



Department of
Primary Industries

Yanco Agricultural Institute – Horticulture, Biosecurity, Water & Irrigation, and Southern Cropping Systems



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Yanco Agricultural Institute – Horticulture, Biosecurity, Water & Irrigation, and Southern Cropping Systems

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More information

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Foreword

The 'Yanco Agricultural Institute – Horticulture, Biosecurity, Water & Irrigation, and Southern Cropping Systems' booklet provides stakeholders with an overview of the resources, structure, people, programs and projects of these four Units that are located at the Yanco Agricultural Institute. The staff of the Research Services Unit are also profiled.

This booklet is available as an electronic document on the Department's website at www.dpi.nsw.gov.au.

The Southern Cropping Systems, Horticulture and the Water & Irrigation Units are three of four units located within the Plant Systems Branch. The Northern Cropping Systems Unit is the fourth.

The Southern Cropping Systems Unit's purpose is to contribute to the profitability of cropping systems in southern NSW by conducting research projects developed and partnered with industry stakeholders and collaborators. Similarly, the Horticulture Unit's purpose is to support a sustainable and profitable horticulture industry across NSW.

The Water and Irrigation Unit develops land and water management practices for NSW irrigation and rainfed industries that increase economic activity and farm profitability. This is achieved through multi-disciplinary research and development to increase the productivity and sustainable use of available water supplies and minimise risks of adverse impacts from agricultural water use.

The Plant Biosecurity Research Group is part of the Plant Biosecurity and Product Integrity Branch of DPI Biosecurity. This group is responsible for research to minimise the impact of biosecurity threats that could reduce the productivity and competitiveness of plant-based agricultural industries.

The Research Services Unit is part of DPI Agriculture and is responsible for managing NSW DPI facilities and assets by providing administrative, maintenance and farm-management support to research and other NSW DPI activities.

For more than 100 years NSW DPI has been a significant contributor to agricultural production through its research, development and extension activities across the State. This has been achieved thanks to the foresight of previous generations to develop and resource research facilities. Notably, the Department's research outputs are both nationally and internationally recognised.

Dr Shane Hetherington
Director Horticulture
Orange

Peter Jessop
Manager, Research Services – Southern
(Wagga Wagga, Yanco, Griffith, Narrandera and Dareton)
Wagga Wagga

Dr Tracey MacDonald
Director Water & Irrigation
Orange

Deb Slinger
Director Southern Cropping
Wagga Wagga

Dr Mark Stevens
Institute Director and Principal Research Scientist
Yanco

Contents

Foreword.....	i
Contents	ii
Yanco Agricultural Institute	1
Our Structure	2
Southern Cropping Systems—Staff	3
Horticulture—Staff.....	10
Water & Irrigation—Staff	12
DPI Biosecurity—Staff	15
Research Services—Staff	17
Southern Cropping Systems—Programs	21
Program 1: Germplasm improvement.....	21
Program 2: Farming systems management.....	22
Program 3: Plant protection	23
Program 4: Supply chains and market access.....	24
Southern Cropping Systems—Projects.....	25
Program 1: Germplasm improvement.....	25
Horticulture—Programs	28
Program 1: Germplasm improvement.....	28
Program 2: Farming systems management.....	28
Program 3: Plant protection	29
Program 4: Supply chains and market access.....	30
Horticulture—Projects	31
Program 2: Farming systems management.....	31
Program 3: Plant protection	31
Program 4: Supply chain and market access	31
Water & Irrigation—Programs	32
Program 1: Water productivity	32
Program 2: Water sustainability	33
Water & Irrigation—Projects	34
Program 1: Water productivity	34
DPI Biosecurity—Projects	36

Yanco Agricultural Institute

The Yanco Agricultural Institute (YAI) has been the major research institute supporting the development of irrigated agriculture within the Murrumbidgee Irrigation Area (MIA) for over 100 years. Development of profitable and sustainable irrigated farming systems remains a key focus. Research teams actively collaborate with local farming systems groups and industry partners, as well as with national and international research collaborators. Broadacre irrigated crop and horticulture research and development teams from both DPI Agriculture and



DPI Biosecurity are co-located at the YAI along with the Tocal College Yanco Campus, NSW DPI Regulatory Officers, and the Office of Environment and Heritage's Natural Resource Laboratory.

The Institute is situated in the centre of the Murrumbidgee Irrigation Area, and between Wagga Wagga and Griffith, on 813 ha of mixed irrigation and dryland farming country. It is primarily used for research into rice, wheat, soybean, canola, citrus, and vegetables; a new planting of hazelnuts and cotton in spring 2014 will broaden research opportunities. It has facilities and equipment for drip, flood, travelling and siphon irrigation, as well as row and broadacre cropping on a wide range of soils from grey self-mulching clays to light sandy soils. Rice physiology and entomology trials are conducted at the Institute and the Rice Breeding Program is concentrated at the Leeton Field Station, a separate 242 ha irrigation property located 7 km west of YAI. With an elevation of 136 m, the Institute experiences hot, dry summers and cool, damp winters. Temperature can range from a minimum of -3°C in winter to a maximum of 42°C in summer, with an average rainfall of 433 mm. Irrigation requirements are supplied from the Burrinjuck and Blowering Dams via the Murrumbidgee River and an extensive canal system.

YAI is well positioned to conduct industry relevant and scientifically valid research. Its ISO 9000 accredited laboratories are equipped for wet chemistry, agronomy, entomology, and plant pathology and physiology research. Glasshouses, shade houses, temperature-controlled rooms and large driers ensure that the challenges plant industries are facing with limited resources and a variable climate can be met by targeted applied research. A nine metre tall suction trap is available to monitor insects.

YAI is the home for the internationally renowned Temperate Rice Breeding Team, which is responsible for the breeding of all commercial rice varieties grown in Australia. The breeders work closely with the Cereal Chemistry Laboratory Team assessing the quality attributes of promising lines to ensure the varieties meet food processing and consumer requirements. With the recent development of molecular research capability and collaboration with the well-equipped molecular laboratory at the Wagga Wagga Agricultural Institute, the Rice Research Group is looking at reducing the time-to-release of new varieties.

The agronomy researchers design trials to provide recommendations on how best to optimise soil water and nutrient resources to maximise yields, as well as crop sequencing and double cropping trials. These trials are aimed at improving industry profitability and sustainability in a time of increasingly limited resources. The Water and Irrigation Team conducts research and development in partnership with industry to improve water productivity, develops management systems that minimise adverse impacts of agriculture on water and ecosystems, and informs the development of water policy and planning.

The Soybean Evaluation Team select varieties best suited to the MIA and conduct agronomy trials to develop recommendations for maximising the potential of the selected varieties. YAI is one of the three national GRDC funded cereal evaluation sites where research is focused on drought tolerance and understanding the interaction between the environments, water and cereal genetics. The Managed Environment Facility Group provide a service to the successful GRDC funded research teams to plant, manage and collect a wide range of data, primarily from wheat varieties, under a variety of water stress conditions, which is managed with a travelling irrigator and rainout shelters. The Breeding, Germplasm Evaluation, Agronomy, Crop Protection and Crop Development Groups each conduct trials to answer questions or provide information on the best performing varieties for growers.

Our Structure

Director Southern Cropping, Deb Slinger, Wagga Wagga			
Leader Southern Irrigated Systems, Dr Sandra McDougall, Yanco			
Rice Breeder, Dr Peter Snell, Yanco Technical Officers: Fred Ciccia, Greg Napier, Kim Philpot Technical Assistants: Minna Russell Nathan Doss	Cereal Chemist (Rice), Dr Laura Pallas, Yanco Cereal Chemist (Rice), Dr Rachelle Ward, Yanco Technical Officers: Margrit Martin, Kylie Elliott Technical Assistants: Leanne Johnston, Yuki Sims	Technical Officer, (Managed Environment Facility), Kathryn Bechaz, Yanco Technical Assistants: Peter Davidson, Dionne Wornes	Research & Development Agronomist Irrigated, Tony Napier, Yanco Technical Officer: Daniel Johnston Technical Assistant: Glenn Morris
Rice Breeder, Ben Ovenden, Yanco	Research & Development Agronomist Irrigated, David Troidahl, Yanco	Soybean Research Agronomist, Mark Richards, Wagga Wagga Field Officer: John Dando	Dr Sandra McDougall, Leader Irrigated Cropping Systems, Yanco Technical Officer: Sarah Beaumont Technical Assistant: vacant
Director Horticulture, Dr Shane Hetherington, Orange			
Leader Southern Horticulture, vacant			
Research Horticulturist, Temperate Nuts, Jacqueline Simpson Technical Officer: Alan Boulton	Entomologist, Dr Jianhua Mo, Yanco Technical Assistant: Scott Munro	Development Officer Citrus Industry, Andrew Creek, Yanco	Professional Officer (Publications), Valerie Draper, Yanco
Director Water and Irrigation, Dr Tracey MacDonald, Orange			
Leader Water Research, Peter Regan, Orange			
Leader Water Policy, Planning and Development, Anthea McClintock, Orange			
Research Agronomist, Brian Dunn Technical Assistants: Craig Hodges Chris Dawe	Research Officer, Dr Harnam Gill	Research Officer Irrigation, John Smith Technical Officer: Tina Dunn	Irrigation Development Officer Southern Broadacre, Robert Hoogers
Director Plant Biosecurity and Product Integrity, Dr Satendra Kumar, Orange			
Manager Plant Biosecurity, Dr Leigh Pilkington, Ourimbah			
Principal Research Scientist (Entomology), Dr Mark Stevens Technical Officer: Glen Warren Technical Assistant: Rachael Wood		Research Officer (Plant pathology), Andrew Watson	
Director Research Services Branch, Tim Sandford, Orange			
Manager Research Services – Southern, Peter Jessop, Wagga Wagga			
Farm Manager, Joe Valenzisi, Yanco			
Farm Supervisor: John Fiegert Maintenance Supervisor: Gary Ryan Operational Staff: Bill Conroy, Kyle Dodds, John Field, Garry Heath Allen Hone, Ronald Morris, Neville Smith, Richard Smith		Office Supervisor, Leonie Napier	
		Clerk: Luciana Borese Administration Assistant: Leanne Polsen	
		Accommodation Manager, Charmaine Lee	

Southern Cropping Systems—Staff

Research Officers

Dr Sandra McDougall, Leader Southern Irrigated Systems

Dr Sandra McDougall is a member of the Southern Cropping Systems Management Team and leads the irrigated broadacre research and development staff in southern NSW. She works collaboratively with growers, industry, research scientists and extension specialists to find science-based, practical solutions to grower recognised production issues. Sandra's professional interests are in developing integrated pest management systems, including turning research outputs into practical information, and training tools to facilitate adoption of new practices. This has recently broadened from vegetable integrated pest management to integrated crop management and broadacre irrigated crops. A recent achievement is obtaining funding for a Southern Cotton Integrated Pest Management project. This project will focus on thrips management and review whether the integrated pest management recommendations developed in the north are applicable in the southern cotton production areas.

