® reader for the kit.
- We have also signed contracts with Byron Australia, for the commercial development of novel foods from Centre germplasm, and with Austgrains International, to produce commercial quantities of our specialist biscuit wheat variety QAL2000®.

In addition, our links with the CRC for Molecular Plant breeding have developed, with new research collaborations under discussion, and the Managing Director serving on the Industry Advisory Committee of the Adelaide-based Centre.

There has been a continued high level of effort this year put into workshops, seminars and publications specifically designed to enhance technology transfer between Participants and to outside commercial and research entities. For example our Wheat Supply Chain Symposium attracted high-level industry staff and postgraduate students, and we also organised eight Wheat Market Quality courses around the country.

A workshop on the use of test kits to detect the late maturity alpha amylase defect in breeders’ wheat lines was conducted in August with participants from wheat breeding programs all over Australia.

We continued our active program of technology transfer to farmers, notably with a grain storage training module made available nationally.

Over the year substantial numbers of growers have signed on to the Great Grain program, in some cases encouraged by non-participant companies such as The Grain Pool of WA, Pivot and Cargill. Further details of all these linkages are to be found in other sections of the Annual Report.
Analysis of grain quality using high performance liquid chromatography (HPLC) equipment. In the size exclusion mode, this form of analysis indicates the size distribution of the gluten proteins.
The focus of Program 1 is on development of diagnostic tools and methods for wheat and wheat products, at all stages of the supply chain. These tests will measure valuable quality traits such as starch properties, flour proteins that influence dough properties during processing, or end product quality, as well as providing a tool for varietal identification.

This program will continue the leadership of the Wheat CRC in developing antibody-based diagnostic tests that offer great advantages, either through lower costs, or via very rapid test results. We will explore the potential of capillary electrophoresis to quantify specific quality attributes such as dough strength and extensibility, grain hardness, starch characteristics, water absorption and milling yield, in addition to its potential as a complementary technology to antibody-based diagnostics.

This program has a strong emphasis on development of on-the-spot tests, similar to the WheatRite® test for rain-damaged grain developed in the Quality Wheat CRC. This emphasis will satisfy industry’s demands for robust, rapid testing and immediate decision making, whether by operators on farm, at receival, or during processing.

Program Aims
The aims of the program are to identify specific industry needs for diagnostic tests, to invent new tests, to evaluate these tests against industry needs, and if appropriate, to commercialise these tests and ensure their uptake by the industry. A key feature of the program is consultation with relevant industry bodies at each of these steps in the process of innovation. We will also be interacting strongly with researchers in Program 3, whose pure research will generate some of the target proteins and markers for application through the Diagnostics Program.

Research Scientist Jan Gooden confirms reliability of the GBSS null 4A test.
Project No: 1.1.2

Project Title: Antibody-based diagnostics
Project Leader: Dr James Chin

Background and Objectives
The aim of this project is to develop new antibodies with the potential to define one or more grain quality attributes. Previous research in the Quality Wheat CRC has demonstrated the potential of this approach, but also the limitations of existing methods. Advances in antibody technologies provide the opportunity to produce new antibodies with improved specificity and utility as diagnostic tools. Technologies now available include the production of monoclonal antibodies, alternative detection systems, such as phage peptide display, and the development of novel peptide immunization techniques such as multi-antigenic peptides and lipid core peptides.

Progress
Following recruitment of key research staff, including the first two postgraduate students for this project, we have established effective collaborative links, and a functioning monoclonal laboratory has been set up. Variety-specific candidate synthetic peptides have now been identified and synthesised, immunization protocols for the production of monoclonal antibodies have been initiated, and purification of starch granules and characterisation of variety-specific starch-related proteins completed. We have placed a greater emphasis on minor water- and urea-soluble proteins as targets, and in particular, enzymes that influence quality or are suitable candidates for variety identification.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and synthesise peptide sequences polymorphic to wheat varieties</td>
<td>07/02</td>
</tr>
<tr>
<td>Test various peptide constructs for immuno-genicity</td>
<td>07/02</td>
</tr>
<tr>
<td>Purify and analyse starch granules from different wheat varieties</td>
<td>07/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 Months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuse spleen cells from most promising synthetic peptides</td>
<td>01/03</td>
</tr>
<tr>
<td>Assess immunogenicity and specificity of antigens prepared from starch granules</td>
<td>07/03</td>
</tr>
<tr>
<td>Fuse spleen cells from lipid core protein constructs</td>
<td>01/04</td>
</tr>
<tr>
<td>Evaluate phage peptide display technology</td>
<td>07/04</td>
</tr>
</tbody>
</table>

Project No: 1.2.3

Project Title: Diagnostics delivery
Project Leader: Mrs Felice Driver

Background and Objectives
The aim of this project is to develop antibody-based commercial diagnostic test kits, for breeders and for the grain delivery, processing and export industries. Antibodies with the potential to define one or more grain quality attributes have been developed in the Quality Wheat CRC. We have prioritised these diagnostic tests in the following groups:

1. alpha amylase, for late maturing amylase and sprout damage,
2. starch and hardness characteristics,
3. varietal identification, and
4. dough properties during processing.

We will proceed with development of commercial diagnostic test kits under these categories, in regular consultation with industry for their requirements.

Progress
For breeders, two new test kits have been provided, in addition to the existing wheat-rye translocation test. The new tests are for the detection of late maturing alpha amylase, and for the lower amylose starch type associated with granule-bound starch synthetase (GBSS)-null 4A wheats. The alpha amylase test (Wheat-Rite®) for sprouted grain has been commercialised by C-Qentec Pty Ltd as a rapid (5 minute) test using Proteome Systems flow-through technology. This rapid, on-the-spot test is suitable for monitoring grain and flour alpha amylase levels in samples direct from the producer's paddock, or at any stage through grain handling, milling and the final point of processing.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assemble &amp; distribute 1B/1R kits to breeders</td>
<td>05/02</td>
</tr>
<tr>
<td>Demonstrate simplified GBSS breeder kit using new Mab 14C6</td>
<td>07/02</td>
</tr>
<tr>
<td>Identify and confirm useful antibodies for prototype varietal identification</td>
<td>07/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial GBSS test kit with breeders</td>
<td>03/03</td>
</tr>
<tr>
<td>Demonstrate GBSS (null 4A) test in Wheat-Rite® cassette format</td>
<td>07/03</td>
</tr>
<tr>
<td>Evaluate new antibodies for GBSS (null 7A and null 7D) as a breeders’ test</td>
<td>12/03</td>
</tr>
<tr>
<td>Test-run varietal identification prototype, using receival samples from grain handlers</td>
<td>07/04</td>
</tr>
</tbody>
</table>

Program 1: Major Achievements/Outcomes

- A new test kit for breeders to screen wheat lines for the presence of the GBSS null 4A phenotype, resulting in lower amylose starch
- Capillary electrophoretic methods for varietal identity of Australian soft wheats developed
The end uses of wheat are diverse, and Australian wheats are used for a wide variety of end products on the domestic and export markets. As such, wheat specifications for end products have become increasingly important in breeding programs.

Every wheat-based end product must undergo several processing stages before reaching the final consumer. Each processor in the value added chain requires raw materials of specific quality to achieve the desired outcome, i.e. quality processed or partially processed product. Formulations to achieve many end products can be quite complex, incorporating a variety of ingredients. Ingredients such as gluten can improve the functionality of product formulations, in this instance, by improving dough strength.

Correct processing is also of critical importance to deliver product quality, and there are opportunities for processors to optimise processes to minimise waste and deliver consistent, high quality products. Such process optimisation can offer considerable savings to manufacturers.

The outcomes from this program will be directly applicable to industry and the program has a high level of industry involvement.

Program Aims

The aims of this program are to generate knowledge for the enhancement of the processing performance of wheat and flour and for the creation of new and improved products.

Wheat processing performance will be targeted from the initial breeding stages, through wheat selection - particularly for specialist products, milling and secondary processing, to end product manufacture and the final consumer. The emphasis is on cost-effective ingredient formulations and optimum processing conditions for all wheat based products, from bread to noodles.

Project No: 2.1.1

Project Title: Blending – consequences for wheat breeding

Project Leader: Mr Geoffrey Cornish

Background and Objectives

QWRC scientists developed prediction models for blending wheat and flour. Varieties with dissimilar high molecular weight (HMW) glutenin alleles at the Glu-D1 loci (2+12 and 5+10) show non-linear blending characteristics for dough peak resistance and mixing time to peak. Adding to the complexity, there are interactions between the HMW glutenin alleles at the Glu-D1 locus and LMW glutenin alleles such as the Glu-A3d allele of Kukri.

We aim to extend the blending models, to explain why blends have better or poorer qualities than predicted from parent varieties, and to apply these models in wheat breeding programs. The potential commercial applications include production of varieties that are blends of two biotypes, and prediction of dough properties of hard and soft wheat blends.

Progress

Bulked samples of Kukri and Janz were commercially milled, and flours blended 1:3, 1:1 and 3:1 revealed non-linear interactions for extensibility, mixing time and Farinograph stability and breakdown. Fifty-two samples, selected from a Kukri/Janz doubled haploid population from the National Wheat Molecular Marker Program, have been test milled and will undergo rheological testing.

A replicated field trial of the chosen lines plus parents of the Kukri/Janz population was sown at Roseworthy. Selected lines of an Egret/Sunstar population, covering a range of glutenin alleles, hardness and GBSS types were also sown, to provide material to study the effect of hard/soft blends used for cake, donuts and cracker biscuits. Field trials of Chara, Mitre, and Silverstar isolines have been sown at Horsham.
Project No: 2.1.1 continued

Fig 2.1 - Electrophoresis gel of high (HMW) and low (LMW) molecular weight glutenins of Kukri/Janz doubled haploid wheat lines used to study interactions between flour blends.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection of lines for quality testing from Kukri/Janz DH population</td>
<td>05/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality test blends of selected lines from field trials of Kukri/Janz DH population</td>
<td>12/02</td>
</tr>
<tr>
<td>Quality test blends of selected lines from field trials of Chara and Mitre</td>
<td>12/03</td>
</tr>
<tr>
<td>Blending studies on Egret/Sunstar DH lines completed</td>
<td>12/03</td>
</tr>
</tbody>
</table>

Project No: 2.1.2

Project Title: Quality assessment and applications for new and novel germplasm

Project Leader: Ms Helen Allen

Background and Objectives

A number of novel wheat lines, including wheat with varying A and B starch granule contents, waxy wheat, and soft wheat genetic variants, are under development. These studies will provide an understanding of the different starch properties of single, double and triple null waxy wheats, as well as determining the optimum A and B starch granule ratios for major food products. Small-scale assessment techniques will be developed to evaluate quality, and potential commercial applications, including new and novel end products, will be investigated.

Progress

Waxy Janz lines from the 2001 preliminary yield trials were milled and starch quality tests conducted. Waxy lines from Wagga were analysed for null alleles. Advanced yield trials were sown in 7 sites, along with large plots of waxy Janz for laboratory scale tests.

