CURRENT RESEARCH PROJECTS

– FARMING SYSTEMS –

(Last updated 14 January 2009)

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Research Project Description

Project Title:

Eritrean Capacity Building Project – Dryland Agriculture

(Activity #453)

Principal Investigator:

Dr Alison Bowman

Funding Sources:

Federal Department of Agriculture, Fisheries and Forestry (DAFF).

Summary:

Following the exchange (2004) and signing (2005) of a Memorandum of Understanding between the Australian and Eritrean Ministers of Agriculture, two projects (Dryland Agriculture, Agricultural Education) were initiated in 2005 by DAFF. The undertaking of the Dryland Agriculture project was contracted to Alison Bowman (NSW DPI) and Prof Ted Wolfe (CSU).

A Stage 1 visit to Eritrea for the project was made in April – May 2005, to investigate: "… the current status of Eritrean agriculture with the aim of identifying specific areas of Australian research, expertise and experience that could be the focus of further technical capacity building to assist Eritrea in developing its natural resources and increasing its agricultural capacity, productivity and the efficient use of agricultural land and water resources."

A series of recommendations was produced for DAFF on possible activities that could be undertaken as part of a package of assistance to the National Agricultural Research Institute (NARI) of Eritrea. These recommendations were targeted toward livestock production and resource conservation. The 7 recommendations included proposals on forage evaluation, technical support, developing a strategic plan for the Livestock Division of NARI, landscape management, human resource development, stubble management and intensive livestock production for export.

In July 2005 a second visit was undertaken to Eritrea. The Stage 2 visit comprised reviewing the possible future project with the relevant research directors and staff at NARI and other potential stakeholders. We were particularly interested in assessing the capacity of staff of the Livestock Division of NARI to undertake and/or support research with potential pasture/forage species, and in understanding the local systems of land management and agricultural extension.

We concluded that the highest priority for the Australian Government was to assist Eritrea with a program to introduce a range of pasture and forage species and varieties sourced from the tropical, sub-tropical and temperate genotypes that are held in Australian collections. Australia has considerable strengths in evaluating pasture species and forages in terms of their productivity, persistence and commercialisation. Furthermore, Eritrean scientists would benefit from Australian expertise in animal nutrition, particularly in relation to the nutritive value of feedstuffs for grazing livestock and the use of decision support systems and information packages to guide the management of vegetation, land and livestock resources.

A 3-year project comprising these ideas was proposed to DAFF in August 2005. We are waiting for a response.

Research Project Description

Project Title:

Best Management Practices (BMPs) for Dryland Cropping Systems – Murrumbidgee Catchment

(Activity #454)

Principal Investigator:

Dr Alison Bowman

Funding Sources:

Murrumbidgee Catchment Management Authority (NAP funds).

Objectives:

Although this is only a 1 year project it is intended to help meet the longer term objectives of the CMA of optimising water use in dryland cropping systems in the mid and lower Murrumbidgee catchment through:

1. Better weed and disease management in cropping systems.
2. Improved ground cover through the increased implementation of conservation farming practices.
3. Improved landholder knowledge and management of soil water.

Summary

To achieve the above outcomes, the project consists of 3 component parts each managed by an independent project officer:

(a) A survey to benchmark landholder practices throughout the mid and lower Murrumbidgee catchment in 2005. This survey will provide a snapshot of landholder activity in the region, concentrating on conservation farming practices. The data will also provide the CMA with a basis on which to monitor and evaluate the impact of their other programs and activities.

(b) The development and packaging of information in relation to best management practices for identified problem weeds and disease in cropping systems. A needs analysis was undertaken with 5 landholder and 1 agribusiness group within the target region to prioritise problem weeds and diseases. These groups also identified what was required to assist with the implementation of BMPs. That is: either (i) management packages were available but needed extending to growers; or (ii) information was available but needed to be packaged; or (iii) information was not available and R&D effort needed to be made to rectify this. From this activity 4 issues have been identified (Management of Brome Grass, Management of Fumitory, Management of Cereal Root Disease and Economic Management of Summer Weeds) as requiring information packaging. This will now be the primary objective for the project officer.

(c) Monitoring of wateruse by a range of crop and pasture systems across the catchment. Five “Focus Farms” have been established in conjunction with the Murrumbidgee Grain and Graze project on which crop and pasture production and water use are being monitored. This will provide some “real life” data of what is happening under annual vs perennial pasture and grazed vs ungrazed crop systems. Monthly “Fact Sheets” are produced for growers and agribusiness to raise landholder awareness of water use by dryland crop and pasture systems.