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Tony Napier, Research & Development Agronomist Irrigated

Tony Napier has a Bachelor of Applied Science (Agriculture) and has worked in the agricultural industry for over 30 years. Tony recently joined the Southern Cropping Systems Program and has a broad agricultural background with proven research capabilities. He spent the previous 15 years with NSW DPI working with the horticultural industry as an advisory officer for vegetables. As a District Horticulturist, Tony delivered a high quality advisory program and managed industry funded projects. Since joining the Southern Cropping Systems Unit as a Research and Development Officer, Tony has been working on two GRDC co-funded projects. The first project is aimed at increasing irrigated cereal and canola production by developing variety specific agronomic packages for the different southern irrigated growing regions. The second project is evaluating the agronomic and management factors required to best manage double cropping and crop sequencing under irrigation.

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Ben Ovenden, Rice Breeder

Ben Ovenden is a rice breeder for the Australian Rice Partnership, based at the Yanco Agricultural Institute in Southern NSW. The Australian Rice Partnership aims to release varieties with greater water use efficiency and seeks to achieve this through conventional selection for reproductive cold stress tolerance and shorter growth duration. Ben has previously been employed as a Research Officer working on an Irrigated Winter Cereals Project with NSW DPI evaluating elite bread wheat, Durum wheat, barley and triticale breeding material for performance under high-input conditions. Ben graduated with a Bachelor of Science and Bachelor Applied Science (Hons) from Charles Sturt University in 2005. He began his PhD program in 2009 studying the physiology and genetic architecture of carbohydrate accumulation in wheat. Ben's research interests include conventional plant breeding and quantitative genetics, marker-assisted selection, genome wide association mapping and genomic selection, and providing research outcomes to growers.

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Dr Laura Pallas, Cereal Chemist



Dr Laura Pallas leads the Grain Quality Group in the development of new Australian rice varieties. Laura has a Bachelor of Science in Biological Engineering with processing emphasis from Georgia University. She received her Master's in Food Science from the University of California, and researched physical and chemical interactions of blended edible films. Laura returned to The University of Georgia for her PhD in Food Science, developing a blueberry drying process for South Georgia Blueberry Growers while studying the relationship between drying processes and antioxidant activity of blueberries relating to moisture, sensory and nutritional properties. In the past four years, Laura has applied her research knowledge to develop and improve a suite of gluten-free breakfast cereals, biscuits and bars for Freedom Foods; and a children's rice-snack range and multigrain square cake

range for SunRice (Leeton NSW). Laura's passion is bridging research and development with industry to achieve quality products with economical returns for growers and manufactures. Laura looks forward to continuing the research and measurements on potential rice varieties to ensure quality performance.

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Mark Richards, Soybean Research Agronomist



Mark Richards became the Soybean Research Agronomist at Wagga Wagga in 2015. With 25 years of experience in agricultural research with NSW DPI, Mark started his career with the Department as a Technical Assistant on sub-clover evaluation in 1989. In 1992 he moved to the Lupin Breeding Program as a Technical Officer. With the closure of the Lupin Breeding Program in 2009, Mark now leads the NSW evaluation node for narrow-leaf lupin improvement in Australia as well as a project evaluating remaining *albus* breeding program material from the closed NSW Breeding Program. He also leads the Southern Irrigated Soybean Agronomy Project and is the southern node leader for the Australian Soybean Breeding Program. He was involved in the release of *Goulburn* and *Riverina* sub clover, and numerous lupin varieties,

namely *Wonga*, *Jindalee*, *Quilinock*, *Jenabillup*, *Mandelup*, *PBA Gunyidi*, *PBA Barlock*, *Luxor* and *Rosetta*. Mark's work requires skills in project management and a capacity to work with a diverse range of stakeholders. He has developed a sound understanding of southern cropping systems by working closely with individual producers, producer groups, advisors and researchers.

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Dr Peter Snell, Rice Breeder



Dr Peter Snell has 13 years rice-breeding experience at Yanco since his appointment in 1998 and is responsible for the release of five commercial rice varieties. He has implemented a wide range of new techniques including increasing the number of quantitative measures recorded throughout small plot testing, and increased accuracy in determining breeding value through the use of restricted maximum likelihood statistical methods to account for field-based spatial variation and lab-based temporal variation. He has re-introduced backcrossing into the program for germplasm enhancement and stress tolerance. Peter is the lead researcher evaluating aerobic rice varieties for temperate and tropical production in Australia and has a Bachelor of Agricultural Science (Hons 1) and a PhD in crop physiology. His

current projects include Rice Cold Tolerance for Yield Stability and Water Use Efficiency, Rice Improvement, and Enhancing Rice Germplasm Development for Transforming Production Systems in Cambodia and Australia. Peter's interests include rice breeding and genetics, genetic improvements in rice water productivity, and genetic improvements through selection to abiotic and biotic stresses.

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David Troidahl, Research & Development Agronomist Irrigated

David Troidahl is a Research and Development Agronomist in Southern Irrigated Cropping Systems at Yanco. David works closely with the rice industry and other irrigated crops, and has been involved in the publication of various rice factsheets and the 'Rice Field Guide to pests, diseases and weeds in Southern NSW'. Previously he has been the NSW DPI, Riverina Fruit Fly Campaign Coordinator as well as the District Horticulturist (vegetables). Prior to this David worked for over 20 years in the NSW DPI Rice Breeding Program, which involved working with the rice industry and coordinating rice variety trials on site at Yanco and throughout the NSW rice growing region. During this time he was a Project Leader with the Rice Cooperative Research Centre investigating the effects of salinity on rice varieties. He has an excellent knowledge of the Riverina area and its diverse agricultural industries.

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Dr Rachelle Ward, Cereal Chemist

In 2008 Dr Rachelle Ward graduated from the University of Sydney with a PhD and started as a Rice Cereal Chemist with NSW DPI. Rachelle is primarily involved in the Australian Rice Partnership, and also has experience in co-supervision of PhD students with her links with Southern Cross University, The University of Western Sydney, Charles Sturt University and University of New South Wales. The Australian Rice Partnership is aimed towards the development of new Australian rice varieties that exceed agronomic and quality performance of existing varieties. Rachelle supports the grain quality arm that analyses breeding lines for a suite of molecular, physical, compositional and cooking qualities that are used by breeders to make breeding selections to meet various quality types. Underpinning these direct outcomes is a body of research that ensures the analyses conducted are relevant, efficient and sound. Her work has been presented at conferences and in peer reviewed journal articles.

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Technical Officers

Sarah Beaumont, Technical Officer (IPM)



Sarah Beaumont joined NSW DPI in 2015 as a Technical Assistant on the Cotton Integrated Pest Management (IPM) Project. Sarah completed her Bachelor of Science (Hons) in 2013 where she developed an interest and skills in entomology. Her role involves collecting and identifying invertebrates to determine seasonal patterns of pest and beneficial communities in southern cotton crops. She is currently monitoring early season thrips threshold trials and simulated thrips defoliation damage to determine if IPM recommendations for northern cotton correspond to southern cotton requirements. Outside of the cotton season Sarah assists with maintaining insect cultures and conducting glasshouse trials to better understand the damage caused by sucking insects on cotton seedlings. Sarah is also involved in the Australian Centre for International Agricultural Research (ACIAR) project— Integrated crop management (ICM) to enhance vegetable profit—which is looking at the validity of different control options for whitefly in melons.

Kathryn Bechaz, Technical Officer (Managed Environment Facility)



Kathryn Bechaz holds the position of Technical Officer managing the Managed Environment Facility (MEF) at the Yanco Agricultural Institute. Her brief is to manage and provide support for field research projects directed towards identifying adaptive traits and management strategies for improved productivity of wheat growing in water limited or drought-prone environments. Research projects from CSIRO, the Western Australia Department of Agriculture and Food, NSW Department of Primary Industries, University of Adelaide, University of Sydney and AGT Wheat Breeding are being evaluated at the Yanco MEF site. Kathryn's professional interests include being involved in research that benefits growers, liaising with like-minded people and leading a team that is well organised, skilled and provides results efficiently. Kathryn is often called upon to provide technical advice to the Narrabri (NSW) and Merredin (WA) MEF sites.

Alan Boulton, Technical Officer (Horticulture)



Alan Boulton has worked as a Technical Officer at Yanco Agricultural Institute since 1996. He initially worked for 12 months with the Rice Physiology Team and then for 15 years with the National Vegetable Industry Centre. For the last three years Alan has been largely working on the Soybean Breeding and Agronomy Program. Alan has a Bachelor of Science from Monash University. He has expertise in planting, growing and managing the agronomy of a wide range of broadacre and vegetable crops grown under a range of different management systems. He has considerable skills in trial design, data collection, data management and analysis. Alan also has specialist skills in aphid, thrips and weeds identification. Alan is currently working on both soybean and horticulture projects.

Fred Ciccio, Technical Officer (Rice Breeding)



Fred Ciccio started with the NSW DPI Rice Breeders in 1985, carrying out field work and working on rice storage. He then moved to the Farm Section where he managed the irrigation of all crops including the Rice Breeding Program crops for six years. From 1991 to 1996, Fred worked as a Field Assistant with the Rice Breeding Program where he liaised with farmers, sowed trials, sampled and harvested plots, and recorded moisture. Fred currently works as a Technical Officer with the Rice Improvement and Rice Breeding Program where he is responsible for field setup, spraying, irrigation, fertilising, assisting with sampling, recording data and plot harvesting. He has completed several courses relevant to his position.

Kylie Elliott, Technical Officer (Rice Quality)

Kylie Elliott joined the Rice Cereal Chemistry Team at Yanco in 2014. Prior to this she had worked with NSW DPI intermittently since 1987. Kylie has worked at EMAI, Wagga Wagga, Orange and different sections at Yanco. In her current position, Kylie is working in the molecular section of the Plant Breeding Program. Kylie has always had an interest in plant improvement due to a long association with rice breeding and the rice industry. She has a Bachelor of Applied Science (Biotechnology) Degree from Charles Sturt University. Kylie's primary roles include DNA extractions, PCRs, running agarose gels and scoring for various marker validation projects. An interesting project she is currently involved with is finding molecular markers for coloured rice such as purple and red rice.



Daniel Johnston, Technical Officer (Agronomy)

Daniel Johnston works on the GRDC co-funded project evaluating the agronomic and management factors required to best manage double cropping and crop sequencing under irrigation. He undertakes all aspects of everyday management and preparation of field trials and the use of new technologies. Daniel began on this project in 2015 and was previously with the Rice Breeding Team where he was primarily responsible for the management of district and breeding trials. Daniel also worked with yield stability for cold tolerance and water use efficiency, and increased the production of glasshouse trials by implementing heating coils in the tanks. Daniel has been with the Department since 2002, working on the Permanent Beds for Irrigated Rice-Wheat and Alternative Systems in Australia and India Project before joining the Rice Breeding Team in 2008. Daniel graduated with a Bachelor of Science (Agriculture) in 2011 through CSU Wagga Wagga and has been in the industry for 26 years, progressing from the private sector where he managed an irrigation property attaining high performing rice yields.