During the course of the year, this work became part of a confidential commercialisation project with George Weston Foods. When soft wheat, Thornbill, was fractionated, then reconstituted (100% A, 100% B and a 50/50 blend), doughs with more B granules showed higher mixing resistance and lower RVA peak and final viscosity.

A cookie making procedure has been scaled down for small-scale product evaluation. Large plots of a Kewell/Vulcan cross have been sown at Wagga for subsequent quality assessment.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting with collaborators to discuss partial waxy wheat and internal confidential report published</td>
<td>08/01</td>
</tr>
</tbody>
</table>

Closing Summary

This project will be incorporated into project 4.1.3 from July 1, 2002.
Project No: 2.1.4
Project Title: Optimisation of key stages of the baking process
Project Leader: Mr Thomas Adamczak

Background and Objectives
Through this project, we seek to establish greater control and efficiency in plant bakeries, by development of process control modules to increase plant efficiency, and systems and strategies that direct process improvement. To achieve these goals, we will further develop the work initiated in QWCR, and implement computer modelling, visual analysis and simulation for the baking process. Following implementation of the systems, a cost/benefit analysis can be conducted, as well as a technical feasibility study.

Progress
We are currently investigating ways to optimise bread yield by reducing moisture loss, with improvements in consistency and product quality. Early results indicate that there are a number of points in the process which provide options to achieve these goals. The Bakery Advisory System (BAS) has been set up at a demonstration site in a commercial bakery, where it is operating during commercial bread production. Several new BAS elements have been developed, including a dough stickiness meter to optimise water addition during mixing. This has been coupled with an improved strategy for water cooling during mixing, and should be applicable with changing seasonal conditions. Since the introduction of the bread stickiness meter, we have confirmed, by textural analysis of bread crumb softness, that both softness and quality have improved.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity probe applied in commercial bakery</td>
<td>09/01</td>
</tr>
<tr>
<td>Design of stickiness meter completed</td>
<td>02/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercialise individual bakery advisory system modules</td>
<td>04/03</td>
</tr>
<tr>
<td>Implement computational fluid dynamics model in bakery</td>
<td>04/03</td>
</tr>
<tr>
<td>Complete studies to identify and achieve bread optimum moisture content</td>
<td>07/03</td>
</tr>
</tbody>
</table>

Project No: 2.1.5
Project Title: Australian wheat for the sponge and dough bread making process
Project Leader: Dr Ken Quail

Background and Objectives
Wheat is a major rural industry in Australia and more than 80% is exported to Asia and the Middle East, where it is used for a variety of end products, including flat breads and noodles. To date, most Asian bread markets consider Australian Prime Hard wheat does not have adequate quality for their sponge and dough breadmaking process. US and Canadian wheats are preferred. Through this project, we will identify the key quality parameters for sponge and dough bread manufacture, and Australian wheat cultivars that have these characteristics. It is critical to implement an appropriate test baking procedure for sponge and dough bread into the wheat breeding program.

Progress
The sponge and dough test baking method developed at BRI has now been implemented at QDPI Toowoomba and the method has undergone a number of refinements. Baking results between the two organisations show a good correlation. Chemical and physical analysis, and test baking of flour samples from the 2000 harvest at Roma and Billa Billa have been completed. The 200g test baking procedure was found to discriminate effectively between wheat lines in the trials. Best performers overall were Kennedy, Hartog, QT01778, Banks and QT10757, followed by Chara, QT9174 and QT9933. The project has received a two year funding extension from GRDC.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baking and chemical analysis of flour samples from 2000 harvest, selected for sponge and dough performance</td>
<td>03/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete assessment of 2002/03 harvest</td>
<td>09/03</td>
</tr>
<tr>
<td>Provide guidelines to develop wheats for sponge &amp; dough breads</td>
<td>10/03</td>
</tr>
<tr>
<td>Select most effective tests for sponge and dough prediction</td>
<td>05/04</td>
</tr>
</tbody>
</table>
Project No: 2.1.6
Project Title: Strategies to replace flour chlorination as a treatment for cake flours
Project Leader: Dr Ken Quail

Background and Objectives
Cake flours in Australia and NZ are typically chlorinated. The chlorination treatment modifies the starch, protein and lipids and enables the production of high ratio cakes, with sugar levels up to 140%. Cakes made from chlorinated flour have improved volume, crumb strength and resilience.

As chlorine gas is a dangerous chemical, prompting environmental concerns, its use is not permitted in most European countries or the UK. Australian flour millers need cost-effective, "clean" alternatives to flour chlorination that will produce sponge cakes of comparable quality. Overseas solutions on chlorine replacement are not effective here because of differences in Australian wheat, flour and cake products.

Progress
Further flour treatment options, including ozone, heat treatment, commercial fine grinding and ingredient modifications, have been evaluated. Significant improvements in cake baking were obtained with heat treated fine particle-size flours. Treatments have been monitored using the Rapid Visco Analyser (RVA). A number of novel wheat types from a Gabo x Tincurrin cross have been selected on the basis of their starch characteristics and have been evaluated on the basis of their sponge cake performance. While still inferior to the chlorinated flour control, these cake scores were above average for non-chlorinated flours.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select 10 most promising options based on literature and preliminary experiments</td>
<td>08/01</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete trials to assess 3 milling variables &amp; 2 flour treatments</td>
<td>09/03</td>
</tr>
<tr>
<td>Select systems for commercial evaluation</td>
<td>05/04</td>
</tr>
<tr>
<td>Complete commercial trials</td>
<td>06/04</td>
</tr>
</tbody>
</table>

---

Project No: 2.1.7
Project Title: Microbiological safety and stability of noodles, breadcrumbs and steamed breads made from Australian flour
Project Leaders: Dr Ailsa Hocking and Ms Nancy Jensen

Background and Objectives
There is no published information on the microbiological safety of refrigerated noodles, or shelf-stable noodles, imported products expected to have up to 12 months shelf life. A market place survey detected only low numbers of Bacillus cereus in refrigerated noodles. This project will enable us to prepare processing guidelines for refrigerated noodles, to assess the microbiological safety and stability of two of the most popular long-life noodle types, and to recommend safe pH limits.

Studies on production of breadcrumb, valued at about $24 million p.a. in Australia, will provide information on potential hazards from mycotoxigenic mould contamination, and the fate of heat-stable mycotoxins during crumbing and roasting.

A study to evaluate the microbiology of steamed breads, implicated on occasions with food-borne disease, is also proposed.

Progress
In microbiological challenge studies on shelf-stable noodles, we assessed potential growth of Bacillus cereus and acid-tolerant spore-forming bacteria (which could survive the manufacturing process). There was no growth of spores in 4 weeks. Over 6 months, no spoilage or discolouration was found in noodles stored at 20°C, but some packs had spoiled after 2-3 months at 37°C. The spoiled packs showed higher total aerobic and anaerobic counts (Figure 2.2), probably due to the growth of Bacillus coagulans.

We are also developing HACCP guidelines for the manufacture of refrigerated noodles.

Early results of our microbiological survey of breadcrumb before and after drying indicate that dried breadcrumbs have low microbial counts.
Background and Objectives
Conditioning of wheat is the first stage in the milling process. Correct conditioning moisture is essential to ensure clean separation of flour and bran during milling. The long time taken for conditioning (8-12 hours) represents a significant delay in a commercial mill. Australian wheat, being relatively low in moisture content, requires a longer conditioning time compared with wheat from other countries.

The objectives of the project are to investigate chemical and biological methods which could reduce conditioning time and hence increase milling efficiency, as well as investigating the effect of these processes on flour quality and mill offal.

Progress
In previous trials, the effect of acid, alkali, surfactants and alcohol in the conditioning water were assessed. The effects of the chemicals tested were not significantly different from water alone. In the final phase of the project, 3 enzyme formulations, widely used in the starch and juicing industries, were tested. These contained xylanases, carbohydrases and pectolases in liquid form. The rate of moisture penetration using these enzymes was very similar to that with water alone. Although use of multi-component carbohydrases gave a slight increase in flour yield, there was a corresponding slight increase in bran contamination. There was no significant effect on dough or end product qualities.

Targets and Milestones Achieved
Target/Milestone Date Achieved
Marketplace survey of micro-biology of fresh noodles completed 09/01
Complete literature survey of stability of mycotoxins in breadcrumb production 05/02

Plans for the next 12-24 months
Target/Milestone Date
Complete mycological survey of breadcrumb production 10/02
Complete challenge studies and recommendations on shelf stable noodles 10/02
Guidelines for fresh noodle manufacturers 12/02
Report on microbial status of steamed breads 06/03

Closing Summary
Overall, the use of chemicals and enzymes in the conditioning water appeared to offer no advantages in improving the efficiency of the conditioning process. The Project was terminated on September 2001.
**Project No:** 2.1.9  
**Project Title:** Gluten structure and modification for ingredient use  
**Project Leader:** Dr Ian Batey

**Background and Objectives**
Approximately 25% of wheat milled in Australia is used for starch and gluten manufacture. Most dry gluten produced is exported, although gluten is used in a wide variety of food manufactured in Australia. Production of gluten in modified form for ingredient use is expected to increase over the next few years and commercial opportunities exist for the development of better production methods and extension of its use in food products.

Through this project, we will enhance knowledge about the composition and structure of gluten proteins, with the objective of adding value to commercial gluten. We will also develop methods for modifying gluten so as to make it suitable for a range of new applications.

**Progress**
The project commenced in May, 2002 with appointment of a post-doctoral fellow in Werribee, who will be able to develop skills in the area of gluten chemistry. Collaborations have been set up between a major gluten manufacturer and CSIRO Food Science Australia at Werribee and North Ryde.

**Targets and Milestones Achieved**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post doctoral fellow appointed</td>
<td>05/02</td>
</tr>
</tbody>
</table>

**Plans for the next 12-24 months**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report results of review of gluten and food industry uses</td>
<td>07/03</td>
</tr>
<tr>
<td>Report on enzymic treatments for potential commercial use</td>
<td>12/04</td>
</tr>
<tr>
<td>Successful laboratory production of modified gluten for ingredient use</td>
<td>01/04</td>
</tr>
</tbody>
</table>

**Program 2: Major Achievements/Outcomes**
- Demonstration and evaluation of Bakery Advisory System in commercial bakery
- Production process for shelf stable noodles shown to control microbial growth successfully, provided pH is below 4.2
- Significant progress made in finding a replacement for chlorination of cake flour
The wheat growing and utilisation industries rely on detection and management of the variation in wheat plants, wheat grain and the products made from the wheat harvest.

Program 3 is directed at providing scientific knowledge, technologies and resources that will enable better use of this variation. Many of the outputs of this program will find use in other programs of the CRC, especially Program 1 (Diagnostics) and Program 4 (Germplasm Development).

The projects in Program 3 cover three areas of technology: proteomics, molecular markers, and targeted mutagenesis. Key world-class partners have been sought and engaged so that the research is at the leading edge of science and technology.