Research Project Description

Project Title:

Analysis of farming systems on the NSW western plains

(Activity #538)

Principal Investigator:

Dr Alison Bowman

Funding Sources:

NSW Department of Primary Industries and the Grains Research & Development Corporation (Project number DAN 00107).

Objectives:

1. Develop a clear understanding of the farming systems in place on the Western Plains of NSW (region bound by Warren, Trangie, Coonamble, Dubbo, Nyngan).
2. Identify a range of prioritised research objectives which aim to correct gaps in knowledge and constraints to production as identified in Objective 1.
3. Report to stakeholders on the reasons why the benefits from current R,D&E activities are not being captured on-farm and the identification of requirements for increasing participation, information access and training for growers.

Summary:

In 2003 GRDC commissioned a scoping study that reviewed research requirements for dryland farming systems on the Western Plains region of NSW. The scoping study identified highly variable soils and aseasonal rainfall as significant biophysical constraints to cropping systems. It also identified that regional growers believed that research outcomes from other areas were not always suitable for their individual conditions. They also believed insufficient emphasis had been placed on collation and delivery of available knowledge. The 2003 report identified three future research areas: (i) soil health; (ii) crop rotations; and (iii) understanding management of weeds and diseases. However areas of required activity within each of these broad groups were not identified or prioritised, making R&D investment difficult to deliver.

Specific issues will be identified through this project to allow grain growers in the region to take advantage of future investment in R,D&E. The project consists of six stages – a literature review, an analysis of two commercial agribusiness databases containing paddock histories to identify biophysical and economic constraints to production in the target region, face to face consultation with growers and agribusiness stakeholders, initial reporting to industry for feedback based on these prior activities, followed by community consultation forums for advice on research and extension initiatives that would help overcome those constraints. A Final Report containing recommendations from all stages will be submitted within 12 months of the project commencing.

Research Project Description

Project Title:

Developing Cropping Best Management Practices (BMPs) for the Western Catchment Management Authorities

(Activity #563)

Principal Investigator:

Dr Alison Bowman

Funding Sources:

NSW Department of Primary Industries and the Western Catchment Management Authority (Project number W CMA WN-0037)

Objectives:

Benchmark the impact of cropping and cropping practices on soil physical and chemical properties in the Western Catchment region of NSW and use this information to develop Best Management Practices (BMP's) for land managers in that catchment.

Summary:

This project will benchmark the impact of cropping history, and cropping practices, on soil physico–chemical properties in the Western region of NSW in order to assist with the development of best management practices for cropping for the Western Catchment Management Authority.

Cropping in this low rainfall zone provides an alternate source of income to large grazing activities and is used to control invasive native scrub in the landscape. There is a strong understanding of the impacts of cropping activities on soil properties for the traditional 'wheat belt' cropping regions of NSW. For example Chan *et al. (*2003) reviewed the impact of conservation tillage on the properties of light-textured chromosols, sodosls and kandosols. They concluded that organic carbon contributions in low rainfall regions were not significantly different for soils that had been cropped conventionally or using direct drilling but that improved physical and biological properties were reported where conservation tillage was used. However, with the exception of detailed research conducted on frequently cropped vertosols near Walgett in North Western NSW by Chan and his colleagues (1988, 1995, 1997 and 2001), there is limited knowledge of the impact of cropping activities on physical, chemical and biological properties for different soil types west of Walgett and Nyngan.

This project aims to use current knowledge to select different cropped fields for a comparison of soil properties and to assess the impacts of different crop management practices on soil resources. For example, the 2001 AgCensus showed that stubble was managed very differently by growers in the Western Catchment Management Authority (47% ploughed in, 23% left intact for direct drilling and 12% was burned).

An estimated 100 sampling sites will be selected from the main cropping soils of the Walgett, Bourke, Cobar and Nyngan regions. Climatic information for sites will be obtained from the Bureau of Meteorology's SILO service. Soil profile descriptions will be made at each site to a depth of 1.2 m, and samples collected at 5 increments (0 – 0.1 m, 0.1 – 0.3 m, 0.3 – 0.6 m, 0.6 – 0.9 m and 0.9 – 1.2 m). Descriptions of soil profiles will include an assessment of texture, the degree of structure, rooting depth and a prediction of plant available water holding capacity. Soil bulk density will be determined for each of the sites at the 0 – 0.1 m depth and all soil samples collected in the field at each of the depth increments field will be analysed for an array of physico-chemical properties using a certified analytical laboratory. This will provide soil pH, electrical conductivity, chloride, total organic carbon, phosphorous, and the suite of exchangeable cations. Sub-samples from the 0 – 0.1 m and 0.1 – 0.3 m depths of each site will be assessed using Mid Infrared (MIR) to predict particulate organic carbon, inert carbon and organic carbon.