Margrit Martin, Technical Officer (Rice Quality)

Margrit Martin is the Senior Technical Officer for rice-grain quality in the Australian Rice Partnership. She has 18 years of experience in this field and previously worked on two GRDC funded wheat projects. In 1970 Margrit qualified as a Laboratory Technician with Ciba Geigy in Switzerland and in 1980 completed a Dipl. Ingenieur Agronom, Eidgenoessische Technische Hochschule in Zuerich. Her responsibilities range from training new technical staff, to improving and introducing new methods to measure rice-quality parameters. She works closely with the Rice Breeding Team and much of her work has been presented in reviewed journal articles or at conferences.



Greg Napier, Technical Officer (Rice Breeding)

As part of the Rice Breeding Team, Greg Napier is involved in the pre-breeding stage of the Rice Breeding Program. His duties include crossing rice varieties with different milling and agronomic traits to produce first generation (F1) material in a glasshouse environment. These F1 seeds will be grown and visually inspected in a field environment. He is also responsible for the maintenance and continual replacement of the rice seeds of the international rice varieties in the collection, which is held in cold storage. This collection of international rice varieties is the source of all the genetic material used in the breeding program. Greg's interest lies in the crossing program in the glasshouse that produces the F1 seeds for later field inspection. Recent achievements include upgrading the pre-breeding program to include a more significant number of F1 seeds with fragrant traits.



Kim Philpot, Technical Officer (Rice Breeding)



Kim Philpot joined NSW DPI in 2000 and worked as a Technical Assistant in citrus entomology and later in rice entomology. As a Technical Officer in 2002 she worked with the National Vegetable Industry Centre investigating irrigation systems for carrots and onions. From 2003, Kim worked in Cereal Chemistry on rice quality evaluation, assessing both physical and cooking properties of rice crossbreds and advanced breeding lines from the Rice Breeding Program. Kim was also responsible for implementing a DNA extraction technique for high purity DNA which allowed a wider range of molecular markers to be introduced into the Program. In 2011, Kim became a member of the Rice Breeding Team working in yield stability and investigating cold induced sterility. She has been directly involved in the introduction of an image-analysis system for detecting and counting viable and aborted pollen. Currently Kim is looking into *in vivo* pollen germination using fluorescence microscopy.

Technical Assistants

Peter Davidson, Technical Assistant (Managed Environment Facility)



Peter Davidson is a Technical Assistant with the Managed Environment Facility (MEF) Project at Yanco (appointed 2013). He carries out core measurements for the Project's field trials. Core measurements are establishment counts that include NDVI biomass data and photos, neutron probe moisture measurements, anthesis data, harvest-index data, and yield and quality traits at harvest. Peter's other responsibilities include general management and preparation of the trials (sowing, spraying, irrigating and harvesting). Research projects from CSIRO, the Western Australia Department of Agriculture and Food, NSW DPI, University of Adelaide, University of Sydney and AGT Wheat Breeding are being evaluated at the Yanco MEF site. Peter's interests lie in providing accurate information so project milestones are met.

Nathan Doss, Technical Assistant (Rice)



Nathan Doss joined the Rice Breeding Team as a Technical Assistant at Yanco in February 2013. He undertakes a range of duties supporting research trials from cleaning and packing seed, to sowing trials at both the Leeton and Jerilderie sites. Nathan also takes part in harvest preparation of individual trials, and the provision of documentation that is extremely important to the successful development and eventual release of commercially viable rice varieties. When required, Nathan is responsible for water management of the Leeton Field Station trials and maintenance of equipment used throughout the season. Nathan has undertaken training in various courses through both Tocal College and the private sector including safe tractor handling, senior first aid and forklift training.

Leanne Johnston, Technical Assistant (Rice Quality)



Leanne Johnston joined the NSW DPI Rice Cereal Quality Team in 2012 bringing 13 years of experience and training in the finance industry. Consequently she has an attention to detail, an aptitude for figures and an appreciation of accuracy. Living and working in the district for almost 20 years, Leanne understands the importance of superior quality and better agronomic rice varieties. Her focus is based around the production of quality data each year for breeder assessment through sample milling, and the measurement of physical and cooking properties of the various standards and breeding lines undergoing development. During the wet chemistry stage of the program she works primarily with the Rapid Visco Analyser and the Texture Analyser for assessment of cooking and texture attributes. Leanne is currently examining cooked grain texture and its correlation with existing testing methods.

Glenn Morris, Technical Assistant (Irrigated Cereals and Canola)

Glenn joined NSW DPI at Yanco Agricultural Institute in 1995 as a Regulatory Officer in the Queensland Fruit Fly Eradication Program. In 2014 Glenn began work in the Southern Irrigated Cropping Program as a Technical Assistant on an Irrigated Cereals and Canola project. The project aims to identify the most suitable varieties and the growing practices required to achieve maximum yields for irrigated cropping. Glenn's role in the project is to conduct the daily operations program where he is involved in the sowing, irrigating, monitoring, data collection and harvesting operations.



Minna Russell, Technical Assistant (Rice Breeding)

Since 2012 Minna Russell has worked closely with the Rice Breeding Team gaining experience in all areas of rice trial preparation. In this position her duties include all aspects of trial work such as sowing, harvesting, weighing and moisture testing, measuring lengths and heights of individual rice block/plots as well as labelling and packing rice trials. Minna is competent in operating both field and laboratory equipment and has completed courses relevant to her position.



Yuki Sims, Technical Assistant (Rice Quality)

Yuki Sims joined the Rice Breeding and Quality Program in 2010. She is a key member involved in the Quality Evaluation Program (QEP) within the Rice Cereal Chemistry Team, assisting with rice milling and wet chemistry measurements. Born in Japan where rice is widely grown and a staple of the diet, Yuki has a passion for and interest in the chemistry and mechanisms that affect the cooking and eating qualities of rice. In addition to QEP, one of Yuki's projects involves exploring the relationship between gel temperature and cooking time of rice to cooked rice texture. With the milling portion of the 2014 Rice QEP season recently completed, she is currently engaged in the subsequent wet chemistry side of the Rice QEP.



Dionne Wornes, Technical Assistant (Managed Environment Facility)

Appointed in 2012, Dionne Wornes is assigned to the Managed Environment Facility Project at Yanco. Dionne carries out core measurements for field trials included in the Managed Environment Facility Project. Core measurements are establishment counts that include NDVI biomass data and photos, neutron probe moisture measurements, anthesis data, harvest-index data, and yield and quality traits at harvest. Research projects from CSIRO, the Western Australia Department of Agriculture and Food, NSW DPI, University of Adelaide, University of Sydney and AGT Wheat Breeding are being evaluated at the Yanco MEF site. Dionne's interests lie in assessing a diverse range of varieties/lines for the respective projects and liaising with research leaders.



John Dando, Field Officer (Soybeans)

John started with NSW DPI at the YAI in 1997 where he specialised in spray-application technology. John was involved with the SMARTtrain Program for six years, instructing in spray-application techniques. In 2004 John moved to the Soybean Breeding Program. He is now involved in conducting the daily operations of the Program where he conducts sowing, irrigation, monitoring, data collection and harvesting of trials. Recently John has been involved with the Irrigated Cereal and Canola Project as well as the Irrigated Crop Sequencing Project.



Horticulture—Staff

Research Officers

Dr Jianhua Mo, Entomologist



Dr Jianhua Mo's brief is to lead with integrity and work towards a productive, sustainable and biosecure NSW Agriculture. His professional interests and skills are in integrated pest management including chemical, biological and cultural management; project experience with key pests of onions, cotton, citrus and brassicas; vector disease interactions; insecticide efficacy trials; modelling insect population dynamics, dispersal and movements, and phenological processes; sampling statistics in pest monitoring and detection; qualitative risk analysis of pest incursions; and data mining. Jianhua's recent achievements include obtaining more than \$1.8 million in industry funding since 2001, publishing 31 papers in peer-reviewed journals, and co-authorship of a paper awarded as highly commended by Emerald Publishing Group. Prior to joining NSW DPI in 2000 he held entomologist positions at SARDI, SA; the CRC for Tropical Pest Management, QLD; and the Tropical Weeds Research Centre, QLD. Jianhua studied Agricultural Science (B.Sc. and M.Sc.) at the Central-south University of Forestry and Technology (China), and received a PhD in Forest Entomology from the Australian National University.

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Jacquelyn Simpson, Research Horticulturist



Jacquelyn Simpson is the Research Horticulturist responsible for planning and conducting research with the temperate nut industries. Her research interests include tree nutrition, soil nutrient cycling and optimising plant productivity. Jacquelyn has recently submitted a PhD thesis on understanding the role of organic nitrogen in the nutrition of Eucalyptus plantations for optimising fertiliser management. She has a Bachelor of Science (Plant Science and Biochemistry) and a Graduate Diploma (Biology) from the University of Sydney. Jacquelyn will develop research projects and work closely with the rapidly emerging NSW temperate nut industry.

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Professional Officers

Andrew Creek, Citrus Industry Development Officer Riverina

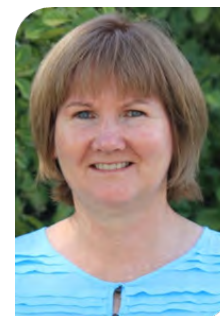


Andrew Creek's role is to develop the Riverina Citrus Industry working through industry grower groups, processors and exporters in the Riverina. Andrew works with a project reference group from these organisations on a three-year citrus development project aiming to improve long-term profitability and sustainability of Riverina citrus enterprises. The challenge of his role is to build industry capacity to access new export and domestic market opportunities. Andrew assists growers to meet market protocols through improved farm management, new varieties and IPM. Andrew is also involved in citrus trials in the local area which aim to demonstrate new technologies. Andrew was previously in private industry as a Farm Superintendent, managing a large vegetable farm in the MIA (300 ha grapes, 600 ha cucurbits and 16 ha citrus). He also worked for seven years as the NSW DPI District Horticulturalist based at Griffith focusing on vegetable and citrus. Andrew completed his degree (Bachelor Horticultural Science) at UWS.

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Valerie Draper, Professional Officer (Publications)

Valerie Draper joined the Horticulture Unit in August 2014 to provide editorial and desktop publishing support to the development of a citrus production manual. In her current position she works in editing and project management. She is a skilled developer of on-line instructional design and learning environments for education packages. Valerie wrote, designed and gained accreditation for the on-line course Salinity Management; co-authored, designed and narrated the Soil Biology Course and a module of the Managing Climate Risk in Agriculture Course. She also developed and narrated an EverTrain induction tutorial. Valerie has been instrumental in marketing, coordinating clients, and reviewing and evaluating courses. Valerie has written various scientific, technical and advisory publications and edited the 'Salinity Training Manual' and field identification guides on Cucurbits, fruiting Solanaceae in Australia and Cambodia, and bunching vegetables. She has a Science Degree from Sydney University, teaching qualifications, experience and training in adult learning and design methodologies, and is proficient in the e-learning authoring tool Captivate and the desktop publishing application InDesign.