The proteomics project involves a National Major Research Facility, the Australian Proteome Analysis Facility (APAF) at Macquarie University, the marker project involves the Centre for the Application of Molecular Biology in International Agriculture (CAMBIA) in Canberra, while the targeted mutagenesis work is in a joint program with Cibus Genetics LLC in San Diego. Key outputs from the program will be knowledge of wheat grain proteins related to quality traits and/or useful in cultivar diagnostics, new molecular markers and systems useful for breeding programs, and new specific variation in wheat.

Program Aims
The aim of this program is to develop strategic science in three areas that will contribute to the commercial success of the CRC, and to the development of the wheat industries. The first area is provision of high-throughput molecular markers, based on microsatellite and microarray technology.

Secondly, the wheat grain proteome will be searched to identify proteins related to quality, or that are variable as targets for diagnostic test development.

Lastly, new, specifically designed variation in particular genes of commercial interest will be the product of the targeted mutagenesis program that is applying this advanced technology to wheat for the first time.

Project No: 3.1.1
Project Title: Markers and Mapping Wheat Quality Traits
Project Leader: Assoc. Professor Peter Sharp

Background and Objectives
Microsatellites (SSRs) are a preferred molecular marker for genetic variation, as they have high levels of polymorphism (variation), codominance (all variations visible), and enable rapid and simple genotyping. SSRs are also easily distributed between laboratories by the exchange of primer sequences. Although a large number of wheat SSRs are available, a high-density microsatellite map providing good coverage of the genome is not yet available. An objective is to develop a large number of polymorphic SSRs. These will facilitate the tagging of genes, and provide the means to select a range of commercially important traits during breeding.

Progress
A recently developed technique, sequence tagged microsatellite profiling (STMP), was used to generate SSR markers. Initially, markers varying in the number of repeats of a two base sequence, “AC” were developed. These showed good specificity in the Polymerase Chain Reaction (PCR), but had low polymorphism. Higher polymorphism was found with markers based on compound repeats, and effort was focused on this class. Sequence tag profiles were constructed for six types of compound repeats, and these are being used to develop a large set of markers. To facilitate the use of these SSRs, we developed a multiplex PCR procedure, allowing assessment of four markers per reaction (Figure 3.1). Initial work on microarray-based polymorphism detection has begun.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Further development of STMP technology for new SSR development</td>
<td>03/02</td>
</tr>
<tr>
<td>Initiation of library construction for polymorphism array development</td>
<td>06/02</td>
</tr>
<tr>
<td>“Proof-of Concept” of polymorphism array in bread wheat</td>
<td>12/02</td>
</tr>
<tr>
<td>Possession of a collection of ~1000 SSRs with high polymorphism</td>
<td>12/03</td>
</tr>
<tr>
<td>Attainment of a prototype polymorphism chip for wheat with 500 elements</td>
<td>06/04</td>
</tr>
</tbody>
</table>
**Project No: 3.1.2**

**Project Title:** Wheat Grain Proteomics & Bioinformatics  
**Project Leader:** Professor Gary Cobon

**Background and Objectives**  
The major objective of this project, which continues the world-leading work of the CRC in wheat grain proteomics, is the discovery of proteins determining variation in wheat grain quality. The advanced proteomic technologies available at APAF will be used toward this objective. A key commercial aim of the CRC is to develop diagnostic kits, including kits for the differentiation of wheat cultivars for users through the value-added chain. Consequently, effort is initially focused on finding proteins that differ between cultivars. These will be identified, and samples of the proteins, or information of their amino acid sequences, will be transferred to the diagnostics program.

**Progress**  
There were two main areas of progress. Detection of cultivar differences in endosperm proteins relies on the extraction and diagnosis systems being compatible. Standard methods of protein extraction were modified to make them ELISA-compatible, and this revealed no difference in proteins extracted. The closely related cultivars, Bowie and Rosella, were compared, revealing almost 40 protein differences in gliadins, albumins and globulins. To increase knowledge of wheat grain proteins, the CRC’s lead in wheat endosperm proteins will be extended to the germ and bran tissues of the mature grain. Extraction methods were developed for these difficult tissues. Figure 3.2 shows an example gel.

**Targets and Milestones Achieved**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteome studies of Bowie &amp; Rosella</td>
<td>05/02</td>
</tr>
<tr>
<td>Preliminary characterisation of germ and bran proteins</td>
<td>06/02</td>
</tr>
</tbody>
</table>

**Plans for the next 12-24 months**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full characterisation of germ and bran proteins</td>
<td>06/03</td>
</tr>
<tr>
<td>Characterisation of alien segments for proteome differences</td>
<td>12/02</td>
</tr>
<tr>
<td>Isolation of variant alpha amylase inhibitor for Program 2</td>
<td>08/02</td>
</tr>
<tr>
<td>Detection of protein amino-acid modifications in endosperm proteins</td>
<td>12/03</td>
</tr>
</tbody>
</table>

---

**Project No: 3.1.3**

**Project Title:** Targeted Mutagenesis of Wheat Grain Characteristics  
**Project Leader:** Assoc. Professor Peter Sharp

**Background and Objectives**  
Variation in wheat grain characteristics continues to be an important resource for wheat breeders. In some cases variation in particular genes does not exist, is very rare, or occurs in exotic germplasm or related species that are difficult to use in normal breeding. High frequency mutagenesis in plants has been demonstrated using hybrid DNA-RNA oligonucleotides specific for target gene regions. Cibus Genetics LLC is the leader in this technology. This project will develop this technology for wheat, in partnership with this company. The immediate objective is to establish “proof-of-principle” in wheat, and subsequently to produce particular mutations on a number of genes known or suspected to control wheat quality characteristics.

**Progress**  
The project has been awaiting agreement with Cibus LLC. In the meantime, germplasm required for the project has been assembled, and potential target genes identified.

**Plans for the next 12-14 months**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microspore technology in wheat established</td>
<td>03/03</td>
</tr>
<tr>
<td>Proof-of-principle of targeted mutagenesis in wheat</td>
<td>06/03</td>
</tr>
<tr>
<td>First targeted mutation of a quality related gene produced</td>
<td>06/04</td>
</tr>
</tbody>
</table>

**Program 3: Major Achievements/Outcomes**

- Initiation of DArT technology research to produce polymorphism array technology for wheat
- Discovery of proteins that differentiate Bowie and Rosella soft wheats, and technology for protein extraction from germ and bran tissue
- Construction of many STMP libraries for further SSR development
Value can be added to wheat through development of improved germplasm or through the management of that germplasm during growth and storage. Consequently, a key focus of the VAWCRC research and development program is to assist Australian wheat improvement programs to add value, by identifying and providing new germplasm that extends the extremes available in key traits, and by enhancing the tools available to breeders for selection. Such wheats are important to enhance the total production and value adding opportunities to the Australian wheat industry. They are also an important mechanism by which much of the intellectual property developed within VAWCRC can be delivered to industry.

Having wheat varieties with enhanced processing qualities is crucial to Australia’s ability to sustain markets. However, their value is lost if the availability of these varieties is not matched by the capability of growers to ensure those wheats can reach their full market potential. Therefore, another key focus within VAWCRC is on developing farm management tools to help growers increase the quantity of grain that can be delivered into premium wheat grades, and to ensure quality is not lost during storage.

Program Aims
In this context the aims of this Program are to:
- identify new sources of variation for key quality traits;
- capture the key attributes of that variation in appropriate germplasm that can be utilised effectively by wheat improvement programs, or by producing finished varieties with novel traits;
- develop and utilise molecular tools to assist in the introgression of the key traits and
- develop management packages to help growers increase the quantity of grain delivered into premium wheat grades.

The key commercialisable outputs will be novel wheat germplasm, new wheat varieties with enhanced attributes for target regions or target grades, and farm management packages for growers.

Project No: 4.1.1
Project Title: New genetic variation and markers for quality traits
Project Leader: Dr Matthew Turner

Background and Objectives
Through this project we are identifying novel variation in economically important wheat quality and processing characteristics, not currently available to breeders. We are focussing on high apparent amylose content, improved noodle brightness and colour, reduced blackpoint expression, and increased milling yield and water absorption. To enable rapid introgression of the novel traits into adapted germplasm, molecular markers are being developed. We are targeting markers for pre-harvest sprouting tolerance, late maturity alpha amylase (LMA), blackpoint resistance, low polyphenol oxidase (PPO) activity, starch granule
size distribution, amyllose:amylopectin ratio, and white salted noodle quality.

**Progress**

Germplasm with extreme variation in blackpoint resistance, PPO activity, high amyllose content and high milling yield have been identified. We have evidence that the same quantitative trait locus (QTL) controls LMA expression in Spica and Cranbrook. DNA markers have been identified for this QTL, for seed dormancy in the line AUS1408, and for the Wx-D1 locus. Chromosomal mapping results suggest the Vp1 locus on chromosome 3AL has a significant association with seed dormancy, and implicate chromosome 4BL. A rapid technique was developed to prepare template DNA from single seeds in a 96-well plate format. Other results obtained show that starch granule size distribution may influence flour extraction.

**Targets and Milestones Achieved**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 synthetic and hexaploid wheats assessed for blackpoint</td>
<td>12/01</td>
</tr>
<tr>
<td>Apparent amyllose content measured in 600 tetraploid wheats</td>
<td>12/01</td>
</tr>
<tr>
<td>DNA markers for pre-harvest sprouting and LMA identified</td>
<td>01/02</td>
</tr>
</tbody>
</table>

**Plans for the next 12-24 months**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverse sets of germplasm screened for noodle and pasta colour, &amp; extreme variants identified</td>
<td>12/02</td>
<td></td>
</tr>
<tr>
<td>Validation of markers to Spica and Inia sources of LMA.</td>
<td>12/02</td>
<td></td>
</tr>
<tr>
<td>Structural framework map of Ajana x WAWHT2046 and Cadoux x Reeves constructed using at least 200 markers to identify markers for water absorption, Null4A-GBSS, FSV and flour colour</td>
<td>12/02</td>
<td></td>
</tr>
</tbody>
</table>

**Project No: 4.1.2**

**Project Title:** Rapid breeding technologies – novel adapted wheats

**Project Leader:** Dr Nizam Ahmed

**Background and Objectives**

In this project we are building on the outputs of Project 4.1.1 by rapidly introgressing the new sources of variation into adapted germplasm. Doubled Haploid (DH) technologies and marker-assisted selection, including the deployment of molecular markers developed in 4.1.1, are being used along with conventional strategies to accelerate the introgression of these new and valuable quality characteristics. Our initial focus is on introgressing zero PPO, blackpoint tolerance high flavonoid content and low enzyme levels, to reduce colour darkening in noodles. To ensure rapid development of new varieties, opportunities to improve DH production protocols are being evaluated.

**Progress**

In production of DH’s, we are achieving an average of 8 embryos per spike, up to 80% embryo germination and up to 80% chromosome doubling rate. Nearly 5000 haploids have been produced and 1000 doubled haploid lines harvested. 100 lines, varying in B-granule content, and with significant genotypic variability for yield & quality, were evaluated, and 32 selected for further yield & quality evaluation. Sixty nine BC2 durum lines, homozygous for granule bound starch synthase, were shown by RVA analysis to have increased paste viscosity, breakdown and final viscosity.