This project will provide a snap shot of carbon activity in the assessed soils. Concurrently, a small number of sites (3 sites for each of the broad soil classes) will be sampled for analysis of soil mineral contributions, which will provide baseline data for the different soil types studied.

Research Project Description

Project Title:

High water use farming systems that integrate crops with perennial pastures (the “Lucerne Extension”)

(Activity #639)

Principal Investigator:

Dr Alison Bowman

[Note: This is a collaborative project with the Department of Agriculture & Food – Western Australia (DAFWA), the University of Western Australia, Charles Sturt University, the Victoria Department of Primary Industries and the Grains Research & Development Corporation. The project is led by Perry Dolling from DAFWA]

Funding Sources:

The Future Farm Industries Co-operative Research Centre, the NSW Department of Primary Industries, the Department of Agriculture & Food – Western Australia (DAFWA), the University of Western Australia, Charles Sturt University, the Victoria Department of Primary Industries and the Grains Research & Development Corporation.

Objectives:

1. Increased adoption of lucerne and other perennial plants through the use of better extension packages.
2. Characterisation of farmers and their motivating influences in relation to social and industry drivers that influence their decision to adopt or not adopt perennial plant technologies.
3. Develop a preliminary extension framework to devise the most appropriate extension strategy for different segments of the market for adoption of perennial plants. It is proposed that extension providers use this information to characterise their clients and guide them on the most appropriate adoption pathway.

Summary:

This project is an extension of a project funded from January 2002 until June 2006 under the Salinity Co-operative Research Centre which set out to establish the viability of integrating perennial plants into annual cropping systems. In this extension the project team seeks to obtain new knowledge on adoption pathways used by farmers and extension staff when making decisions about adopting technologies associated with incorporating perennial plants into annual plant based cropping systems. The learnings gained from farmers and extension providers with respect to why they do or don't adopt perennial plant technologies will then be used to develop a national extension framework to assist the uptake of other perennial plant technologies in the cropping zone.

The NSW project team will be responsible for providing information gained from interviewing farmers and extension providers across NSW with respect to their views about the adoption of lucerne and other perennials in the mixed farming zone. This information will be used in conjunction with similar information from Western Australia and Victoria to develop an understanding of the factors influencing a farmer's decision-making process. It will also provide a picture of whether extension providers act as a motivating factor in the farmers’ adoption pathway. The project also aims to increase knowledge about the market place for perennial plants. All these pieces of information will be used to develop a more effective extension strategy that will be used across other projects within the Future Farm Industries CRC.

Research Project Description

Project Title:

Healthy soils in the Central West of NSW

(Activity #461)

Principal Investigator:

Mr Rohan Brill

Funding Sources:

NSW Department of Primary Industries, the Central West Catchment Management Authority and Land & Water Australia.

Objectives:

1. Review literature on soil health.
2. Assist with analysis of a paddock history database to establish soil health benchmarks.
3. Development and delivery of Soil Masterclass workshops and the development of other communication materials.

Summary:

The Central West Catchment Management Authority is responsible for providing education, training and other capacity building activities to improve natural resources in the catchment. In this catchment, the area downstream of Narromine has significant soil health and water quality issues. There are also incomplete data sets for water and soil characteristics in the region and unused monitoring networks as well as few appropriate benchmarks from which to measure change. This project will help address these issues by establishing appropriate benchmarks and involving the community in development of best management practice to improve soil and water health.

NSW DPI will be involved in reviewing existing data and literature and establishing benchmarks for soil health. This information will be incorporated into to "Soil Masterclass" workshops that will be delivered to stakeholders in the catchment to assist them to meet the CMA's soil health targets.

Research Project Description

Project Title:

Eastern Farming Systems (Phase II) – a partnership for participatory research, development and extension in the north eastern grain belt

(Activity #335)

Principal Investigator:

Giles Butler (NSW Leader)

[Note: This is a collaborative project with the Queensland Department of Primary Industries & Fisheries (Mr David Lawrence – QDPI&F leader and overall EFS leader), the Queensland Department of Natural Resources, Mines & Energy (Dr Geoff Titmarsh – QDNRME leader), and the CSIRO (Dr Peter Carberry – CSIRO leader)].

Funding Sources:

NSW Department of Primary Industries, the Queensland Department of Primary Industries and Fisheries, the Queensland Department of Natural Resources, Mines & Energy, the Commonwealth Scientific & Industrial Research Organisation and the Grains Research & Development Corporation (GRDC Project No. DAQ00050).

Objectives:

1. Priority Farming Systems themes for the project identified through a partnership of the project team, farmers and agribusiness in the region.
2. Greater participant understanding and insights developed from participatory on-farm research on priority farming systems themes identified in the project.
3. Greater participant understanding and improved management decisions resulting from the development and use of action learning activities on priority farming systems themes identified in the project.