Technical Assistant

Scott Munro, Technical Assistant

Scott Munro is a Technical Assistant with 11 years experience in insect pest management of Australian horticulture crops. He has been involved in a number of research projects including light brown apple moth, Fuller's rose weevil and citrus gall wasp in citrus, onion thrips in onion, and Heliothis grub in sweet corn. The areas of research he has been involved in include chemical and biological control, mating disruption, cultural control through crop hygiene, pruning and use of mulch, insect rearing and phenology studies, monitoring and sampling of a range of horticulture crops and Integrated Pest Management. Scott is currently working on the Management of Red Scale in Citrus and Iris Yellow Spot Virus in Onions. Scott holds a Certificate III in Horticulture from the TAFE NSW Riverina Institute, Leeton Campus.



Water & Irrigation—Staff

Research Officers

Brian Dunn, Research Agronomist (Irrigation)



Brian Dunn has been involved in irrigated research since joining NSW DPI in 1987. His research experience covers a wide range of issues associated with rice soil suitability; irrigated crop water management; rice nitrogen management; and rice-based, irrigated-farming systems. More recently his research has focused on opportunities to increase water productivity from rice and other crops in the irrigated-farming system. Brian currently leads three Rural Industries Research & Development Corporation (RIRDC) funded projects which all provide practical water, nutrient and agronomic information to growers and commercial agronomists.

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Dr Harnam Gill, Research Officer



Dr Harnam Gill has investigated sustainable agricultural production for more than 32 years. After joining NSW DPI in 1992 at Condobolin he moved to Yanco in 1996. Harnam has an Agricultural Science Degree, and a Masters and PhD (Soil Science). Initially Harnam specialised in the assessment, management and amelioration of saline and/or sodic soils and water for agricultural and irrigation use. In India he developed techniques for revegetating highly alkaline sodic soils. More recently he has worked on assessing the impact of rice-farming systems on soil nutrients, evaluation of shallow and deep aquifer groundwater for irrigation, performance of deep-rooted pasture species in shallow and saline groundwater situations, long-term impact of tillage and stubble management practices on soils. Harnam is currently involved in a research project on field evaluation of polymer compounds for reducing

evaporative losses from water storages in collaboration with CRC for Polymers and the University of Melbourne. He has published more than 110 refereed journal and magazine publications and presents his research at national and international meetings, seminars, symposia conferences and workshops. He is also a referee for international journals and examiner of research theses for postgraduate degrees.

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John Smith, Research Officer (Irrigation)



John Smith has over 20 years of research and extension experience in irrigated farming systems within southern NSW and southern QLD. John has worked in the Murray Valley as a Technical Officer managing rice trials, a District Agronomist at Barham investigating options for the best use of the water resource, and as a Regional Development Officer on the Darling Downs for the Australian cotton industry. He was also involved with a project in Laos investigating the application of Ricecheck in rice production systems. In 2009 John completed a Master of Philosophy looking at factors that influence the screening of rice varieties for low temperature tolerance. John is currently leading a Rural R&D for Profit funded project titled 'Maximising Irrigation Profitability – Southern Connected Systems'. This project is part of a broader Smarter Irrigation for Profit project, and is investigating options to improve water

productivity in rice, cotton and maize production across the southern irrigation areas. John is interested in the interaction between irrigation management and nitrogen uptake efficiency in cotton which forms the basis of his Cotton Research and Development Corporation funded PhD scholarship through The University of Queensland.

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Professional Officer

Robert Hoogers, Irrigation Development Officer (Southern Broadacre)

Robert Hoogers has more than 28 years experience in the irrigation industry. He joined NSW DPI in 1987 and started at Yanco in 1995, working in irrigation extension. Robert holds diplomas in agriculture and irrigation, and is a certified irrigation agronomist Irrigation Australia. He has worked across a range of areas including: broadacre and horticultural production, irrigation systems and technologies, farm planning and best irrigation management practises. He has contributed to the design and presentation of education packages, represented NSW DPI on the Water Sharing Plan and emergency management committees, and has been a key contributor to the development and implementation of on-farm irrigation modernisation programs in NSW. Robert is currently involved in projects co-funded by the Cotton Research and Development Corporation, the Commonwealth On-farm Infrastructure Program and ACIAR to work on irrigation projects relating to irrigation system layouts, management, scheduling, and benchmarking water use efficiency within NSW, Vic, QLD, Cambodia and Laos.

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Technical Officer

Tina Dunn, Technical Officer

Since starting with NSW DPI at Yanco in 1984, Tina has worked with a number of research groups including Soil and Plant Chemistry, Rice Physiology and the CRC for Sustainable Rice Production. She is currently working in water research. Tina has extensive research experience and a strong background in glasshouse and field experimentation, laboratory analysis, and data presentation. Her major areas of interest research include wheat and rice nutrition, rice establishment, Straighthead disease in rice, and near-infrared and remote sensing. Tina is currently involved in three RIRDC funded rice projects researching several varietal and agronomic issues of importance to growers and the industry.



Technical Assistants

Chris Dawe, Technical Assistant

Chris Dawe has been a member of the Water Research Team at Yanco since 2012. His position supports several irrigated agricultural research projects based on water resources and farming-systems agronomy. Several experiments are conducted each season with Chris carrying out sowing, irrigation, weed control, nitrogen treatments and harvest. A large component of his work involves the accurate collection and processing of soil and plant samples for three RIRDC funded rice research projects. The results from these experiments provide growers with current water, agronomic and nutrient-management recommendations.



Craig Hodges, Technical Assistant



Craig Hodges has worked on a variety of projects since he began with the Water Research Team at Yanco in 2011. His duties involve establishing several experiments each season and the day-to-day management of experiments which involves carrying out irrigation, weed control, nutrient management and harvest. Craig is also responsible for the accurate collection and processing of soil and plant samples for three RIRDC funded rice research projects. The results from these experiments provide growers with up-to-date water, agronomic and nutrient-management recommendations.

DPI Biosecurity—Staff

Research Officers

Dr Mark Stevens, Principal Research Scientist and Institute Director

Mark is an entomologist and has worked at Yanco since 1989. He has a PhD in insect taxonomy and phylogenetics from the University of Sydney, and now works on applied pest management across a range of different crops. Whilst he has worked on pests of rice, citrus, lucerne, and cotton, a strong focus on rice pests has been maintained throughout his career. His current projects involve improving pest and disease management in the Australian rice industry, developing improved techniques for monitoring stored grain pests, and developing integrated pest management strategies for cotton in southern NSW. Mark has published over 65 papers in peer-reviewed scientific journals covering a broad range of topics including community ecology, biological control, host-plant resistance and responses to pesticides. He is an Adjunct Professor with the Graham Centre for Agricultural Innovation at Charles Sturt University and currently co-supervises PhD students at both Charles Sturt University and the University of Canberra.

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Andrew Watson, Research Officer (Plant Pathology)

Andrew Watson is employed as a Research Officer (Plant Pathology) based at the Yanco Agricultural Institute where he undertakes both research and diagnostic roles. He joined NSW DPI in 1983 and has Bachelors and Masters Degrees in Agricultural Science from the University of Sydney. He has recently concentrated on projects researching diseases in vegetables and rice. His recent projects have included root rot control in beans, leaf disease control in carrots, iris yellow spot virus in onions, postharvest management in rockmelons, and both disease surveys and management for the rice industry. He has a broad knowledge of local cropping situations from cereals, pulses to fruit and vegetable crops and provides surveillance expertise for biosecurity threats. As the only plant pathologist at Yanco he is often the first contact for plant disease identification, information and advice from the public, farmers, researchers, private consultants and industry.

Contact details: E: andrew.watson@dpi.nsw.gov.au P: 02 69512647



Technical Officer

Glen Warren, Technical Officer (Entomology)

Glen Warren has more than 30 years experience in entomological research. He started at Yanco in 1981, working on pest management in rice and on the use of pheromones for insect mating disruption in horticultural crops. Glen completed his degree in environmental analysis externally through Charles Sturt University, and has worked on many different pests over the years, including mites, fruit flies, lucerne weevils, stored grain pests and rice pests. Glen has specialised skills in rearing aquatic invertebrates and assessing their response to pesticides from both agricultural and environmental perspectives. He is currently funded to conduct research on the management of pests and diseases of rice.



Technical Assistant

Rachael Wood, Technical Assistant (Entomology)



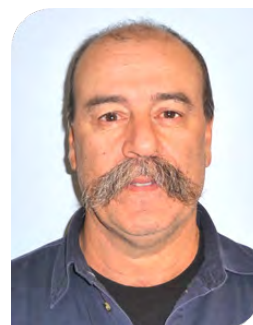
Working in stored grain pest management, Rachael Wood is one of the newest members of the Yanco research team, starting there in January 2015. She has an honours degree in animal and veterinary biosciences from La Trobe University, where she conducted a research project on vibrational signalling in insects. Rachael is currently working on developing improved techniques for monitoring stored grain pests in outdoor environments. Using both field and laboratory experiments, she is evaluating interactions between the pheromones of different beetle species, and the use of volatile compounds produced by plants and fungi as co-attractants for species that respond poorly to currently available commercial pheromone lures. Her work is supported by the Plant Biosecurity Cooperative Research Centre.

Research Services—Staff

Joe Valenzisi, Farm Manager

As Farm Manager and Local Office Coordinator for the Yanco Agricultural Institute Joe Valenzisi and his Research Services Team support research by ensuring the Institute's resources are available and well maintained. The Team maintains resources including cropping paddocks, infrastructure and buildings, grounds and gardens, irrigation systems, machinery, livestock and orchards. Joe gained employment at the Yanco Agricultural Institute in 1997 as an operational staff member. Joe also oversees the commercial activities undertaken on land not currently used for research or in rotation to capitalise on these resources. Supervising the administration staff is another of his responsibilities. Joe also manages the inquiries and research projects undertaken by private research groups and other Government Departments at the Yanco, Leeton and Griffith sites.

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Garry Ryan, Maintenance Supervisor

Garry Ryan has extensive experience in construction and maintenance from working in mining and construction. Garry successfully completed his trade in Fitting, Machining and Welding in Melbourne and was nominated for Apprentice of the Year. He also has experience teaching with TAFE NSW. Garry commenced his employment with NSW Agriculture in 1987 as Supervisor of the Welding Workshop. His duties also included training Murrumbidgee College of Agriculture students in welding fabrication and providing training to Aboriginal communities through the ARTP training program. He received a Staff Achievement Award for his contribution to this program. Garry is currently involved in the upgrading of assets at the Leeton Field Station and ongoing maintenance of the Yanco Agricultural Institute.