**Targets and Milestones Achieved**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 synthetic and hexaploid 12/01 wheats assessed for blackpoint</td>
<td></td>
</tr>
<tr>
<td>Apparent amylose content measured in 600 tetraploid wheats</td>
<td>12/01</td>
</tr>
<tr>
<td>DNA markers for pre-harvest sprouting and LMA identified</td>
<td>01/02</td>
</tr>
</tbody>
</table>

**Plans for the next 12-24 months**

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverse sets of germplasm screened for noodle and pasta colour, &amp; extreme variants identified</td>
<td>12/02</td>
<td></td>
</tr>
<tr>
<td>Validation of markers to Spica and Inia sources of LMA.</td>
<td>12/02</td>
<td></td>
</tr>
<tr>
<td>Structural framework map of Ajana x WAWHT2046 and Cadoux x Reeves constructed using at least 200 markers to identify markers for water absorption, Null4A-GBSS, FSV and flour colour</td>
<td>12/02</td>
<td></td>
</tr>
</tbody>
</table>
Project No: 4.1.3

Project Title: Elite germplasm with new and novel quality attributes
Project Leader: Ms Helen Allen & Dr Mohammad Shariflou

Background and Objectives
Our aim in this project is to develop elite germ-plasm with novel processing and manufacturing qualities in Australian backgrounds. The initial focus is on wheats with soft biscuit qualities, high and low B-granule content, and waxy starch attributes. Wheats incorporating traits such as sprouting tolerance, increased milling yield, improved noodle colour and brightness (low PPO), and blackpoint resistance will subsequently be developed. This germplasm will be important in delivering the benefits of CRC research to both producers and processing industries through enhanced production or value adding opportunities. They will also be important in facilitating the commercialisation of the intellectual property developed by the CRC.

Progress
Two new soft wheat breeding lines have been developed. Cultivar 2001-13 is similar to our soft biscuit variety, QAL2000. Cultivar 2001-15 is a quick in tillering club type. During the year the waxy work became part of a confidential commercialisation project with George Weston Foods. Thirty four waxy lines in a Janz background were evaluated and 10 lines selected. Approximately 200 F4 lines generated from crosses, involving the low B-granule winter exotic wheat, Outlier 67, and Australian spring wheats, were harvested for further evaluation. RVA pasting viscosity and swelling volume of variously combined A and B starch granules from cv Thornbill were measured. Peak viscosity and final viscosity showed proportional decrease with the addition of B starch granules.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft grained wheats, with disease resistance, quality characteristics and appropriate agronomic adaptation to northern NSW, identified for progression/ release</td>
<td>01/02</td>
</tr>
<tr>
<td>Assessment of waxy allele nulls in populations harvested Dec 2001</td>
<td>03/02</td>
</tr>
<tr>
<td>Harvest of 100 extreme lines for B-granule content from Vulcan x Kewell population and 700 F3 lines from crosses</td>
<td>12/01</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilising material with extremely weak dough strength, conduct blending studies with stronger soft wheats and assess biscuit quality</td>
<td>12/02</td>
</tr>
<tr>
<td>Evaluate specific crosses for high and low B-granules with respect to specific product qualities, particularly hard wheats with high B-granules and soft wheats with low B-granules</td>
<td>12/02</td>
</tr>
<tr>
<td>Soft grained wheats, with disease resistance, quality characteristics and appropriate agronomic adaptation to target regions, identified for progression/ release</td>
<td>04/03</td>
</tr>
</tbody>
</table>

Project No: 4.1.4

Project Title: Flexibility of wheat use
Project Leader: Ms Helen Allen

Background and Objectives
The four components of this project were developed from grower’s initiatives and workshops arranged by GRDC with the objective of providing flexibility in the production of quality grades of wheat. One component involves conducting regional and national benchmarking of quality potential by growing and quality-testing a range of wheat types at diverse sites.

In previously completed, but related components, we investigated the biochemical and genetic explanations of environmental variations in quality, aspects of management of within-paddock variation in quality, and principles and models to predict the outcome of blending wheat quality types for specific ends.

Progress
Field work and quality analysis of the benchmarking component has been completed, and data collation finalised. The data is being statistically analysed to assess the equivalence of quality of the predominant Australian Premium White/Australian Hard and noodle varieties from different regions and the extent of environmental sensitivity of these varieties.

Adverse seasonal conditions in several regions have rendered many trial sets unsuitable for quality evaluation. This will reduce the range of environments which the analysis can incorporate. Preliminary results reinforce the huge genotype x environment (G x E) effects that can be observed across the country.

Closing Summary
The benchmarking study consisted of a set of trials of 11 hard and 4 soft varieties, from breeding programs around Australia, at 12 sites around the main Australian wheat belt, annually 1998 to 2000.

NSW Agriculture, Wagga Wagga, performed grain tests, milling quality, flour colour, flour pasting RVA and pan bread quality analysis. SARDI, Adelaide assessed physical dough characteristics and flat bread quality. Agriculture Victoria, Horsham, assessed the samples for yellow alkaline noodle quality and Agriculture WA, Perth tested the quality of the starch and the suitability of the flour for white salted noodle production.

Once biometric analysis is complete, conclusions will be included in a report, to be delivered to breeding programs in September 2002, detailing the assessment of the equivalence of quality of the predominant APW/AH and noodle varieties from different regions, and the extent of environmental sensitivity of these varieties.
Project No: 4.1.5
Project Title: Increasing the quantity of grain delivered to premium grades
Project Leader: Dr Andrew Verrell

Background and Objectives
The continuity of supply of grain into premium-paying grades is being targeted using an integrated agronomic research program, in which we are evaluating management options for growers to improve the probability of achieving quality targets.

In NSW, the focus is on management options for successful targeting of quality types in new regions, particularly biscuit and noodles types in northern NSW, and durum quality types in southern NSW.

In WA, our aim is to explain some of the variation in quality measurements attributed to "environment" through management variables.

In SA, we are looking at management requirements in the medium-high rainfall districts to produce quality durum.

Progress
Three sets of experiments have been established.

In NSW, we have set up factorial experiments, to address effects of variables such as water x nitrogen x time of application of nitrogen, disease interaction, and soil type, on targeted yield and protein levels for selected biscuit and durum varieties.

In WA, factorial experiments will address the effects of variables such as sowing time, seed rate, rainfall, temperature, soil type and nutrition on a small number of varieties.

In SA, experiments involve the foliar application of nitrogen at particular growth stages, to evaluate best management options for durum in the medium-high rainfall regions.

Wheat trials to maximise productivity and value-adding for Australian growers and industry

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field experiments planned, variables to be measured defined, and experimental designs approved by biometricians.</td>
<td>04/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set of grain quality data collected, enabling decisions for more detailed quality testing to be made.</td>
<td>03/03</td>
</tr>
</tbody>
</table>

Program 4: Major Achievements/Outcomes

- Germplasm with extreme variation in blackpoint, PPO, high amylose content and high milling yield identified.
The education program is widely dispersed throughout the Centre, with PhD training included in securely funded projects in all programs. The aim is for at least 30 postgraduates, co-supervised by industry and academic supervisors, within the lifetime of the Centre. Additional training in project and people management, presentation skills, intellectual property management, commercialisation, occupational health and safety and quality assurance will be supplied, to enhance employment prospects in the industry.

Technical workshops, relevant to VAWCRC research and industry issues, will be run to foster innovative research and provide for the continuing education of researchers. These will involve both internal and external experts, and, where appropriate, collaboration with other CRCs. We will use the workshops to assure the rapid adoption of VAWCRC R&D outcomes, such as advances in breeding technology, diagnostics and processing flexibility, as they become available. Practical manuals, CDs and publications will be created for researchers’ future use and for integration into secondary and tertiary courses.

Building on the success of the “Quality Wheat for Quality Foods” market-awareness workshops in QWCRC, decision support systems and short courses feature in the program. These approaches are fundamental to achieve vertical integration within the added value wheat business.

Program Aims
Our aims in this program are:

- to generate a succession of tertiary and quaternary educated scientists and technicians, with practical experience of wheat quality science, and business skills
- to achieve effective technology transfer of outcomes of VAWCRC research programs through publications, workshops, and development and revision of nationally accredited courses
- to develop tools for managing production risk, higher productivity and returns to enable growers to achieve more consistent quality of wheat production
- to provide information on current developments to researchers, industry sectors and consumers through targeted conferences, workshops and publications.

Project No: 5.1.0
Project Title: Program Management
Project Leader: Ms Clare Johnson

Background and Objectives
The Education and Technology Adoption Program Manager’s function is to identify and resource an effective network of staff, in order to facilitate education and adoption of the CRC’s innovative technology across all industry sectors, as described in detail within the projects of this program. This involves provision of an internal communications system, and ensuring regular reporting against objectives for each project. It is important to monitor progress in CRC research and development, to interact constructively in commercialisation, and to be aware of appropriate technologies and delivery vehicles, and of issues and critical control points affecting grain quality.

Progress
An induction package was generated and issued to all VAWCRC secondees in the first quarter. All program 5 staff were provided with project charters, quarterly reports were requested in advance of due dates, and compiled reports were filed on target. In the third quarter, projects were reviewed and revisions incorporated for the next financial year. A breeding-focussed program was also drafted for the CRC’s supplementary funding bid.

The Program Manager obtained training in web design to enable management of the web page and construction of educational resources, and took courses in relational database design and Excel for applications such as formatting a wheat quality database.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timely quarterly reports for each project submitted</td>
<td>06/02</td>
</tr>
<tr>
<td>Produce annual report for Program</td>
<td>07/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timely quarterly reports for each project submitted</td>
<td>06/03</td>
</tr>
<tr>
<td>Produce annual report for Program</td>
<td>06/03</td>
</tr>
</tbody>
</table>
Project No: 5.1.1

Project Title: Skilled graduates and postgraduates for industry succession

Project Leader: Mr Bob Caldwell

Background and Objectives

The VAWCRC aims to support at least 30 postgraduate students during the life of the CRC. The students will receive training in management of intellectual property, projects and people, and safety and information skills, as well as their research training. Vacation scholarships and undergraduate scholarships will be provided from 2002/2003 to attract talented students to the industry. A program of technical workshops will be offered for research staff and students, run jointly with other CRCs where appropriate. Publications, decision support systems and software such as a manual on industrial enzymology will be produced to make the workshop content available in the longer term.

Progress

Five postgraduate students were appointed, students and supervisors were provided with guidelines including critical progress target dates, and quarterly reports are submitted. Of 8 students continuing from QWCRC, or still writing up at the start of the year, 2 have completed and 5 are expected to complete satisfactorily. New students attended the internal CRC conference in February, including sessions on research, the industry, communications and IP.

An Enzymes in Industry workshop run in February 2002 attracted 30 industry participants. A short course, “Prebiotic Carbohydrates and Gut Health,” was run for 16 attendees in Perth in February, with repeats in-house for Goodman Fielder, Rutherglen (May) and at the Cereal Chemistry Conference, Christchurch (Sept.). Courses on Near Infrared Spectrometry, 3-D design considerations for mutagenesis, and diagnostic technologies are planned.