Summary:

The Eastern Farming Systems project (EFS) relies heavily on the involvement of farmers, agribusiness and relevant Research Advisory Committees (RACs) in the planning and conduct of on-farm research. EFS began in July 1997 and has demonstrated the value of participatory Farming Systems Research in the higher rainfall zone of the northern grains belt – roughly delineated as east of the Newell and Leichhardt highways in northern NSW and southern Queensland.

Phase I of the project generated new scientific knowledge, instigated changed farming practices, and improved research, development and extension processes. The field research program ranges from paddock monitoring and data collection to on-farm replicated experiments using farm scale equipment. Data collected from farmers' fields are used to validate the Agricultural Production Simulator (APSIM) a model that can extrapolate and generalize the findings. The second phase is continuing with these initiatives, but will also place greater emphasis on the diffusion of research findings beyond the research locations.

The vision for Phase I was that farming systems practiced in the north-eastern grain belt would benefit from farmers, advisers and researchers together exploring options for improved economic and environmental sustainability. This vision, the mandate area, types of research issues addressed and participative processes of the initial EFS project remain highly relevant and are again proposed for the second phase.

Phase II will concentrate on addressing 3 – 4 priority Farming Systems themes each year as negotiated and reviewed with industry and the project team. RAC representatives on the management committee will ensure the relevence of these themes to the region. Phase II will produce Action Learning Modules (ALMs) to address priority systems issues. ALMs are designed to enhance participants' understanding of priority issues and consequently improve their management with more informed decision making. ALMs will help farmers to "navigate" through the available information, to understand it, and apply it to their own "real-time" farm decisions. This will help EFS Phase II bring technical issues to life for growers and ensure activities go beyond simply creating awareness.

Research Project Description

Project Title:

Legumes and reduced tillage for cereal-based cropping in southeastern Australia and the Democratic People's Republic of Korea (DPRK)

(Activity #325)

Principal Investigator:

Dr Jeffrey Evans

Funding Sources:

NSW Department of Primary Industries and the Australian Centre for International Agricultural Research (ACIAR Project No.: SMCN/2001/048)

Objectives:

1. In the DPRK, restore soil fertility and yields of staple cereal crops (rice and maize).
2. In Australia, evaluate the role of clover forage conservation crops in sustaining wheat production.

Summary:

In the Democratic People's Republic of Korea, rice and maize are staple foods. Fifteen years ago, yields of rice and maize achieved with inputs of nitrogen, phosphorus and potassium fertilisers (NPK) were frequently 6 – 8 t/ha. However, supply of these inputs declined with the collapse of the Russian economy, and with subsequent continuous cropping, soils have now become severely impoverished and eroded. Staple cereal yields have declined to 2 – 3 t/ha. Recovery of yields to historic potential is essential for self-dependence of the DPRK population for food.

The strategy for sustainable achievement of higher cereal yields involves restoring organic carbon and nitrogen in the soils by cultivating single-season winter tolerant legumes, such as hairy vetch and certain medics, and returning all the legume biomass to the soil (green manuring). In the sloping maize country, the second strategy is to preserve the fertility benefits of green manuring by using minimal soil cultivation and retaining plant material on the soil surface to protect soil from erosion. Over time, the project will measure the cumulative effect of these strategies on soil fertility, crop requirement for nitrogen fertiliser, and soil erosion.

In Australia, sustainable cropping also depends on diversifying crops in rotation. Single-season legume crops other than grain legumes are required to meet farmer needs for greater diversification. The Australian component of the ACIAR project aims to evaluate the agronomic and economic impact in cereal systems of clover grown for forage conservation. Both field experimentation and simulation modelling are being used to evaluate the clover-cereal system at the plant and soil level.

Research Project Description

Project Title:

Enhancing production and marketing of maize and soybean in north-western Cambodia and production of summer crops in north-eastern Australia

(Activity #648)

Principal Investigator:

Prof. Bob Martin (Primary Industries Innovation Centre) and **Dr Bob Farquharson** (NSW DPI team leader)

Funding Sources:

NSW Department of Primary Industries, the University of New England, the University of Canberra, the Commonwealth Scientific & Industrial Research Organisation, the Cambodian Agricultural Research & Development Institute, the Maddox Jolie Pitt Foundation and CARE International.

[Note: This is an international project between Australia and Cambodia. The collaborators in Australia include the NSW Department of Primary Industries, the University of New England, the University of Canberra and CSIRO. The collaborators in Cambodia include the Cambodian Agricultural Research & Development Institute, the Maddox Jolie Pitt Foundation and CARE International. The Provincial Departments of Agriculture in Battambang and Pailin will also be engaged via a Memoranda of Understanding and secondments with the Maddox Jolie Pitt Foundation and CARE International.]