Administration Staff

Leonie Napier, Office Supervisor

Leonie Napier oversees the provision of administrative support to the Yanco Agricultural Institute and supervises three administration staff. Leonie joined the Department in 1996 and has extensive experience in administration and clerical duties. She holds qualifications that enhance the provision of customer service including Certificate IV in Business Administration, Certificate IV in Training and Assessment, and a Diploma of Counselling. Leonie worked for seven years at the Department of Water Resources as the Accounts Payable Clerk and Manager of the records department and was employed as a Customer Service Officer at a local medical centre for two years. She is customer focused and aims to have her administrative team work cohesively, update their skills as required, and assess their performance to ensure continual improvement of services.

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Charmaine Lee, Accommodation Manager



Charmaine Lee commenced working with the Tocal College, Yanco Campus in 2010. She has brought with her extensive clerical and administrative experience having worked for 15 years with the Commonwealth Bank as a Customer Service Officer. Her experience includes handling cash, processing personal-loan applications and customer engagement. Charmaine has a Certificate III in Business Administration and is currently studying for a Certificate IV in Business Administration. She is skilled in administration, customer service, record keeping and time management. In her current position she manages two domestic officers. Charmaine has a business focus with her goal being to use the Yanco Agricultural Institute accommodation and conference facilities to their full potential. This includes lifting its profile through promotion and providing excellent service and superior facilities.

Lucy Borgese, Clerk



Lucy Borgese is a skilled and experienced member of the Yanco Agricultural Institute's Administration Team. Lucy began her career as a laboratory assistant at the local cannery checking for quality assurance of products, preparing fruit for laboratory testing and performing brix testing on fruit. After working on soil sampling at the Yanco Agricultural Institute in 1980 Lucy obtained a clerical position in the Leeton Advisory Office. Her experience in reception and clerical support set her career path and she returned to the Yanco Agricultural Institute working in finance and human resources. She then moved into the position of library technician providing information services to research staff and students. Lucy currently works in administration where she provides a high level of support in processing accounts payable, raising purchase orders, customer service, and she is also undertaking training in the provision of accommodation services.

Leanne Polsen, Administration Assistant



Leanne Polsen provides a high level of customer service in reception and administration for the site. Leanne has completed TAFE NSW Secretarial studies, TAFE studies in the MYOB financial package, a Certificate IV in Business Administration and has a current typing speed of 70 words a minute with 98% accuracy. Leanne began her career with the Department of Water Resources in Griffith and moved to the Leeton office where she built on her skills and experience in the processing of accounts payable, generating accounts receivable, processing payroll, completing BAS statements, and dealing with superannuation and workers compensation. Leanne commenced work at the Yanco Agricultural Institute in 2006 providing reception services, maintaining motor vehicle bookings, data entry and clerical support.

Operational Staff

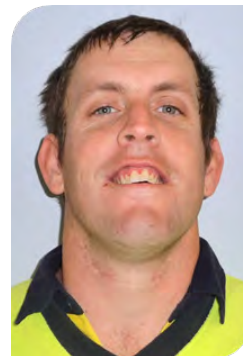
John Fiegert, Farm Supervisor



Having worked on the land for almost 40 years, John Fiegert has extensive farm-management experience in the areas of cropping, machinery operation and contracting services. John worked for 16 years on a dryland, mixed farming enterprise at Barmedman and commenced employment with NSW Agriculture in 1976 as the Farm Foreman at the Temora Research Station. John has been engaged as Supervisor Dryland Farming at the Yanco Agricultural Institute since 2011. John has a Certificate IV in Agriculture and he aims to ensure the ongoing improvement of the land so it continues to be viable.

Bill Conroy

Billy Conroy is a committed member of the Operational Staff at Yanco. Billy started at the Yanco Agricultural Institute through a work-experience program and due to his dedication to agricultural work he obtained a temporary part time position with the Operational Team. He has recently obtained permanency as an Operational Staff member. Billy has been successful in the development of his skills and obtaining qualifications in tractor driving, and the use of quad bikes and chainsaws. He also holds a forklift licence and is working to further his skills, for example, by undertaking the chemical application course. Billy has a great interest in tractor driving and land preparation. He also contributes to maintaining the Institute's extensive grounds and garden.



Kyle Dodds

Kyle Dodds is one of the dedicated Operational Staff members who commenced at the Yanco Agricultural Institute in 2011. He started with a one year traineeship and his attitude and interest in agriculture has earned him a permanent position. Kyle has a wide range of experience having previously worked for an engineering company engaged in welding and construction. He was also employed on a dryland farm operation where he was involved in cropping, cattle and general farm maintenance. In his current position Kyle supports research projects through ground preparation for rice cropping; constructing banks, supply channels and stops; sowing and irrigation management. Kyle continues to build on his skills and knowledge and has obtained competencies in using chainsaws, tractors, chemicals, 4WD vehicles and quad bikes.



John Field (Livestock)

John Field commenced work at the Yanco Agricultural Institute in 1976 as a Stock Attendant. In this position he worked with vets on site to assist in the care and management of cattle and sheep, for example, assisting with calving and lambing, and the milking of jersey cows. John then moved onto the Sheep Milking Program at the Leeton Field Station. His next appointment was with the Murrumbidgee College of Agriculture educating second-year students in horse training. He was involved in breaking horses and teaching students stable maintenance, horse shoeing, feeding and grooming. He is currently involved in the management of sheep on site including shearing, crutching, drenching, joining and weaning lambs. He has achieved his competencies in tractor driving, chemical application and has a frontend-loader licence. His special area of interest is sheep and sheep dogs, and in February 2016 John will have achieved 40 years of service with the Department.



Garry Heath

Garry Heath has over 40 years of agricultural experience. Garry has worked on a range of farming properties, as well as his family rice farm. He has a diverse range of skills and experience relating to sowing, harvesting, hay making, irrigation and stock management. Garry commenced at the Yanco Agricultural Institute in 2006 and has achieved his competencies in tractor driving and chemical application as well as being licenced to operate a backhoe and forklift. Garry maintains the Institute's gardens and orchards.



Allen Hone



Allen Hone has been working at the Institute for 10 years. He has a broad range of experience from his farming background and employment with the Leeton Shire Council where he worked with the Parks and Gardens Team for 27 years. Following that position, Allen worked for an irrigation company building pivot irrigators and installing both residential and river-pumping irrigation systems. Allen enjoys the diversity of agricultural work and has developed a high level of skills and knowledge while working at Yanco. He has achieved all his competencies and holds a backhoe, forklift, excavator and articulated-truck licence. His professional skill set is as a backhoe operator and he is currently involved in a large project cleaning out the Institute's drainage system to ensure more efficient drainage for irrigation.

Ronald Morris



Ron Morris has been employed with NSW Agriculture since 1970 when he was engaged as a Handyman and Motor Mechanic. He has undertaken a diverse range of duties including working in the welding workshop, truck driving and transportation of stock. Ron has achieved his competencies in the use of farm machinery and chemical application. He enjoys the diversity of working in agriculture and being a part of a skilled and cohesive team. Ron is based at the Leeton Field Station where he is involved in ground preparation for rice trials. He works with researchers, management and operational staff to set schedules to ensure work is completed on time.

Neville Smith



Neville Smith is experienced in the agricultural industry having worked for 28 years on irrigation and dryland farms. He has a wide range of experience in cropping, grapes and working with livestock. Neville holds a forklift licence and has achieved competencies in first aid, chemical application, tractor driving and chainsaw use. Maintaining the Institute's garden is Neville's area of interest and he also works on the planting, fertilising, pruning and irrigation of the hazelnuts on site. Neville has a Certificate II in Land Management Aboriginal Heritage and is currently studying to obtain the Certificate III on this topic.

Richard Smith



Richard Smith has been with the Yanco Agricultural Institute's Operational Staff since 1998. Richard has a wealth of experience including a Certificate IV in Agriculture from the Murrumbidgee College of Agriculture in 1993. Prior to working at the Institute, Richard worked for more than 10 years on rice farms engaging in sowing, harvesting, spraying and irrigation as well as dryland cropping, sheep and cattle. Richard's specialised skills include machinery operations, fencing, cropping, machinery maintenance and computer application. His area of interest is integrated pest management and the reduction of chemical usage, as well as new farming technology such as GPS and precision farming in sowing and land preparation. Richard assists the Farm Manager in the supervision, direction and training of staff. He is currently involved in sowing barley, wheat, canola, lupins and peas. He takes great satisfaction from supporting the research achievements at Yanco.

Southern Cropping Systems—Programs

Program 1: Germplasm improvement



One of the most effective methods to improve plant productivity and efficiency is through breeding and selection. Germplasm developed overseas is not necessarily the best for use in Australia. The diversity of geographic and climatic zones in NSW means that new material must be evaluated in those zones.

NSW DPI continues a major investment role in evaluating canola, rice, pulse, chickpeas, durum and cereals under the National Primary Industries RD&E framework for Grains and Rice.

The Germplasm Improvement Program develops parental germplasm with improved tolerance and resistance to biotic and abiotic stresses. The Cropping Systems Unit currently leads three commercially focused breeding programs. These programs are developing improved varieties of rice in partnership with RIRDC and SunRice, and Durum and chickpeas in partnership with GRDC and other state departments and universities.

The Northern and Southern Cropping Systems Units also develop pre-breeding material and genetic markers for a range of traits including heat and moisture stress; and plant diseases in crops including wheat, durum, canola, winter pulses and rice.

The work in this area falls under four main sub-programs:

1: Maintaining Genetic Resources, 2: Pre-breeding, 3: Breeding, and 4: Germplasm Evaluation.

The scope of the pre-breeding, breeding and germplasm evaluation within NSW DPI include:

- emphasis on evaluation of varieties where we are the major providers of RD&E for those industries, under the National Framework for Grains
- evaluation of the agronomic and physiological characteristics of varieties for regional performance
- emphasis on breeding for new and emerging industries that will deliver benefit to NSW (e.g. soybeans).

The benefits of the pre-breeding, breeding and germplasm evaluation within NSW DPI include:

- increased abiotic and biotic stress resistance leading to increase yields, reduced use of pesticides, and increased water-use efficiency
- locally adapted varieties meeting market specifications.

Future directions

Maintaining Genetic Resources: this is unlikely to continue within five years as there is a continued move to nationalise crop genetics resources.

Pre-breeding: research will increase as rice and pulse pre-breeding capacity, in particular, is developed.

Breeding: NSW DPI will maintain its investment in the crop plant breeding programs while investigating different co-investment models such as public/private partnerships.

Germplasm Evaluation: the evaluation of new varieties and advanced breeding lines will continue to be a core research activity. It is likely the Yanco Managed Environment Facility will expand and continue to run as a full cost recovery venture. In 2015, the National Variety Trial (NVT) Program will re-tender for contractors and NSW DPI will need to evaluate the benefits and impacts of being a contractor for the NVT.

Program 2: Farming systems management



Advisers and growers are grappling with managing the entire farming system and not just on a paddock by paddock basis. Low wheat protein levels, increased disease threats and resistant weeds with continual canola/wheat rotations have created greater interest in crop rotation and sequencing management.