Postgraduate Students of QWCRC and VAWCRC

<table>
<thead>
<tr>
<th>Student</th>
<th>Degree</th>
<th>University</th>
<th>Thesis title</th>
<th>Date Commenced</th>
<th>Supervisors/ Organisations</th>
<th>Funding Source</th>
<th>Subsequent Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steven Zounis</td>
<td>PhD</td>
<td>NSW</td>
<td>Measurement of Frozen Bread Dough Stability</td>
<td>Jun-96 To submit by Sept 2002</td>
<td>Dr Ken Quail, BRI Australia Ltd, Dr Mike Wootton, UNSW</td>
<td>QWCRC</td>
<td>Research at BRI Australia</td>
</tr>
<tr>
<td>Kym Turnbull</td>
<td>PhD</td>
<td>Sydney</td>
<td>Genomic and developmental analyses of grain hardness in wheat</td>
<td>Jul-97 Thesis accepted</td>
<td>Dr Sadiq Rahman, CSIRO Plant Industry, Dr Peter Sharp, University of Sydney</td>
<td>QWCRC</td>
<td>Lecturer, Molecular Biology, Canberra Uni. of Technology; wheat research, CSIRO Plant Industry</td>
</tr>
<tr>
<td>Daniel Skylas</td>
<td>PhD</td>
<td>Sydney</td>
<td>The wheat-grain proteome: value as a tool for identifying markers of environmental stress</td>
<td>Oct-97 Thesis accepted</td>
<td>Dr Brad Walsh, Australian Proteome Analysis Facility, &amp; Prof Les Copeland, University of Sydney</td>
<td>QWCRC</td>
<td>Postdoctoral fellowship, VAWCRC project 3.1.2</td>
</tr>
<tr>
<td>Andrew Verrell</td>
<td>PhD</td>
<td>Sydney</td>
<td>Factors affecting wheat yield and protein of wheat in central and northern NSW</td>
<td>Feb-98 To submit by Dec. 2002</td>
<td>Dr Lindsay O’Brien, University of Sydney</td>
<td>QWCRC</td>
<td>Project leader (research agronomist), VAWCRC project 4.1.5</td>
</tr>
<tr>
<td>Dennis Murray</td>
<td>M. Ag.</td>
<td>Sydney</td>
<td>Changes to the hydrogen bonding of gliadin types; Effects on several quality parameters of a wheat flour /water dough.</td>
<td>Feb-98 Thesis accepted</td>
<td>Dr Ferenc Bekes, CSIRO Plant Industry, Prof. Les Copeland, University of Sydney</td>
<td>QWCRC</td>
<td>Dough property research, CSIRO Plant Industry</td>
</tr>
</tbody>
</table>

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appoint PhD students</td>
<td>02/02</td>
</tr>
<tr>
<td>and provide guidelines</td>
<td></td>
</tr>
<tr>
<td>Technical workshops</td>
<td>06/02</td>
</tr>
<tr>
<td>Probiotics manual</td>
<td>02/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appoint PhD students</td>
<td>02/03</td>
</tr>
<tr>
<td>and provide guidelines</td>
<td></td>
</tr>
<tr>
<td>Technical workshops</td>
<td>06/03</td>
</tr>
<tr>
<td>(Curtin 3/year; Uni. of Sydney/VAWCRC 2/year)</td>
<td></td>
</tr>
<tr>
<td>Industrial enzymology</td>
<td>06/03</td>
</tr>
<tr>
<td>manual produced</td>
<td></td>
</tr>
</tbody>
</table>
### RESEARCH - PROGRAM 5

#### Postgraduate Students of QWCRC and VAWCRC continued...

<table>
<thead>
<tr>
<th>Student</th>
<th>Degree</th>
<th>University</th>
<th>Thesis title</th>
<th>Date Commenced</th>
<th>Supervisors/ Organisations</th>
<th>Funding Source</th>
<th>Subsequent Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marcus Newberry</td>
<td>PhD</td>
<td>Sydney</td>
<td>Rheology of yeasted doughs</td>
<td>Feb-98</td>
<td>Dr Nigel Larsen, Crop &amp; Food Research, NZ, Dr Nhan Phan-Thien, University of Sydney Crop &amp; Food Research, New Zealand</td>
<td>QWCRC</td>
<td>Rheology Scientist</td>
</tr>
<tr>
<td>Patricia Chong</td>
<td>PhD</td>
<td>ANU</td>
<td>Structure of glutenin macromonomers in bread/ noodle doughs &amp; products</td>
<td>Jan-99 To submit by Sept 2002.</td>
<td>Dr Ferenc Bekes, CSIRO Plant Industry, Prof. Adrienne Hardham, ANU</td>
<td>QWCRC/ VAWCRC</td>
<td>Currently writing up</td>
</tr>
<tr>
<td>Laila Daqiq</td>
<td>PhD</td>
<td>Sydney</td>
<td>Polymer size and shape in cereal processing</td>
<td>Feb-99 To submit by Sept 2002.</td>
<td>Dr Ferenc Bekes, CSIRO Plant Industry, and Dr Edith Lees, University of Sydney</td>
<td>QWCRC/ VAWCRC</td>
<td>Currently writing up</td>
</tr>
<tr>
<td>Taisir Hubraq</td>
<td>PhD</td>
<td>Sydney</td>
<td>The effects of protein composition on basic and applied rheological parameters</td>
<td>Feb-99 submit as MSc by June 2003.</td>
<td>Dr Ferenc Bekes, CSIRO Plant Industry, Prof. Roger Tanner, University of Sydney</td>
<td>QWCRC/ VAWCRC/ University of Sydney/ CSIRO Plant Industry</td>
<td>P/T completion</td>
</tr>
<tr>
<td>Deirdre Lewis</td>
<td>MAppSc</td>
<td>NSW</td>
<td>Transgenic wheat – future potential</td>
<td>Feb-00 Thesis accepted</td>
<td>Prof. Peter Rogers, UNSW, Drs Ian Batey, Ferenc Bekes, Colin Wrigley and Matthew Morrell, CSIRO Plant Industry</td>
<td>QWCRC</td>
<td>Goodman Fielder</td>
</tr>
<tr>
<td>Mohammad Hassani</td>
<td>PhD</td>
<td>Sydney</td>
<td>Novel storage protein</td>
<td>Mar-00</td>
<td>Dr Peter Sharp, University of Sydney</td>
<td>QWCRC/ VAWCRC</td>
<td>Current</td>
</tr>
<tr>
<td>Araluen Freeman</td>
<td>PhD</td>
<td>Sydney</td>
<td>Diagnostics for wheat varietal identification</td>
<td>Jan-02</td>
<td>Dr. James Chin Elizabeth Macarthur Agricultural Institute, NSW Agriculture Professor Cris dos Remedios, University of Sydney</td>
<td>VAWCRC</td>
<td>Current</td>
</tr>
<tr>
<td>Karon Ryan</td>
<td>PhD</td>
<td>Murdoch</td>
<td>Validation of molecular markers in wheat for the quality traits of flour colour and grain size</td>
<td>Jan-02</td>
<td>Dr Michael Francki Dept. Agric. WA Prof Rudi Appels Murdoch University /Dept. Agric. WA Prof Mike Jones WA State Agric. Biotech. Centre,Murdoch Univ.</td>
<td>VAWCRC</td>
<td>Current</td>
</tr>
<tr>
<td>Yunxian Mak</td>
<td>PhD</td>
<td>Sydney</td>
<td>A proteomic approach to the investigation and characterization of wheat protein</td>
<td>Feb-02</td>
<td>Prof. Les Copeland, University of Sydney Assoc. Prof. Peter Sharp, Plant Breeding Institute, University of Sydney</td>
<td>VAWCRC</td>
<td>Current</td>
</tr>
<tr>
<td>Michelle Powell</td>
<td>MSc</td>
<td>Sydney</td>
<td>Characterisation of polymorphic proteins for variety and quality traits</td>
<td>Feb-02</td>
<td>Dr. James Chin Elizabeth Macarthur Agricultural Institute, NSW Agriculture Dr Elizabeth Hegedus University of Sydney</td>
<td>VAWCRC</td>
<td>Current</td>
</tr>
<tr>
<td>Cindy Soh</td>
<td>PhD</td>
<td>Sydney</td>
<td>Influence of protein composition and non-starch polysaccharides on pasta quality using semolina reconstitution</td>
<td>Jan-02</td>
<td>Dr. Mike Sissons, NSW Agriculture (Tamworth) Dr Matthew Turner, University of Sydney</td>
<td>VAWCRC</td>
<td>Current</td>
</tr>
</tbody>
</table>
Project No: 5.1.2
Project Title: Initiatives for uptake of VAWCRC innovation
Project Leader: Ms Clare Johnson

Background and Objectives
Technology transfer of outputs from the research programs of VAWCRC, and of existing results from Quality Wheat CRC, is to be achieved via liaison with relevant industry sectors, and provision of accredited courses, software and publications for their staff and for consumers. Our methods will include workshops with industry, to promote innovative use of the research outcomes, and to assess industry priorities for further research. We will also support relevant industry conferences and courses.

Progress
After setting up the new CRC’s brochure, web site, induction package, and web-based internal report archive, attention was turned to our first, highly successful internal conference, attended by sixty staff, and to policy revision for a more commercial focus. Outputs were reported for new CRCs in the Education Workshop of the CRCA conference. We played a major role in updating Kondinin Group’s grain storage publication. Incorporating QWCRC research, this book is to be marketed with our CD. Our nutritional literature review on polyphenol oxidase may help provide a basis for reduced downgrading of enzyme-darkened grain. The newly appointed Research Officer, Technology Transfer, has made progress on a wheat varietal database and technology transfer of innovative oven process control instrumentation. We have also sponsored workshops in microarrays, bioinformatics and probiotics, to run in September 2002 at three industry conferences.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liaison/consultation with Participants for technology transfer and industry-relevant research</td>
<td>04/02</td>
</tr>
<tr>
<td>Sponsor relevant conferences</td>
<td>05/02</td>
</tr>
<tr>
<td>Decision support systems and publications for retail</td>
<td>06/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oven technology manual available</td>
<td>10/02</td>
</tr>
<tr>
<td>Wheat quality database compiled. Software/decision support/expert systems &amp; publications for retail.</td>
<td>12/02</td>
</tr>
<tr>
<td>Sponsor relevant conferences</td>
<td>06/03</td>
</tr>
</tbody>
</table>

Project No: 5.1.3
Project Title: Enabling activities for delivery of premium grain
Project Leader: Ms Clare Johnson

Background and Objectives
Along with researchers in project 4.1.5, “Increasing the Quantity of Grain Delivered to Premium Grades”, through this project, agronomists in NSW, WA and SA are running farmer focus groups at test sites, for wheat grades of economic importance to their regions. The know-how generated will be captured in relevant publications and modules for national accreditation. PIRSA Rural Solutions is running two initiatives to support the development of a high protein wheat & wheat flour industry, and a durum wheat industry and durum processing capacity in SA. Creation of their crop nutrition decision support software is also being supported.