Objectives:

Cambodia
1. Enhance smallholder income by improving the functioning of the production – marketing system for maize and soybean in north-western Cambodia using participatory methods.
2. Enhance the adoption of improved technologies and practices for production of upland crops by integrating agronomic, economic, environmental and social factors.
3. Improve post-harvest management, communications along the supply chain and value chain integration for maize and soybean in north-western Cambodia.

Australia
1. Conduct a bio-economic evaluation of the technologies and strategies to reduce the impact of climate variability and climate change on farm.
2. Adapt and develop whole-farm models for extension programs.
3. Determine the social networks that influence farm practice change with a focus on adoption of conservation farming practices.

Summary:

In Cambodia, the overarching aim of the project is to improve agricultural value chains as a key to sustainable growth and poverty reduction. The project will facilitate the sharing of knowledge and information at all stages of the value chain from farmer to end-user. This will deliver practical benefits including improved food security, increased income, and reduced vulnerability to disruptions for rural poor farmers. In north-western NSW, the aim is to address lack of adoption of conservation farming practices, increase summer crop diversity and to develop strategies for adaptation of farming systems to climate change.

ASEM/2006/130 will focus on production and marketing problems faced by poor smallholder farmers in north-western Cambodia. Production of crops such as maize and soybean have rapidly expanded since re-integration of the former Khmer Rouge began in 1996. However, in the space of 10 years, crop yields are now declining and soils are being degraded by excessive cultivation and burning. The development has been largely driven by market demand in Thailand. Local farmers are disadvantaged by lack of market information, inadequate post-harvest technology, and transport infrastructure.

The 3 aspects of the Australian component of the project will: (a) use simulation modelling to identify response-cropping strategies that reduce the risks associated with climate variability and climate change; (b) use whole-farm models and business management tools to enable farmers to evaluate options; and (c) use social network analysis to identify opportunities to facilitate further adoption of conservation farming practices. In the modelling component we plan to use APSIM in collaboration with Dr Colin Birch's group at University of Queensland, Gatton. This group has carried out simulation studies of dryland maize production in north-east Australia using long-term weather data input to the APSIM model. The studies considered sowing time options, population density, cultivars, and water availability at sowing. Simulation outputs from these models will be used in the bio-economic modelling to evaluate technologies and strategies to reduce the impact of climate variability and climate change on farm.

Research Project Description

Project Title:

Weed competition in chickpea, faba bean, canola and wheat

(Activity #378)

Principal Investigator:

Warwick Felton

Funding Sources:

NSW Department of Primary Industries and the Grains Research & Development Corporation (Project No. DAN 465).

Objectives:

1. Determine yield loss caused by weeds in chickpea, fababean and canola compared to wheat.
2. Investigate the effect of row spacing on yield in weed competition trials.
3. Investigate fertiliser placement in weed competition trials in order to improve the crop competitiveness against weeds.
4. Determine the critical stage in the growing season that weeds must be sprayed in order to maintain optimum crop yields.

Summary:

Experiments at Tamworth in 2001, 2002 and 2003 with chickpea, fababean, canola and wheat sown at row spacings of 32 and 64 cm examined competition by "weeds" at densities of nil, 3, 9, 27 and 81 /m^2. Triticale was used as a mimic weed to simulate competition by wild oat. Using mimic weeds in competition or weed control experiments provides more uniform weed treatments than can usually be obtained by sowing actual weeds, or using naturally occurring weed populations. The technique means paddocks do not become contaminated with real weeds, and weeds not wanted can be removed by spraying without compromising the experiment. The heads of the mimic weeds can be removed before the grain of the weed is set allowing easy harvest of the treatments, and contamination of the crop grain sample is avoided. Weeds were more competitive in chickpea than fababean and canola, and least competitive in wheat. However, differences varied between years.

More and more farmers are planting crops in wider rows because there is less chance of the no-tillage planter machine being blocked by residues of the previous crop. Also, wider rows make it possible to apply agricultural chemicals in bands between the crop rows. This enables a wider range of options as well as reducing the overall amount of chemical applied to the field. In weed-free treatments, wide row spacing did not reduce the yield of chickpea, fababean or canola. Wide rows reduced wheat yield in 2002 and 2003. However, weeds are more competitive in wider rows and farmers must be more diligent to effectively control weeds in this system.