The Southern Cropping Systems Unit has completed an analysis for GRDC of the Break Crop, Crop Rotation and Crop Sequencing across the north, south and western GRDC regions. Results indicate that weed resistance and nitrogen management are the greatest concerns that can be addressed

through crop rotation management.

The Farming Systems Management Program develops tools and information packages to enable growers and advisers to manage a farming system with confidence and flexibility. Research includes understanding the impacts of crop sequencing decisions including nutrition and water management. The data enables the development of management packages to maximise the water-limited yield potential of new varieties. Research is conducted across summer and winter broadacre crops. NSW DPI is a trusted provider of independent and evidence-based information to growers and advisers in this area.

The work in this area falls under four main sub-programs:

5: Nutrient Management, 6: Agronomy Packages, 7: Maximise Returns from Water, and 8: Crop Sequencing/Rotation Management.

The scope of farming systems management within NSW DPI includes:

- development of agronomy packages for cereals, pulses, summer crops, canola and irrigated crops
- evaluation of the agronomic management of varieties for regional performance
- emphasis on water-use efficiency and nutrient management.

The benefits of farming systems management within NSW DPI include:

- development of crop rotation options with management packages for individual crops and regions
- identification of best variety options for each region
- maximise returns from water through improved WUE in irrigated and dryland systems
- reduced use of inorganic crop inputs including fertilisers and pesticides.

Future directions

Nutrient Management: is an area of work that will grow in its own right for the Cropping Systems Units and the appointment of Crop Nutrition Research Scientists, co-funded by GRDC will increase research capacity in this area.

Agronomy Packages: it is expected NSW DPI will rebid for the Southern Pulse Agronomy Project, and develop stand-alone agronomy projects for cereals, pulses and oilseeds. Expertise is also building in the crop nutrition, dual purpose cereals and canola agronomy, with a post-doctoral position for each area starting at Wagga Wagga and Tamworth partnered with the GRDC.

Maximise Returns from Water: The current Cropping Systems Unit portfolio will be greatly increased with the development of projects within this sub-program. There is currently one cotton project in this sub-program—Cotton WUE Benchmarking Project that is leveraging off our commitment to irrigated agriculture in the new structure and funded by Cotton RDC.

Crop Sequencing/Rotation Management: this area of research is growing as advisers and growers realise that systems management contributes to addressing weed resistance, disease and pest issues, and nutrient management. The RDCs are considering investing as a group into these areas.

Program 3: Plant protection



Disease, weed and pest management are major issues for broadacre cropping enterprises. Blackleg in canola and diseases in wheat can destroy crop productivity if integrated management practices are not put in place. Environmental conditions and changing production systems can exacerbate disease and pests in any one year, so monitoring and surveillance is a critical industry need.

NSW DPI continues a major investment role in disease and pest management programs, including pre-breeding through to breeding resistant varieties under the National Primary Industries RD&E Framework for Grains, Cotton and Rice.

Developing integrated management strategies that incorporate cultural, chemical, biological and genetic options to manage key pests (insects, weeds and diseases) is critical for all NSW crop production regions. Management recommendations need to take into account cost-effectiveness, resilience of control strategies and flexibility to fit different farming systems. Research is aimed at developing cost-effective control options that prevent pests from reducing crop yield and quality, reduce the use of pesticides, and increase productivity and the profitability of growers. The work in this area falls under three main sub-programs:

9: Entomology and Integrated Pest Management (IPM), 10: Pathology and Integrated Disease Management, and 11: Weeds and Integrated Weed Management.

The scope of plant protection research within NSW DPI includes:

- a primary focus on those industries where we have a co-investment from other providers, agencies and industry partners and for those we are a major investor in under the National RD&E Framework for Grains, Cotton and Rice
- development of innovative plant protection strategies that deliver benefit to NSW cropping industries
- developing and conducting research projects to mitigate the effects of insect pests and fungal, bacterial and viral pathogens

The benefits of plant protection research within NSW DPI include:

- increased crop yields and water use efficiency
- implementation of disease, insect pest and weed integrated management strategies leading to reduced pesticide use
- monitoring and surveillance of new and emerging threats to NSW cropping industries
- crops meeting market requirements.

Future directions

Entomology and Integrated Pest Management: this program is expected to expand with the funding of a southern cotton IPM project and IPM principles being included in crop management packages developed by Research & Development Agronomists.

Pathology and Integrated Disease Management: this program aims to maintain its strong industry support in integrated disease management, and explore opportunities to develop projects that build capacity in our core plant pathology strengths.

Weeds and Integrated Weed Management: integrated weed management is an area NSW DPI intends to build in capacity over the next five years. The appointment of Cropping Weed Research Scientists co-funded by GRDC will increase research capacity for both Cropping Systems Units.

Program 4: Supply chains and market access



Quality of agricultural products determines the price paid for those products. This area of post-harvest/market access is important to the export and domestic markets and Australia's clean, green image. Research in this area is growing as consumers become more discerning over the quality of produce. Issues such as chemical use on products can impact on the sales of the product so correct post-harvest management of product is crucial.

The Australian grains industry also relies heavily on its quality to extract a high price and includes a 'no live insects' policy as a guarantee. However, insect resistance and limited chemical treatments available are becoming problematic to ensuring this policy. NSW DPI grain storage research is a major component of several national projects that are funded through the Plant Biosecurity Cooperative Research Centre.

NSW DPI continues a major investment role in canola, rice, pulses, and cereals under the National Primary Industries RD&E framework for Grains and Rice.

The work in this area falls under three main sub-programs:

13: Edible Oils, 14: Grain storage, and 15: Post Harvest/Market Access.

The scope of post-harvest research within NSW DPI includes:

- emphasis on evaluation of quality attributes of new varieties where NSW DPI is the major provider of RD&E for those industries, under the National Framework for Grains and Rice
- emphasis on monitoring quality characteristics of rice and wheat
- ensuring crop products are internationally competitive.

The benefits of post-harvest research within NSW DPI include:

- development of quality standards to meet market requirements for rice, canola and wheat
- managing stored grain insect resistance to phosphine and other registered chemicals
- integrated pest management in post-harvest grains.

Future directions

Edible Oils: this area of research has current funding and has secured forward funding of the Canola Quality Program. A federally funded ARC grant through Charles Sturt University will provide further capacity building with post doc and PhD students.

Grain Storage & Post Harvest/Market Access: it is expected that funding for phosphine resistance monitoring and management will continue for several years as it is heavily supported by all in the grains industry. Further investment into the ecology of stored grain insects will also be supported as it provides a basis for some of the grain storage management protocols.

* Note that sub-program 12 covers the Wine Science Program

Southern Cropping Systems—Projects

Program 1: Germplasm improvement

Sub-program 2: Pre-breeding

1. Pre-emptive Breeding for Exotic Pests and Pathogens. (30/06/13–31/05/18) Co-investor: Grains Research & Development Corporation (GRDC). DPI lead: Dr Livinus Emebiri*

The project objective is to:

- reduce the risk of potential future economic loss to wheat growers due to the incursion of exotic pests and diseases by providing Australian wheat breeders with parental genetic stocks that carry genes for resistance to Karnal bunt, Hessian fly and Sunn pest.

The parental genetic stocks and associated diagnostic markers will be provided to Australian wheat breeders to facilitate rapid deployment in their breeding programs. Australian breeding entities and breeders will have long-term access to phenotyping sites where Karnal bunt, Hessian fly and Sunn pest are endemic for use in the development and validation of advanced elite lines with putative resistance to Karnal bunt, Hessian fly and Sunn pest.

*Trials also conducted at Yanco although the main project is not based there.

2. National Brassica Germplasm Improvement Program 2. (01/07/07–30/06/15) Co-investor: GRDC. DPI lead: Dr Harsh Raman*

This program is designed to:

- develop and validate method(s) for accurate phenotypic assessment, and gain an understanding of the phenotypic variation for resistance to blackleg and tolerance to drought
- develop germplasm with improved resistance to blackleg (seedling and adult plant) and tolerance to drought (carbon isotope discrimination, early vigour (NDVI)/water-use efficiency and water-soluble carbohydrates content), and make this available to canola breeders
- contribute to identifying loci significantly contributing to the phenotypic variation for resistance to blackleg—both seedling and adult plant resistance (APR), and drought tolerance—water-soluble carbohydrates, carbon isotope discrimination, and NDVI.

*Trials also conducted at Yanco although the main project is not based there.

Sub-program 3: Breeding

3. Rice Research Partnership. (30/06/10–30/06/15) Co-investor: RIRDC. DPI lead: Dr Peter Snell

The partnership between RIRDC, Sun Rice and NSW DPI funds a project with three facets:

- develop rice varieties to meet specific market requirements
- develop rice varieties to meet processing needs
- explore opportunities for breeding new maturity and quality classes.

To cope with an evolving production environment, the varieties developed will enhance adaptation to the following southern issues, for example, improved cold tolerance, salinity tolerance, straight-head tolerance, drought tolerance and water productivity.

4. Australian Soybean Breeding Program. (30/06/12–30/06/17) Co-investors: GRDC, CSIRO. DPI lead (southern node): Mark Richards

Outcomes for this project include:

- new soybean varieties with improved yield, agronomic traits, disease resistance, weathering tolerance, broader adaptation to Australian production environments, and higher value culinary or functional traits
- greater profitability for growers through better varieties and expanded market access, including higher value markets

- increased area planted to new soybean varieties across new and existing Australian production regions
- closer alignment with all sectors of the soybean industry chain.

Sub-program 4: Germplasm Evaluation

5. Managed Environment Facility. (30/06/10–30/06/15) Co-investor: GRDC. DPI lead: Kathryn Bechaz

A Managed Environment Facility established at the Yanco Agricultural Institute has enhanced the Department's research capacity for water-limited environments. The establishment of research facilities and engagement of support staff will ensure the use of the facility by research projects from the 2011 growing season.

Program 2: Farming systems management

Sub-program 6: Agronomy Packages

6. Southern Irrigated Soybean Agronomy Project. (01/01/14–30/06/18) Co-investor: GRDC. DPI lead: Mark Richards

The project aims to:

- improve grower and advisor understanding of the factors limiting soybean productivity across southern NSW by developing management packages for new and existing soybean varieties, and increasing the reliability and profitability of soybeans.

7. Expanding the Use of Pulses in the Southern Region. (01/07/10–30/06/15) Co-investor: GRDC. DPI lead: Mark Richards

This project will contribute to the expansion of the use of pulses in the southern region through:

- research and development that delivers Variety Specific Agronomy Packages, and profitable pulses for modern farming systems.

8. Correct Crop Sequencing for Irrigated Double Cropping. (01/06/14–30/06/16) Co-investor: GRDC. DPI lead: Luke Gaynor

Key potential areas for improving the reliability and profitability of double-cropping systems have been identified, along with any barriers to adoption which will be investigated:

- Herbicides. The use of herbicides in irrigation-crop sequences and double-cropping situations with the aim to harvest and sow the next crop in a short period of time without herbicide issues. Currently some suitable herbicides have no information available as to their plant-back periods under irrigated, double-cropping regimes.
- Irrigation layouts, delivery systems and scheduling. There is a need to test double-cropping systems using modern irrigation layouts, and those using current irrigation delivery systems and scheduling.