Progress
In NSW, grower groups were established, and handouts focusing on seed quality, germination tests and sowing rates, and farm budget handbooks were published, with hard and soft wheat packages planned in WA. We supported PIRSA Rural Solutions’ establishment of a new durum industry on Eyre Peninsula, with segregations made available, the freight barrier removed, and uptake increasing. A TOPACTIVE durum package was completed. The fertiliser decision support software will be available for evaluation shortly. The Upper North SA hard wheat group completed evaluation of the first batch of frozen bakery products, and scoping studies on high protein and Asian noodle market opportunity development are underway on the Eyre Peninsula.

Targets and Milestones Achieved

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine target areas for expansion, survey farmers and ensure industry support and investment</td>
<td>09/01</td>
</tr>
<tr>
<td>Agronomists trained; farmer workshops on rotations, nutrition and management run</td>
<td>10/01</td>
</tr>
<tr>
<td>Publications reviewed; new training materials and production information available</td>
<td>06/02</td>
</tr>
</tbody>
</table>

Plans for the next 12-24 months

<table>
<thead>
<tr>
<th>Target/Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segregations available for SA high protein wheat</td>
<td>10/02</td>
</tr>
<tr>
<td>Production and market nous disseminated for SA durum and high protein hard wheat, and WA hard and soft wheat</td>
<td>06/04</td>
</tr>
<tr>
<td>Develop and publish a manual for sustainable wheat production in NW NSW</td>
<td>06/04</td>
</tr>
</tbody>
</table>
Background and Objectives
To help growers and advisers understand the end-product quality requirements for their wheat, VAWCRC supports travelling 1-2 day "Quality Wheat" workshops in all states. We are also working with the University of Sydney, Orange to develop a "Value Chain Marketing" course for distance delivery to farmers, and the Grain Growers Association has expressed strong interest. These initiatives complement ongoing work with Pulse Australia to implement our Great Grain quality assurance (QA) program.

Progress
Wheat quality courses, updated to incorporate AWB’s sliding scale calculation of premiums, were delivered to 72 progressive participants at seven locations in Vic., SA, and NSW, and 54 participants attended three two-day courses in Northam, WA. A half-day course has also been developed and presented to Topcrop groups in their regions. Accreditation is in progress. The pilot version of the distance course, "Strategic Marketing for Wheat Producers", is ready for review by rural producers and an industry expert.

Great Grain has 270 producers registered, and 500-600 producers with the Grain Pool of WA will be accredited this season. Key alliances are with Pivot, Cargill and Penfords, the SQF Institute, Australian Pork Ltd, and with the Australian Fodder Industry Association, to manage rye grass toxicity in fodder/hay exports. We expect traceability of GMO crops (e.g. canola) to drive QA in future.

Program 5:
Major Achievements/Outcomes
- New durum industry established on Eyre Peninsula; segregations available, freight barrier removed
- 3 technical and 10 farmer workshops run; Value Chain Marketing course developed
- 5 new PhD students appointed and oriented
The original creation of the CRC was partly a response to perceptions of fragmentation in research and education services; a product of distance, focus and culture which are particular to the wheat industry in Australia. The structure of the Centre is designed to overcome this fragmentation by establishing a co-operative culture between the Participants, whilst retaining a focus on commercially valuable outcomes.

To achieve its goals, the Centre is stimulating fundamental improvements in the collaborative arrangements covering research, education, technology transfer and commercialisation throughout the industry. Some of its successes as a catalyst to improve contacts, information flow and collaboration between scientific and industrial groups are listed in the Cooperative Arrangements section of this Annual Report.

Commercialisation of the research and use & management of intellectual property generated in the Centre

The following summary list is confined to the leading on-going examples. The list is divided into the three main business areas of the Value Added Wheat CRC. This list is a useful summary of the main commercialisation activities of the Centre, and demonstrates how the intellectual property being generated, as well as that transferred from the QWRCRC, is being managed and used. All Core Participants and some Supporting Participants of the Centre feature in this list (marked*). Collaborators that could be defined as small/medium enterprises ("SMEs") are so identified at first mention.

Diagnostics:
C-Qentec Pty Ltd* (SME) is working with Proteome Systems (SME) in the production of the new format for WheatRite® and the new instrument for ReadRite®, the CRC-developed rapid test for rain damage in wheat and other cereals. The CRC is ensuring that the intellectual property licensed to C-Qentec Pty Ltd has been adequately protected in the Agreement between C-Qentec Pty Ltd and Proteome Systems.

C-Qentec Pty Ltd is in the process of developing the market for North America and France. Positive feedback has been received from both markets on the new format of WheatRite®. There is optimism about the success of the new product formats in these markets and later in the year in Australia.

Germplasm and Varieties:
Soft Wheats
AustGrains International (SME) are sowing a further 200 tonnes of QAL2000 seed in 2002 with the aim of producing in excess of 15,000 tonnes. Two tonnes of breeder seed will also be sown to produce seed for commercial production in 2003. This will ensure enough pure high quality seed will be available, until commercial quantities of the sister lines 2001-13 and 2001-15 become available, or if QAL2000 continues to be the superior biscuit wheat for Northern NSW.

Approximately two tonnes of breeder seed of 2001-13 and 2001-15, the two improved lines from the program, were produced during the 2001/02 summer period. The seed is being provided to SunPrime Seeds (SME) under the terms of a commercialisation agreement being negotiated. SunPrime (a joint venture of GRDC*, GrainCorp* and the University of Sydney*) intends to sow the seed over two sites at low sowing rates in NSW to spread production risk and maximise seed production for 2003. Plant Breeders Rights (PBR) applications for 2001-13 and 2001-15 were submitted to the PBR office in June 2002, which will provide the lines with provisional protection.

Trials of 13, 15 and of QAL2000 have been planted across Australia. The main area where trials have been organised is WA. There is good opportunity for soft wheat in WA and we have planned new commercialisation agreements to cover the west.

Waxy Wheat:
VAWRCRC and George Weston Foods (GWF) have, in the year under review, finalised a Project Agreement for the exclusive breeding and development of waxy wheat lines for commercialisation by GWF. All cash contributions to the project from the commencement of the year in review are being met by GWF and an End Point Royalty (EPR) will be collected on all grain produced. GWF and the CRC will undertake to ensure that supplies are available to the clients of Byron Australia (SME) who also have an agreement with us on this project. Most of this royalty will be remitted to the CRC.
Sprout-tolerant germplasm
VAWCRC has limited quantities of the wheat line DM5637*B8 available for use as parent material in breeding programs. This material, which combines sprouting tolerance, tolerance to enzymic blackpoint, low polyphenol oxidase, absence of late maturity alpha amylase and useful rust resistance, is an outcome from a QWCRC/GRDC program. It has been offered to all wheat breeding organisations across Australia (mostly SMEs) on a non-exclusive basis for breeding purposes. Agriculture WA*, NSW Agriculture* and SunPrime Seeds have all requested access to the line. The percentage of any EPR payable on the line will be negotiated. The line will be crossed into successful regionally adapted wheat varieties with the aim of producing further advanced germplasm and varieties for commercialisation.

Breeders’ tests:
The breeder tests for defects (caused by late maturity alpha amylase and by the rye chromosome translocation) are being developed and more widely distributed – eighteen thousand tests had been supplied to Australian and overseas wheat breeders in earlier years. It is intended to start making these tests commercially available.

Technology transfer to Growers and Processors:
Work has continued on the process control project and we have started to "test drive" it in a Participant's commercial bakery. Cost reductions from the use of the process control hardware and software in a single bakery were estimated by its managers at a $75,000 per annum reduction in product waste and "give away". We are now studying how best to assure transfer of this technology, either by direct implementation by Participants, or through commercial sale of hardware, software and consultancy services, or both.

Newport Scientific (SME) has expressed continued interest in the commercialisation of the micro-mill, mixer and extensor that came out of QWCRC. The CRC has organised for the prototype mixer to be provided to Newport. Further discussions and negotiations between the CRC, CSIRO Plant Industry, the Technical University of Budapest and Newport will be conducted to evaluate and progress the commercialisation of the three instruments.

Use of the research by Participants:
Many of the above commercialisation activities involve Participants (present or past) in the CRC. However there is evidently a great deal of non-commercial use of the research that is going on too. Many examples are cited elsewhere in the report - the following is an indicative list:

Use by Researchers:
- Proteomic science outcomes from Program 3 now form an important input into the immunology-based diagnostic work (Program 1).
- An important outcome of Program 1 is the transfer of knowledge from senior, partially-retired, wheat researchers to the next generation.

- The breeder tests for defects (caused by late maturity alpha amylase and by the rye chromosome translocation) are being further developed and widely used.
- Program 1, 3 and 4 technology is being developed in coordination with advanced science groups in Australia and overseas. One of these, the Centre for the Application of Molecular Biology in Agriculture* (CAMBIA) is also an SME. The overseas groups include public sector institutes such as the John Innes Centre (UK) and multinational corporations (e.g. Monsanto).
- 47 publications were approved for submission to refereed journals during the year.

Use by Growers:
- Ten wheat quality/market awareness courses were held for growers and their advisors in the last year and national accreditation is planned.
- The value of the on-going additional GRDC* projects directly managed by the Centre is $532,240.

Use by Millers, Bakers and other Buyers of Wheat:
- The outcomes of the microbiology work are being used throughout the food processing industry, Centre Participants and non-participants.
- The continuation of the blending project was supported by miller Participants as it enables them more efficiently to meet quality requirements through grist and flour blends.
- Our Enzymes in Industry and Probiotics short courses attracted operative-level industry staff from a broad range of companies.

Use of the research by groups outside the Centre and overseas:
Again, many examples are to be found elsewhere in the Annual Report, and most of the selection in the previous list is relevant here too.

To avoid repetition of descriptions of the work, the following list is given simply to indicate the scope:
- Research projects in the Centre involve all the wheat growing States of Australia.
- We are negotiating or have other on-going research and development agreements with commercial and research groups in the United States, United Kingdom and Argentina.
- The WheatRite® kit is being marketed on three continents.
At the 30 June 2002, the Centre had four full time and two part time headquarters staff. In addition there are 113 Research staff contributed to the Centre from Participant organisations.

Research
Five Program Managers, in consultation with the Managing Director manage the daily running of VAWCRC’s five programs. They are also supported by other experienced personnel from Participant organisations to provide an ongoing monitoring and assessment role for all projects.

Commercialisation
Peter Vaughan was appointed in February 2002 as the Centre’s Commercial Director. He is responsible for commercialisation and management of Centre IP.

Education, Training & Technology Adoption
Education and training as well as technology adoption (Program 5 of the Centre’s work) is managed by Clare Johnson.