The time of removal of weeds can be an important decision for the grower. If a selective herbicide is applied early, weeds that germinate after the application will continue to grow and compete with the crop. An experiment was carried out where a herbicide was applied to control the weeds in a chickpea crop at 5, 7, 10, 13, 16 and 19 weeks after sowing. There was no significant loss in chickpea yield until spraying was delayed to 13 weeks after sowing with 27 weeds /m^2 and 16 weeks with 9 weeds /m^2. Therefore it is feasible to delay post-emergence herbicide application until 8 – 10 weeks after sowing.

Research Project Description

Project Title:

PROCROP training course – reduced environmental impacts from more profitable broadacre annual cropping enterprises *(Activity #529)*

Principal Investigator:

Mr Chris Cole

[Note: This is a NSWDPI cross-divisional project led by the NSWDPI Division of Agriculture & Fisheries with collaboration from the NSWDPI Science & Research Division (Dr Neil Fettell and Mr Guy McMullen)]

Funding Sources:

NSW Department of Primary Industries and the Natural Heritage Trust Strategic Reserve Fund (via the Department of Natural Resources).

Objectives:

1. Provide farmers with the knowledge and motivation to increase water use by the main broadacre crops.
2. Develop and deliver workshop material to advisers and growers across Catchment Management Authority (CMA) catchment areas.

Summary:

This project uses a similar methodology to the successful Prograze courses that have been well received by farmers and Catchment Management Authorities. The main learning outcomes from the course will be to understand, in annual broadacre crop production systems:

- Environmental and production consequences of not balancing water use with annual rainfall.
- How annual crop plants interact with the environment and natural resources through the crop development cycle.
- Consequences of sub-optimal growth (such as from pests & diseases, soil constraints) on water use.
- Management options in to balance crop water use with annual rainfall.
- Management options for more resilient farming systems that can better match our variable climate.

Much of the material in this course will be relevant across all Catchment Management Authorities in the cropping zone, hence it has been more cost effective to develop this material as a single, state level project. The project allows for local customisation, for example through incorporating local environmental issues, case studies and economic modelling. The set of environmental issues that will be covered are relevant to many soil and water quality targets.

Research Project Description

Project Title:

Best management practices for profitable oilseed production in low rainfall environments

(Activity #356)

Principal Investigator:

Dr Neil Fettell

Funding Sources:

NSW Department of Primary Industries and the Grains Research & Development Corporation (GRDC Project No. DAN 00011).

Objectives / Expected Outcome:

Better profitability and reliability of winter oilseed production leading to an increase in the area sown to oilseeds in lower rainfall areas.

Summary:

Canola is a minor crop in many low rainfall areas when compared to its production in higher rainfall zones. For example, in 2000 cereal production in the Condobolin district occupied approximately 390,000 ha while the canola area was only 7,000 ha. A profitable oilseed crop would be welcomed by producers but, based on current technology, farmers consider that the crop has a higher risk of failure than cereals.

Preliminary research conducted by NSW DPI in collaboration with Central West Farming Systems has indicated that good economic returns are possible from canola in low rainfall environments. These findings may change the way farmers perceive canola particularly if clear Best Management Practice guides can be produced.

Two areas require further field work to obtain results over a range of seasons and give farmers confidence in the results. The first of these is variety choice, particularly choosing the the most suitable maturity type for a particular area. Current NSW DPI recommendations are that farmers consider short-duration cultivars in lower rainfall areas. However, mid-April sowing is often possible and under these conditions it may be that medium duration varieties will be more successful. In 2000, medium maturity varieties performed very well even when sown in late May. This result may have resulted from the cool, wet conditions in late spring in 2000 and therefore the work needs repeating. Other considerations are the increased frost risk associated with early sowing and the danger of canola seedlings dying due to drought stress under the warmer conditions of early autumn. Further work combined with computer modelling will provide the information to answer these questions.

The second area requiring further work is the place of canola in rotations. Farmers have two options, sowing canola as the first crop after pasture or later in the crop sequence, usually following wheat. The choice depends on several factors: the relative profitability of prime hard wheat vs canola; the extent of broadleaf weed problems; the nutrient status of the paddock; and the value of stored water. Rules of thumb need to be developed (between the amount of water stored in the profile at sowing and performance of canola after wheat) to give farmers confidence that the extra investment in canola is worthwhile. A controlled field experiment combined with modelling is likely to be the most cost efficent way of providing this information.

This project aims to combine existing knowledge with carefully targeted field research and modelling to produce a best management package for low rainfall environments of eastern Australia.

Research Project Description

Project Title:

Barley agronomy for southern Australia

(Activity #590)

Principal Investigator:

Dr Neil Fettell

Funding Sources:

NSW Department of Primary Industries, the Grains & Research Development Corporation, the South Australian Research & Development Institute and the Birchip Cropping Group.