Sub-program 7: Maximise Returns from Water

9. Southern Irrigated Cereal and Canola Varieties Achieving Target Yields. (30/06/14–30/06/17) Co-investor: GRDC. DPI lead: Deb Slinger

The purpose of this project is to:

- improve southern-irrigated growers' knowledge of cereal and canola variety selection and best irrigation management practice through the promotion of the results of the high yielding irrigated cereals and canola trials.

By 2017, the aim of the project is to have:

- 300 grain growers and 30 advisers implement management decisions that have been shown to increase production for irrigated cereal and canola varieties
- development of regional variety specific management packages and an Irrigated Wheat and Canola

Manual that will increase grower and advisers' knowledge.

10. Irrigated Faba beans—A profitable break crop for irrigators in southern regions – RDE gap analysis. (01/01/14–30/06/15) Co-investor: GRDC. DPI lead: Dr Sandra McDougall

The project objective is to conduct a review of the current crop status for growing faba beans under irrigation in southern NSW and northern Victoria. It will include:

- a review of the literature, current practice and constraints from the perspectives of growers, agronomists and faba bean marketers
- identifying research, development and extension gaps specific to expanding faba bean production in irrigated farming systems
- a 'Growers Marketing Guide' produced in collaboration with Pulse Australia.

Sub-program 8: Crop Sequencing/Crop Rotation

The three projects under Sub-program 6: Agronomy Packages include research and development work on crop rotations and crop sequencing. The projects are:

- Southern Irrigated Soybeans
- Expanding the Use of Pulses in the Southern Region
- Correct Crop Sequencing for Irrigated Double Cropping.

Program 3: Plant protection

Sub-program 9: Entomology and Integrated Pest Management

11. Establishing Southern Cotton – IPM. (01/07/14–30/06/17) Co-investor: Cotton Sector National RD&E. DPI lead: Dr Sandra McDougall

The objective of this project is to answer the following questions:

- How do thrip communities in southern cotton differ from those in northern cotton growing areas?
- Are treatment thresholds for thrips developed in the north applicable in southern areas?
- What is the pesticide resistance status of Western Flower thrips (WFT) populations in southern cotton?
- Are there better alternative treatments for managing WFT and other sucking pests in southern cotton?
- How effectively does cotton compensate for pest-related defoliation under a shorter growing season?
- Are the pest and beneficial profiles in southern cotton different from the north?
- Are mirid and green vegetable bug thresholds and management options developed in the north applicable in the south (populations permitting)?
- Is the OZCOTT cotton development model suitable for southern cotton regions?

Horticulture—Programs

Program 1: Germplasm improvement



Breeding and selection of superior varieties is one of the most effective methods to improve crop productivity and performance. Through NSW DPI's network of horticultural facilities in diverse locations, germplasm collections are maintained in support of national plant improvement programs in citrus, macadamias, tea tree, apples, grape vines and hazelnuts. As well as providing plant material and seed for breeding and evaluation purposes, these collections provide ideal sites for screening material for productivity, pest and disease resistance, and fruit quality.

Activities in this program involve the evaluation, and to a lesser extent the development of genetic material and varieties with improved tolerance and resistance to biotic and abiotic stresses. Except for citrus and tea tree, and to a degree macadamias, the maintenance of this germplasm is not supported by industry and the plantings are not consolidated at single sites.

The objectives of this program are to:

1. Maintain collections with the support of industry co-investment
2. Evaluate germplasm to determine agronomic performance and consumer acceptability
3. Source promising germplasm from our global research partners for evaluation under Australian commercial conditions
4. Work with collaborators to provide commercial quantities of known health-status germplasm to industry
5. Provide support for commercialisation

The two themes within this program are Breeding, where our Unit has limited involvement; and Germplasm Evaluation, where we are active. Our Germplasm Evaluation Program evaluates material under controlled and Australian commercial conditions and includes citrus, macadamias, hazelnuts and wine grapes. Several of these, such as the citrus rootstock collection and macadamia germplasm block are the best of their kind and are highly valued by industry. NSW DPI hosts the National Citrus Germplasm Repository which amongst other holdings has consolidated material previously held at the NSW DPI Gosford facility and CSIRO.

Program 2: Farming systems management



The management of farming systems in horticulture leads to the development of robust and integrated practices and technologies that improve horticultural productivity and protect the natural environment. This includes improving the management of nutrients in extensive and intensive horticultural industries, such as protected cropping, citrus, and vines.

Production packages are developed and deployed to address issues such as orchard floor and canopy management for perennial tree crops (nuts and citrus), and productivity regimes in protected cropping, field vegetables, and emerging horticultural crops. Programs in vine physiology address crop forecasting and the influence of management, the environment and climate variability on grapevine yield and productivity, and wine quality and styles. Research is conducted into water-use efficiency and irrigation management in perennial tree crops and vegetables. Labour costs are also a limiting factor for many horticultural industries and we seek to partner with co-investors to explore potential solutions to these issues.

The management of farming systems in horticulture involves the development of robust integrated practises and technologies that improve horticultural productivity and protect the natural environment. The objectives of this program are to:

1. Improve the management of nutrients
2. Develop and deploy agronomy packages
3. Improve water-use efficiency and irrigation practises
4. Reduce labour costs

The program is divided into three themes Nutrient Management, Agronomy Packages, and Productivity of Water in Irrigated Agricultural Systems. We conduct a range of research in the Nutrient Management Theme with an emphasis on vegetable systems and fertigation for citrus, nitrogen and carbohydrate management in vineyards and the management of berry ripening in grapes through nutrition manipulation.

Under the theme of Agronomy Packages we develop integrated systems approaches for intensive and extensive horticultural production systems, ensuring product yield and quality whilst reducing waste and environmental impacts. This includes the development of orchard floor and canopy management regimes, the development of production packages, crop forecasting, minimising water run-off, leaching and waste and the evaluation of new and emerging crops with strong potential for growth in NSW.

We work with large and small horticultural industries to improve their financial and environmental sustainability. Recent projects have developed innovations to industries including Asian vegetables (greenhouse production and nutrient accumulation), beetroots (stand management), wine (improving yield prediction), and macadamias (canopy management). We are in a strong position to offer guidance as the climate becomes more extreme.

Within the Productivity of Water in Irrigated Agricultural Systems Theme we seek to optimise the use and reuse of water in horticultural systems from selecting more water-efficient rootstocks to developing practices to reduce water use in irrigated systems, and to effectively capture and reuse water whilst still ensuring food safety.

Program 3: Plant protection



Arthropod pests and microbial diseases impact on the commercial success of NSW horticultural industries in two major ways. Firstly, yield losses and downgrading occur as a direct result of infestation or infection. Secondly, the maintenance and development of lucrative export markets is governed by compliance with phytosanitary requirements and pest presence which, independent of any damage, can limit access to sensitive markets.

In most cases chemical control is well implemented on-farm, but factors such as reduced pesticide availability, and consumer attitudes and the increasing resistance of insects to those pesticides are driving the development of new approaches. This program develops innovative pest disinfection protocols for seamless integration into the value chain and focuses on developing systems approaches to the management of the major pests of our most important crops. This involves combining available and novel techniques to provide effective control with minimal off-target impact.

Pest management is further confounded by farmers now bearing greater liability for off-target pesticide impacts and the diminishing number of registered pesticides available for use, at a time when consumers are becoming increasingly concerned with the nutritive value of their food and a growing desire to eat 'clean and green'.

Within this context the objectives of this program are to:

1. Develop integrated management programs for pests and diseases that augment systems approaches for the State's high priority horticultural crops

2. Evaluate the impact of innovation on horticulture supply chain commercial outcomes and project the commercial, environmental and social benefits associated with novel, integrated control of key pests

The program is divided into two themes: Entomology and Integrated Pest Management (IPM), and Pathology and Integrated Disease Management (IDM). IPM allows farmers to control the pests and diseases which would devastate their crops. IPM requires a full understanding of the pest's lifecycle and almost always results in a reduction in the use of synthetic pesticides providing benefits to our environment and farmer's budgets.

Our teams have also worked on developing an understanding of why some pesticides gradually lose effectiveness as pests develop tolerance or resistance. We also have an interest in the use of alternative chemistries including horticultural mineral oils and GRAS (Generally Recognised as Safe) pesticides.

Program 4: Supply chains and market access



Whilst achieving optimal productivity and managing natural resources are cornerstones of thriving and enduring horticultural industries, produce must also meet consumer expectations in terms of visual appeal, price point and sensory experience. This program conducts research to underpin access of horticultural produce to domestic and international markets.

The objectives of this program are to:

1. Define the parameters that optimise the quality attributes of horticultural products
2. Identify production and postharvest practises such that products satisfy consumer requirements
3. Maximise product out-turn following harvest, packaging, transport, storage and display
4. Proactively develop novel disinfestation and disinfection protocols which meet phytosanitary requirements and can be easily and seamlessly integrated into existing value-chain practices, allowing NSW to gain, maintain and retain market access

The program is divided into two themes. The first theme is Product Value Chains which looks at harvest, cooling, cleaning, sorting, packing, and storage practises, and the control of pests, diseases and physiological disorders following harvest. In most cases, product quality begins to deteriorate immediately after harvest, and so the postharvest handling of produce has an important positive influence on their longevity, nutritional value, appearance, taste and consumer appeal. Overall, research and development in this theme seeks to develop processes and systems along the entire value chain to maximise produce quality, shelf life and consumer appeal, including reducing chemical spray applications and other inputs by developing and utilising more environmentally friendly methods and products.

The second theme is Market Specifications and Compliance, in which we provide research to ensure that horticultural products meet the specifications of their target markets, and comply with pesticide residue limits, quality standards, food handling and safety standards. This includes the proactive development of novel disinfestation and disinfection protocols to meet phytosanitary requirements and yet preserve product quality. A second focus is edible oils, specifically the analysis of olive and canola oil with an emphasis on the effects of production and processing on oil quality as measured through both chemical and sensory analysis. The Australian olive oil industry focuses on standards and authenticity so this work concentrates on the detection of adulterated oils and maintenance of authenticity particularly for Extra Virgin Olive Oil.

Horticulture—Projects

Program 2: Farming systems management

- 1. Hazelnuts—opportunities for long term development RIRDC (June 2012–April 2017). Co-investor: Agri Australis and RIRDC. DPI lead: Lester Snare**

This project will assist the hazelnut industry in Australia to achieve commercial sustainability. Currently the industry is valued at \$0.5 million annually, with mostly small family orchards growing varieties not well suited to larger processors. The project builds on the recent successful importation of commercial numbers of hazelnut plants by commercial interests to rapidly expand and propagate that material. This will provide an alternative long-term market for all producers.