<table>
<thead>
<tr>
<th>Programs</th>
<th>Program Managers</th>
<th>Extended Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program 1:</td>
<td>Dr Neil Howes</td>
<td>Mrs Felice Driver</td>
</tr>
<tr>
<td>Program 2:</td>
<td>Ms Di Miskelly</td>
<td>Prof Don Marshall</td>
</tr>
<tr>
<td>Program 3:</td>
<td>Dr Peter Sharp</td>
<td>Mr Andrew Kennett</td>
</tr>
<tr>
<td>Program 4:</td>
<td>Mr John Oliver</td>
<td></td>
</tr>
<tr>
<td>Program 5:</td>
<td>Ms Clare Johnson</td>
<td></td>
</tr>
</tbody>
</table>

Specified Personnel

<table>
<thead>
<tr>
<th>Name</th>
<th>Contributing Organisations</th>
<th>% time in Centre</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr William Rathmell</td>
<td>VAWCRC</td>
<td>100</td>
<td>Managing Director</td>
</tr>
<tr>
<td>Mr Peter Vaughan</td>
<td>VAWCRC</td>
<td>100</td>
<td>Commercial Director</td>
</tr>
<tr>
<td>Dr Neil Howes</td>
<td>SARDI</td>
<td>70</td>
<td>Manager, Program 1</td>
</tr>
<tr>
<td>Ms Di Miskelly</td>
<td>Goodman Fielder</td>
<td>50</td>
<td>Manager, Program 2</td>
</tr>
<tr>
<td>Dr Peter Sharp</td>
<td>Univ Sydney</td>
<td>50</td>
<td>Manager, Program 3</td>
</tr>
<tr>
<td>Mr John Oliver</td>
<td>NSW Agriculture</td>
<td>20</td>
<td>Manager Program 4</td>
</tr>
<tr>
<td>Ms Clare Johnson</td>
<td>VAWCRC</td>
<td>100</td>
<td>Manager, Program 5</td>
</tr>
<tr>
<td>Mr Deva Jayaretnam</td>
<td>Univ Sydney</td>
<td>50</td>
<td>Finance Manager</td>
</tr>
</tbody>
</table>
Scientific Journals


Studying frozen dough structure using low-temperature scanning electron microscopy.

Books and Book Chapters

Efficient testing of wheat quality at the milligram or megagram level.

Manage on-farm storage for a market edge.
Invited chapter in revised edition of "Stalk to Store", Kondinin.

Segment for inclusion in introduction to "Stalk to Store".

Domestic processors prefer grain stored under aeration.

Ng PKW, Wrigley CW (Editors). (2002). 
"Wheat-Quality Elucidation: The Bushuk Legacy". 

Wootton M, Batey IL, Wrigley CW. (2002). 
Royal Australian Chemical Institute, Melbourne. (CD-ROM and Book).

Grain-protein composition as a document of wheat-quality type: new approaches to varietal identification.

Processing quality requirements for wheat and other cereal grains.

Cereal-grain proteins.

Wrigley CW. (2002). 
Identification of varieties of cereal grains, based on morphology and protein composition.

Wrigley CW. (2002). 
Walter Bushuk: cereal chemist and mentor.

Boolets

NSW Agriculture Publication.

NSW Agriculture Publication.

NSW Agriculture Publication.

NSW Agriculture Publication.

Conference Papers

Cereals 2001 papers have been peer reviewed.

Flexibility of wheat use - benchmarking across Australia.

A compilation of available QTLs in Australian germplasm.

The high molecular weight glutenins and their relevance in white salted and yellow alkaline noodle texture.

The cutting edge of quality: A century of wheat breeding at Roseworthy.

Inheritance of wheat starch pasting viscosity.

Symmetrical flow-field fractionation as a valuable technique for characterization of the molecular size distribution of wheat glutenin protein.
In: "Cereals 2001, Proc. 51st Australian Cereal Chemistry Conference" (Eds M


Italian Australian Technological Innovations Conference & Exhibition, Melbourne. 28th March, 2002.


Moawad J, Southan MD. (2002). Investigations on increasing the conditioning efficiency of wheat.

Rathmell WG, Johnson C, Wrigley CW. (2002). The Value Added Wheat Cooperative Research Centre.


Skylas DJ, Wrigley CW. (2001). Proteome studies of wheat-grain endosperm.


Wrigley CW. (2002). Forty years of cereal chemistry research in the CSIRO Wheat Research Unit.
### PUBLICATIONS AND PRESENTATIONS

**North Ryde.**


**CRC Technical Reports**


**VAWCRC Project Reports**


**Other Publications**


**Thesis**

### Grants
During the year additional monies totalling $512,643 were received from the Grains Research and Development Corporation for research projects on:

- Amelioration of genetic factors which result in downgrading of wheat at receival.
- Flexibility of wheat use.
- Biochemical and genetic mechanisms for reducing zanthophyll oxidation in Asian noodles.
- Australian wheat for the sponge and dough bread making process.
- Strategies to replace flour chlorination as a treatment for cake flours.
- Gluten structure and modification for ingredient use.

A Post Doctoral Fellow was also funded by the GRDC to study a new technology for generating codominant markers without prior knowledge of DNA sequence.

$45,000 was received from Masterfoods for other specific research work.

### Awards
Dr Colin Wrigley has been acknowledged by the American Society for Information Science & Technology as a Highly Cited Researcher, based on the important scientific developments of the last two decades.

### Presentations

VAWCRC Patent Portfolio

<table>
<thead>
<tr>
<th>Filing Date</th>
<th>Application No</th>
<th>Title</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.11.99</td>
<td>15341/00</td>
<td>Detection of pre-harvest sprouting in cereal grains</td>
<td>Australia</td>
</tr>
<tr>
<td>11.11.99</td>
<td>2345403</td>
<td>Detection of pre-harvest sprouting in cereal grains</td>
<td>Canada</td>
</tr>
<tr>
<td>11.11.99</td>
<td>1137935</td>
<td>Detection of pre-harvest sprouting in cereal grains</td>
<td>Europe</td>
</tr>
<tr>
<td>11.11.99</td>
<td>2000-581446</td>
<td>Detection of pre-harvest sprouting in cereal grains</td>
<td>Japan</td>
</tr>
<tr>
<td>11.11.99</td>
<td>09/830876</td>
<td>Detection of pre-harvest sprouting in cereal grains</td>
<td>USA</td>
</tr>
</tbody>
</table>

VAWCRC Trade Mark Portfolio

<table>
<thead>
<tr>
<th>Title</th>
<th>Application No</th>
<th>Country</th>
<th>Filing Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEATRITE in Class 1</td>
<td>771211</td>
<td>Australia</td>
<td>24.08.98</td>
</tr>
<tr>
<td>WHEATRITE in Class 1</td>
<td>533941</td>
<td>Canada</td>
<td>05.02.99</td>
</tr>
<tr>
<td>WHEATRITE in Class 1</td>
<td>1063858</td>
<td>European</td>
<td>03.02.99</td>
</tr>
<tr>
<td>WHEATRITE in Class 1</td>
<td>2338037</td>
<td>USA</td>
<td>10.02.99</td>
</tr>
<tr>
<td>READRITE in Class 9</td>
<td>848572</td>
<td>Australia</td>
<td>01.09.00</td>
</tr>
<tr>
<td>READRITE in Class 9</td>
<td>1082362</td>
<td>Canada</td>
<td>10.11.00</td>
</tr>
<tr>
<td>READRITE in Class 9</td>
<td>76/178915</td>
<td>USA</td>
<td>11.12.00</td>
</tr>
</tbody>
</table>

VAWCRC Plant Breeder’s Rights Applications

<table>
<thead>
<tr>
<th>Variety</th>
<th>Application No</th>
<th>Status</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>QAL2000</td>
<td>2011/304</td>
<td>Accepted</td>
<td>Australia</td>
</tr>
</tbody>
</table>

VAWCRC

Copyright - Quality Assurance Program

The WheatRite® Test for pre-harvest sprouting.
PERFORMANCE INDICATORS AND MEASURES

Effective management of scientific, commercialisation, education and financial performance is an integral component of the Centre’s management. The considerable experience developed in the Quality Wheat CRC in monitoring these areas is being further refined in the Value Added Wheat CRC to provide high levels of performance review and management.

The Wheat CRC management is determined to reach and exceed as many as possible of the performance measures established in the Commonwealth Agreement. The list of performance measures below is taken from, and grouped, according to Schedule 6 of the Agreement. Progress each year is being quantified in the numbered bullet points (after each measure), to provide a cumulative record of the Centre’s success in achieving objectives.

Objectives of the Centre (specific industry need)
- Involvement of industry managers (totalling one full-time equivalent) in running the integrated program.
  1. In the first year, the Senior Management Group included representatives from Goodman Fielder (50%), Arnott’s (10%), C-Qentec Diagnostics Pty Ltd (10%) and the Grains Research and Development Corporation (GRDC - 10%). Four other members of the SMG have previously worked in industry, including the Managing and Commercial Directors (each 100%).

- Involvement of at least two overseas groups (commercial or research) in the program.
  1. Active collaborations have been negotiated, or are in progress, with Monsanto (UK and USA), John Innes Centre (UK), The United States Department of Agriculture, and Cibus Genetics (USA and France). C-Qentec Diagnostics Pty Ltd are negotiating distribution of WheatRite® and ReadRite® through commercial groups in Europe and the USA.

Objectives of the Centre (economic development)
- Increasing dollar value of economic benefit to industry and Participants (assessed by Participants).
  1. The benefits of consistent quality from the oven monitoring project have been estimated by commercial bakers at over $75,000 per annum in each bakery.

- Increasing commitment of the industry as a whole to the Centre (number of Participants and their aggregate cash and in-kind contribution).
  1. Aggregate additional cash contributions to the Centre during the year (from GRDC, MasterFoods and George Weston Foods) amounted to over $622,000.

- Integration of research in different parts of the wheat value-added chain increasing over time.
  1. Programs 1, 2, 4 and 5 have active involvement of managers and/or scientists from commercial Participants. The program 1 and 3 managers are approaching jointly the research towards new diagnostics. Industrial Participants attended our internal conference and provided valuable comments on the annual operating plan. Consultation is a requirement in project design.

Quality and Relevance of the Research Program
- Numbers of refereed journals, conference and other publications from CRC scientists maintained at current levels.
  1. The first years’ tally is 114 publications.

- Centre scientists’ invited presentations; home and overseas recognition of them maintained at current levels.
  1. Contributions of this type continued at levels similar to those of the Quality Wheat CRC. Notably, CRC scientists contributed to two thirds of the papers in the Wheat Molecular Marker issue of the Australian Journal of Agricultural Research (Volume 52, 11/12, ‘01).

- Quality of science relative to overseas research (particularly in multinationals), assessment by overseas and/or multinational company and/or peer review.
  1. Overseas scientists (including those in multinationals) have actively sought collaboration in VAWCRC programs (see above) – recognition of our contribution to global wheat science.

Strategy for Utilisation and Commercialisation of Research Outputs
- Maintenance of old commercialisation contracts and licence agreements and signing of new ones.
  1. Major contracts have been signed/maintained with C-Qentec Diagnostics Pty Ltd (WheatRite®) and George Weston Foods (“waxy” wheats). We have also progressed agreements for commercial production of QAL2000® biscuit wheat and commercialisation of its improved sister lines.