Objectives:

1. Develop management packages for newly released barley varieties based on field research. Emphasis will be given to the use of these varieties in stubble retention/no-tillage and precision farming systems.
2. Characterise the phenology of new varieties to provide growers in different cropping regions with specific time of sowing guidelines and to refine the APSIM model for predicting rates of crop development, response to nitrogen and final grain yield.
3. Inform barley breeders of key traits for which emphasis and selection is required in changing farming systems.
4. Extend the information to growers across southeastern Australia

Summary:

Barley is a major winter crop in southern Australia, ranked second behind wheat in area and production. Barley production during 2005-06 was estimated at 2.2 million tonnes in NSW alone. Grain received as feed is used for domestic stockfeed, or exported as feed grain. The proportion received into malting grades varies with season and location, but is typically 30 – 50%. Malt barley from this region is used for domestic malting and brewing or exported as either whole grain or malt. These markets differ in their quality requirements and therefore in their preferred varieties.

To maximise their returns from barley, growers will need to make the right decisions about markets, varieties and crop management. The first choice is whether to target the malt or feed market. The second choice is which variety, and this requires good information. Since 2002, 13 new malting varieties have been or are about to be released nationally, representing varying improvements in yield, disease resistance and malting quality over the standard varieties.

These new varieties are likely to differ in their optimum sowing time, seeding and fertiliser requirements, weed competitiveness, disease reactions and adaptation to new farming systems.

The project will develop a coordinated network of agronomic research and extension across the southeastern region ensuring that both a range of farming systems and environments are serviced, and that advanced knowledge on barley agronomy is provided to growers and advisors across the entire region.

Research Project Description

Project Title:

High yielding irrigated grains in cotton farming systems

(Activity #600)

Principal Investigator:

Ms Verity Gett

[Note: This is a collaborative project with the Northern Grower Alliance, Queensland Department of Primary Industries & Fisheries and the Queensland Department of Natural Resources]

Funding Sources:

NSW Department of Primary Industries and the Grains Research & Development Corporation through the Cotton CRC.

Objectives

1. Establish best practice recommendations in regards to establishment and irrigation for high yielding, high input grain crops in rotation with cotton in Northern Farming Systems.
2. Demonstrate cereal rotations are a profitable use of irrigation resources when high yields are achieved.
3. Ultimately, Farmers with access to irrigation choosing to allocate irrigation water to grain crops grown in rotation with cotton to maximise the dollar return per megalitre and thus the profitability of the whole farm enterprise.

Summary:

This project aims to generate best practice recommendations for establishing and irrigating winter cereals in cotton growing regions of NSW and Queensland.

Previous farming systems research has shown that there are significant yield and soil health benefits from producing cotton in rotation with high input wheat. Increasingly, irrigators are judging their profitability in terms of $/ML rather than $/Ha. On this basis, cereal rotations are a profitable alternative use of the irrigation resource when high yields are achieved.

Research is required to determine how to consistently establish the uniform, high plant populations required for yield potential of high input cereal crops and to evaluate irrigation practices. The outcome will be irrigators choosing to allocate irrigation water to winter cereal crops to maximise the profitability of their cropping system.

In this project ‘high input’ is characterised by full water and nitrogen allocation together with a monitoring and management regime of similar intensity to that used in cotton production. While yields of 5-7 T/ha do occur, the production system is currently viewed as high risk due to its inconsistency. This project aims to refine the management system to improve consistency of results so that average yields of 5-7 t/ha are realistic.

Research Project Description

Project Title:

Impact and role of novel insecticides in integrated pest management (IPM)

(Activity #380)

Principal Investigator:

Viliami Heimoana

Funding Sources:

NSW Department of Primary Industries and the Cotton Research & Development Corporation (Project No. DAN 160C).

Objectives:

1. Research the efficacy of new insecticides for controlling *Helicoverpa* species in cotton.
2. Evaluate the impact of these insecticides on other pests and beneficial insects.
3. Evaluate the efficacy of new insecticides for controlling aphids in cotton.
4. To evaluate the impact of these new insecticides on other pest and beneficial insects.
5. Assess the most appropriate positioning of these new insecticides in the cotton crop protection IPM strategy.

Summary:

Transgenic cotton varieties such as Ingard® and Bollgard® II were developed by inserting genes from the soil bacterium *Bacillus thuringiensis* (Bt) into cotton. These genes produce proteins that are toxic to the main insect pest of cotton – the cotton bollworm (*Helicoverpa*). When the caterpillars eat the Ingard® or Bollgard® II cotton they die. The introduction of transgenic cotton has reduced the overall volume of insecticide application in cotton. However, it is anticipated that insecticides will continue to play a significant role in pest management in the cotton industry. Transgenic cotton still needs *Helicoverpa* protection late in the season and protection from secondary pests throughout the season. The secondary pests become more important as the moderating effect of *Helicoverpa* sprays on these pests is delayed.