- 2. Citrus in Bhutan and Australia (April 2012–March 2017). Co-investor: ACIAR. DPI lead: Graeme Sanderson***

The main focus of project activities in Bhutan is securing germplasm, improving nursery and production practices and the knowledge of key citrus pests and diseases. The main focus of the Australian component is to strengthen the Australian citrus variety and rootstock evaluation program, assess potential new rootstock for mandarins, and improve field- and laboratory-based diagnostics and strategies for major exotic pests and diseases. The project will provide Bhutan with a clean and healthy source of citrus germplasm, and ensure both countries improve citrus productivity through management practices, more targeted nutrition and irrigation application, and implementing control methods for key pests and diseases.

*trials also conducted at Yanco although the main project is not based there.

Program 3: Plant protection

- 3. Improving vegetable industry profitability through IPM (Australia & Philippines) (March 2013–June 2017). Co-investor: ACIAR. DPI lead: Sandra McDougall**

This project seeks to build research capacity, vegetable farmer incomes and consumer health through development and adoption of integrated crop management practices for vegetables in both Australia and the Philippines. NSW DPI leads the crop protection component on integrated pest management, diagnosis of a disease in cucurbits, and evaluation of the efficacy of sanitisers to reduce food safety risks.

Program 4: Supply chain and market access

- 4. Sustained development of the PNG sweet potato value chains (June 2012–July 2015). Co-investor: ACIAR. DPI lead: Shane Hetherington**

This project aims to support development of a sweet potato value chain in PNG and Australia using an integrated and participatory approach. Postharvest losses from the farm are very high in PNG as a result of poor postharvest handling, inadequate storage and transport infrastructure and lack of value-chain coordination. The Australian component of this project will focus on increasing our understanding of the New South Wales sweet potato industry value chains.

Water & Irrigation—Programs

Program 1: Water productivity



The Water Productivity Program develops land and water management practices for NSW irrigation and dryland industries that increase economic activity and farm profitability. This is achieved through multi-disciplinary R&D into on-farm practices and technologies to increase the productivity of available water supplies and reduce the cost of production. The Program also provides policy and planning advice to support more profitable irrigation enterprises.

NSW DPI water and irrigation productivity research and development activities at Yanco Agricultural Institute (YAI) align to the National Water Use in Agriculture RD&E Strategy

and directly support the Strategy's objectives:

- Modernise irrigation systems and practices
- Facilitate getting knowledge into practice and building human capacity
- Improve capacity to inform planning and policy of agricultural water use.

The work in this program falls under two main subprograms:

1. Productivity of water in irrigated systems
2. Modernise irrigation infrastructure to improve irrigation efficiency

1: Productivity of water in irrigated systems

This subprogram aims to increase the return per megalitre (ML) of water for NSW irrigators by undertaking research and development to improve irrigation practices. NSW DPI undertakes research that improves current, and develops new, agricultural systems to improve water use efficiency and productivity. Research is undertaken to assist at the farm and industry scale and includes projects that investigate:

- maintaining or improving food and fibre productivity under reduced and more variable irrigation water supplies
- alleviating constraints imposed by a variable and changing climate, particularly with regard to reduced and increasingly variable water availability
- utilisation of innovative techniques to monitor crop health and irrigation water use efficiency
- the design and implementation of programs that promote best management, reduce the costs and increase the rate of adoption of new technologies
- improving the returns from shared water sources.

In doing so we assist the irrigated agricultural industry to adapt to changing water availability and to manage NSW water resources for productive and sustainable outcomes.

Program 2: Water sustainability



This program increases economic activity by minimising farm production risks associated with variable and uncertain water supply and quality, and the risk of adverse offsite impacts from irrigated production on soils and water sources. The program also provides evidence-based water policy and planning advice to support more profitable irrigation enterprises while maintaining the condition of NSW water resources.

NSW DPI water and irrigation sustainability research and development activities at YAI align to the National Water Use in Agriculture RD&E Strategy and directly support the

Strategy's objectives:

- Manage water use in agriculture to minimise adverse impacts of water
- Facilitate getting knowledge into practice and building human capacity
- Improve capacity to inform planning and policy of agricultural water use.

This program aims to maintain or improve the condition of NSW water sources for NSW communities through agricultural research and development to identify better water management practices. The R&D activities associated with this program:

- identify and promote implementation of sustainable technologies and practices
- assist industry and individual agricultural enterprises to manage key risks to ecosystems
- determine opportunities to share water equitably between productive and environmental needs.

The ultimate objective of this program is to assist farmers to achieve a positive impact on the natural resources essential for their enterprise. We will inform the development of management systems for agricultural industries that minimise negative off-site impacts and impacts on water quality and ecosystem functions. Our program achieves this outcome by undertaking research that:

- informs on the movement and use of water in response to landscape, land use and climate
- improves knowledge of interaction between land uses and hydrological processes affecting water flow and quality
- investigates interactions between land management practices on nutrient loads to water ways and groundwater
- investigates interactions between on-farm water storages and hydrologic processes that impact water quality and aquatic ecology

Through this initiative we will assist primary producers to improve the returns from agriculture and forestry industries in a way that does not cause an unintended impact on shared water resources.

Water & Irrigation—Projects

Program 1: Water productivity

Project 1: Maximising on-farm irrigation profitability (July 2015–April 2018). Co-investor: Rural R&D for Profit, Cotton RDC, RIRDC. DPI lead: John Smith (Robert Hoogers)

This project will develop profitable and sustainable broadacre irrigation systems that increase the profitability and flexibility of agriculture in the southern connected systems of the Murray Darling Basin. The two main areas of research are to:

1. Assess the ability of precision irrigation to apply defined irrigation depths on time and determine its potential to reduce deep drainage and waterlogging risk, and increase nutrient and water productivity
2. Develop irrigation design criteria to allow precision irrigation to occur.

Project 2: Impact of irrigation methods and management strategies on nitrogen fertiliser recovery in cotton (July 2015–December 2019). Co-investor: Cotton RDC. DPI Lead: John Smith

This project will investigate how fertiliser nitrogen (N) recovery is impacted by irrigation system, in-crop irrigation management, fertiliser application strategy and product type within irrigated cotton. It will determine the impact of different irrigation systems on nitrogen use efficiency and investigate alternate irrigation practices to improve nitrogen recovery. It will also determine the impact of alternative fertiliser practices and product types on the recovery of fertiliser N in irrigated cotton.

Project 3: Influence of plant population on rice growth and yield (July 2013–May 2016). Co-investor: RIRDC. DPI Lead: Brian Dunn

Rice plant population recommendations used by growers are unsatisfactory for current rice varieties and sowing methods and do not provide sufficient guidance on when it is economically viable to continue, re-sow or abandon a crop with poor establishment. This project will determine optimum plant populations and upper and lower economic population thresholds for both aerial and drill sown rice in south east Australia leading to increased plant and water productivity and profitability in the rice farming system.

Project 4: Rice variety nitrogen and agronomic management (July 2015–May 2020). Co-investor: RIRDC. DPI Lead: Brian Dunn

There is a knowledge gap in the nitrogen and agronomic management of many current and soon to be released rice varieties resulting in inadequate crop management information for growers and agronomists. This project will determine varietal nitrogen management requirements and phenology information which will lead to improved agronomic management resulting in higher grain yields, water productivity and profitability across the industry.

Project 5: Moving forward with NIR and remote sensing (July 2015–June 2018). Co-investor: RIRDC. DPI Lead: Brian Dunn

Nitrogen management is very important for achieving high grain yields, water productivity and profit from rice growing with growers using the Near Infrared (NIR) Tissue Test and physical sampling of their crops as important tools to determine mid-season rice crop nitrogen requirements. The project maintains the NIR Instrument and calibrations used for the NIR Tissue Test and several research projects and is also investigating the use of remote sensing to determine mid-season crop nitrogen requirements without the need for physical sampling of the crop.

Project 6: Benchmarking water use efficiency and crop productivity in the Australian cotton industry (July 2014–August 2019). Co-investor: Cotton RDC. DPI Lead: Janelle Montgomery (Robert Hoogers)

Program 1: Water productivity

This project will deliver more accurate crop water use information for weather based irrigation scheduling and involves: developing the IrriSAT system to provide water management information over large areas at low cost to improve water productivity; and benchmarking water use and production across fields, farms and catchments to improve water and resource use efficiency.

Project 7: Sub surface drip irrigation management in the Murray Darling (August 2015–March 2019).
Co-investor: ACIAR. DPI Lead: Robert Hoogers

This project will assess the productivity and productivity of irrigated lucerne grown in high evapotranspiration (ET_o) environments with sub-surface drip irrigation (SSDI) compared to conventional surface irrigation and scheduling. The production risks associated with growing lucerne using SSDI irrigation under conditions of high and variable ET_o will also be assessed.

Project 8: Murray Irrigation Ltd partnership in infrastructure improvement program (May 2014–June 2016).
Co-investor: Murray Irrigation Ltd. DPI Lead: Robert Hoogers

To support the objective assessment and training needs of irrigation infrastructure applicants in the Murray Irrigation Area to improve water-use efficiency as part of the Commonwealth on-farm irrigation efficiency program.

Program 2: Water sustainability

Project 1: Systems for reducing evaporation from water storages (July 2011–June 2016). Co-investor: CRC for Polymers. DPI Lead: Harnam Gill

This project aims to develop an automated polymer-based evaporation control system and assess its performance on large water storages. The system applies and maintains a thin surface layer of a novel monolayer-polymer complex which can restrict the transfer of water to air.

DPI Biosecurity—Projects

Project 1: Combining monitoring and incursion surveillance for grains. (01/07/14–30/06/17)
Co-investor: Plant Biosecurity CRC. DPI lead: Mark Stevens

Project objectives include:

- Simplify the monitoring of established and exotic stored-grain beetles by determining which pheromone lures are compatible for simultaneous monitoring of multiple species on individual insect traps.
- Improve the effectiveness of *Cryptolestes* and *Sitophilus* monitoring by investigating plant and fungal volatiles as co-attractants for use with existing and newly developed pheromone lures.

Project 2: Improving pest and disease biosecurity in the Australian rice industry. (01/07/12 – 30/05/16)
Co-investor: RIRDC. DPI leads: Mark Stevens and Andrew Watson

Project objectives include:

- Develop alternative chemicals for the management of aquatic snails in rice.
- Determine how sowing method influences seed disease incidence, and evaluate seed dressings for disease control during crop establishment.
- Conduct systematic disease surveys across the NSW rice growing regions in order to maintain market access.

Project 3: Integrated Crop Management (ICM) to enhance vegetable profitability and food security in the Southern Philippines and Australia (01/03/2013–30/07/2017) DPI Lead: Sandra McDougall.
Collaborator: Andrew Watson

Project objectives include:

- Mitigate microbial and fungal field contamination of melons with washing and sanitation practices postharvest, prior to shipping to market.
- Identify practices within the rock melon packing line to reduce product breakdown.