- Income from commercial users of the research per schedules 1 and 4 of the Commonwealth Agreement (from germplasm, diagnostics, educational and QA material etc).
  1. Royalty and contract income from QAL2000® and the WheatRite® and “waxy” agreements totalled $100,000 this year. Additional moneys were received from GRDC and MasterFoods for contract research this year (>-$980,000). Educational publication and CD sales exceeded $1,200 last year, and workshop registrations of around $10,000 were received.

- Returns from science and technology directly exploited by Participants (uptake of technology reported in Annual Report):
  1. Diagnostics and markers in breeding
  2. Process improvements
  3. Agronomic knowledge
  4. Quality Assurance technology
  5. Genetic and physiological knowledge
1 Process improvements are being implemented in mills and bakeries etc as direct results of Program 2 exploitation by Goodman Fielder (bakery process control) MasterFoods and others (microbiology). Commercial production of QAL2000® has provided direct benefits to Goodman Fielder and Arnott’s.

- Patents, trademark, copyright and other forms of IP protection (increasing portfolio, with costs borne by industry).
- One-third involves commercial participants and four projects (about 20%) involve overseas participants.

1 Plant Breeders’ Rights (PBR) were sought for several types of new germplasm. The WheatRite® and ReadRite® patent and trademarks were maintained, with responsibility for 50% of the costs passing to C-Qentec Pty Ltd.

1 Sixty employees and secondees attended our internal conference in February 2002. A further sixty industry staff attended our Enzymes in Industry and Probiotics workshops and ten wheat quality workshops reached 126 farmers.

1 Steady flow of technology-transfer publications and decision aids for industry reported in the Annual Report.

1 We produced manuals for the workshops, and supported publication of a set of six “Agnotes”, four farm budget handbooks, a durum wheat package for farmers, in addition to revised public and internal web sites.

1 Contract research agreements and consultancies in increasing numbers.

1 Major agreements this year (detailed above) with C-Qentec Pty Ltd, George Weston Foods, AustGrains and GRDC.

Education and Training

- PhD student numbers to targets in schedule 1 of the Commonwealth Agreement.
- There are eight postgraduate students at present in the Centre, of whom five have started in the year under review.

- Industry co-supervision of two-thirds of students also spending time in industry.
- All VAWCRC students are co-supervised by university and State Department of Agriculture scientists, and participate in project meetings focussing on end-use and industry requirements.

Collaborative Arrangements

- Three quarters of projects with multiple, commercial and/or overseas participants/sites.
- Ninety-five percent of current projects are multi-participant, one-third involves commercial participants and four projects (about 20%) involve overseas participants.

- Increasing leverage of Commonwealth funds from industry sources.
- The royalty income and contract research income detailed above has increased the leverage of Commonwealth cash funds.

Ownership of projects by Participants’ management and staff (manifested by involvement of Centre Management in annual performance appraisals of seconded staff).

1 Only informal appraisals have taken place. However it has been agreed that the MD will participate in the replacement/recruitment process in the University.

Resources and Budget

- Cash and in-kind budgets achieved or exceeded (per schedule 1 of the Commonwealth Agreement).
- Both cash and in-kind budgets are close to contract; an intentional underspend on cash (2-3%) is to allow flexibility in research planning for future years.

- Numbers of scientific and support staff engaged on Centre projects (per schedule 4 of the Commonwealth Agreement).
- Achieved. In the University there have been far-reaching staffing changes, but the overall in-kind contribution has stayed close to budget.

- Timeliness, flexibility and transparency of budget allocation decisions by Centre Management.
- The commercial evaluation of individual projects has begun, led by the Commercial Director and the Senior Management Group. Several Directors attended a workshop to finalise the Operating Plan, and all Commercial Participants were represented and provided input.

Management Structure

- Active case-by-case decision making on commercialisation at Board level.
- Specific Board approval has been obtained for the George Weston Foods (“waxy” wheat) agreement and general approval has been given for the Supporting Participants’ agreements. The specifics of the Commercialisation clauses in the Centre Agreement were finalised during the year in review by the Board.

Performance Evaluation

- Meeting and reporting against project milestones and outcomes.
- The Senior Management Group has monitored quarterly project reporting and achievement of milestones. A schedule of Program reviews by the SMG and by the Board has begun during the year in review.

Specific Performance Indicators

These relate to the scientific program of the Centre and were drawn up and appear in schedule six of the Commonwealth Agreement. They are listed in the table on the following page. Achievement is assessed in the right hand column on a scale of 1- 5, where:

1 = Progress greatly exceeding expectations
2 = Progress exceeding expectations
3 = Progress on track
4 = Slower progress than expected
5 = Little or no progress.

Where N/A is written, it is too soon or inappropriate to assess achievement.
## Performance Indicators

<table>
<thead>
<tr>
<th>Program</th>
<th>Performance Indicator</th>
<th>Measurement Criteria</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Diagnostics</td>
<td>Flow of new quality diagnostic tests as demanded by industry. Latest world-class science being deployed.</td>
<td>• New test available every 2-3 years.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Number of licensing agreements.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Royalty/income flow to Centre.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Uptake by international organisations.</td>
<td>3</td>
</tr>
<tr>
<td>2: Products and processing</td>
<td>Practical methods for blending to enhance quality. Innovative applications of speciality wheats.</td>
<td>• Number of organisations employing technology.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Novel foods and wheat-derived products.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improved efficiency and reduced wastage in processing.</td>
<td>2</td>
</tr>
<tr>
<td>3: Proteomics/genomics</td>
<td>New genes for wheat quality detected. New environmental determinants of quality detected. Acceleration of application of molecular markers to improved wheat quality.</td>
<td>• Number of new genes identified.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Annual increase in rate of uptake by Germplasm Program</td>
<td>1</td>
</tr>
<tr>
<td>4: Germplasm production, agronomy and storage</td>
<td>Improved application of agronomic knowledge by growers. Wheats with specific qualities beneficial for processing.</td>
<td>• Increased deliveries into premium grades</td>
<td>3 (N/A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New germplasm available to breeders.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• VAWCRC germplasm appearing in wheat varieties throughout Australia.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Quality varieties more rapidly available to growers.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Genetic stocks with novel qualities available to breeders.</td>
<td>2</td>
</tr>
<tr>
<td>5: Education and Technology Adoption</td>
<td>Number of postgraduates trained. Industry training for postgraduates uptake of Centre generated knowledge.</td>
<td>• Postgraduate students fill all appropriate positions</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Target of 15 PhDs per 3 years.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Postgraduates familiar with IP- and business management.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Participants and trainees report effective uptake of Centre generated knowledge.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Number of workshops/seminars – minimum of 6 per year.</td>
<td>2</td>
</tr>
<tr>
<td>Business Management</td>
<td>Effective use of resources. Commercialisation of outputs as planned.</td>
<td>• Exception report where projects do not meet objectives.</td>
<td>4 (N/A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Competitive tendering for projects.</td>
<td>3</td>
</tr>
<tr>
<td>Collaborative arrangements</td>
<td>Proportion of projects with multi-site collaboration.</td>
<td>• Majority of projects with multi site collaboration of research or post-graduate student supervision.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Minimum of 80% of all publications to be by multi-party contribution.</td>
<td>1</td>
</tr>
</tbody>
</table>

The Performance Indicators and Measurement Criteria in the above table require modification as the Centre progresses. In the first year, we have focussed on revising the commercial and business structure of the Centre whilst building and maintaining momentum in the science and education programs. In next year’s report we will measure Business Management against the following criteria:

- Quantitative commercial measures and portfolio analysis used to assess and rank projects.
- Progress and signing of agreements to develop and commercialise Centre outcomes.
- Enhanced intellectual property portfolio.
- Adherence to budgets and compliance guidelines.

The Program 2 (Products and Processing) Performance Indicators will next year include:

- Improvements to product quality, revenue and profit resulting from enhanced processing technology.

The Program 3 (Proteomics/Genomics) Measurement Criteria will include:

- Increased uptake of enhanced marker and other biotechnology by wheat breeding programs.
DIRECTORS’ DECLARATION

In accordance with a resolution of the directors of Value Added Wheat CRC Limited, we state that:

In the opinion of the directors:

(a) the financial statements and notes of the company and the consolidated entity are in accordance with the Corporations Act 2001, including:

   (i) giving a true and fair view of the company’s and consolidated entity’s financial position as at 30 June 2002 and their performance for the year ended on that date; and

   (ii) complying with Accounting Standards and Corporations Regulations;

(b) There are reasonable grounds to believe that the company will be able to pay its debts as and when they become due and payable.

On behalf of the Board

Dr. W. Rathmell
Managing Director
Sydney, 13 September 2002

TO THE MEMBERS OF VAWCRC

SCOPE

We have audited the financial report of Value Added Wheat CRC Limited for the year ended 30 June 2002, as set out on pages 3 to 15 including the Directors’ Declaration. The financial report includes the financial statements of Value Added Wheat CRC Limited, and the consolidated financial statements of the consolidated entity comprising the company and the entity it controlled at the financial year end. The company’s directors are responsible for the financial report. We have conducted an independent audit of the financial report in order to express an opinion to the members of Value Added Wheat CRC Limited.

Our audit has been conducted in accordance with Australian Auditing Standards to provide reasonable assurance whether the financial report is free from material misstatement. Our procedures included examination, on a test basis, of evidence supporting the amounts and other disclosures in the financial report, and the evaluation of significant accounting estimates. These procedures have been undertaken to form an opinion as to whether in all material respects. The financial report is presented fairly in accordance with Accounting Standards, other mandatory professional reporting requirements and statutory requirements, so as to present a view which is consistent with our understanding of the company and the consolidated entity’s financial position and performance as represented by the results of their operations and their cash flows.

The audit opinion expressed in this report has been formed on the above basis.

AUDIT OPINION

In our opinion, the financial report of Value Added Wheat CRC Limited is in accordance with:

(a) the Corporations Act 2001 including:

   (i) giving a true and fair view of the company’s financial position as at 30 June 2002 and of its performance for the year ended on that date; and

   (ii) complying with Accounting Standards and the Corporations Regulations 2001; and

(b) other mandatory professional reporting requirements.

Ernst & Young

Partner
Sydney, 13 September 2002
Work in Program 3 on microarray-based molecular markers in wheat. This “DArt™” technology has great promise for cost effective whole genome profiling in wheat breeding programs.

Value Added Wheat
CRC Limited

Riverside Corporate Park,
1 Rivett Road, North Ryde NSW 2113
Phone: 02 9490 8488
Fax: 02 9490 8503
Email: hwarwick@wheatcrc.com.au
Website: www.wheat-research.com.au
Postal Address:
Locked Bag No 1345
PO North Ryde NSW 1670

Acknowledgement: The pictures in this report were kindly supplied by current and past participants in VAWCRC and QWCRC.
Value Added Wheat
CRC Limited

Riverside Corporate Park,
1 Rivett Road, North Ryde NSW 2113
Phone: 02 9490 8488
Fax: 02 9490 8503
Email: hwarwick@wheatcrc.com.au
Website: www.wheat-research.com.au
Postal Address:
Locked Bag No 1345
PO North Ryde NSW 1670