Recently the industry has been at risk of loosing some of the insecticides registered for cotton due to resistance build-up or environmental problems. There are also chemicals which are not recommended for use due to their negative effect on beneficial insects and the consequently adverse effects on the IPM strategy. IPM by definition is "The utilisation of all available resources to achieve the most sustainable, economical, practical, and effective solution to control a pest population". One of the IPM options is to find new pesticide chemicals that can be used for pest management in cotton that satisfy the requirements described above. This project allows timely independent assessment of the claims of chemical companies as to the impact of new chemicals on target pest and beneficial insects under Australian conditions.

The chemicals tested are either newly registered or yet to be registered insecticides and, for *Helicoverpa*, include amorphous silica, azadirachtin, novaluron, indoxacarb, methoxyfenocide, phenyl ether derivative and semicarbozone. For aphid control they include acetamiprid, carbosulfan, chlothianidine, imidacloprid, pymetrozine, pyriproxifen, thiamethoxam and a PSO/Carltex oil mixture.

The ‘old’ and ‘new’ insecticides are tested under experimental conditions on non-transgenic and transgenic cotton in the field. The results of this research provide essential data that will assist in placement of these insecticides in the Integrated Pest Management (IPM) and Integrated Resistance Management (IRM) programs. This will provide regular field monitoring of the efficacy or resistance stage of these insecticides on the target pest and their effect on other pest and beneficial insects.

Research Project Description

Project Title:

High water-use farming systems that integrate crops with perennial pastures

(Activity #348)

Principal Investigators:

Brett Honeysett & Dr Neil Fettell

Funding Sources:

The Grains & Research Development Corporation and the Cooperative Research Centre for Plant-Based Management of Dryland Salinity (Program 4, subprogram 7). Funded until June 2006.

Objectives:

This project is exploring ways in which perennials, capable of utilising surplus soil moisture can be successfully integrated into annual farming systems to minimise deep drainage and prevent dryland salinity. This involves evaluating lucerne and other perennial pastures as productive components of crop and livestock systems. We are monitoring soil water use (down to 3m) and production on the Central West Farming Systems (CWFS) trial site, a lucerne companion cropping trial (cereal sown into an established lucerne stand), a phase farming trial at several district sites.

Summary:

Central West Farming Systems Trial (CWFS) 2003

Full scale monitoring began in September 2003, a very dry season. However, the long term effects of the rotations (Conventional tillage, Reduced tillage, Zero tillage and Perennial pastures) could be seen as 2003 marked the first year of the second 5 year rotation for the CWFS core site.

- After 6 years the two rotation systems which include lucerne (CT, RT) contained over 200 mm less soil water (after the pasture phase) than the continuous annual cropping system, in the top 3m of soil.
- Soil moisture contents below 100cm were considerably higher in annual plots

CWFS Site 2004

A very dry start to the year but hopefully the finish will be better. Total rainfall to date is 232 mm (about 50mm below average), much of this in late summer. The plots were sown in June/July with good establishment. The soil profile under the continuous cropping system in June 2004 contained 50 mm more soil water within the crop root zone than the crops sown after 2 or 3 years of lucerne. It will be interesting to see if this variation influences yield.

Companion Cropping Trial

Barley was sown into an established four year old lucerne stand with some plots receiving added N, and chemical suppression of lucerne at critical times to reduce competition. The aim is to see if opportunistic cropping can be carried out into a lucerne stand.

Phase farming trial

Annual crops (wheat, barley and peas) and pastures (medic sub-clover mix) and lucerne were sown in June and water added to some plots. The aim is to measure the rate and depth of water extraction under a wider range of soil moisture conditions than have occurred naturally so far in the years of the project.

Condobolin district sites

We have four properties located around Condobolin monitoring soil moisture and production in a perennial pasture and an annual crop. CSIRO are also monitoring drainage on these sites. Crops were sown June/July with good emergence on most sites. Pasture growth has been very poor to date due to seasonal conditions. Soil moistures in August 2004 indicated a rapidly drying top soil down to 50cm but some moisture at 70cm, possibly stored from the January – February rain.

Research Project Description

Project Title:

Tools to reduce the impact of climate variability in South Eastern Australia

(Activity #408)

Principal Investigator:

Dr De Li Liu

Funding Sources:

NSW Department of Primary Industries and collaboration with the Victoria Department of Primary Industries through the Grains Research & Development Corporation.

Objectives:

1. Identify and quantify the risks associated with management options available to growers, in relation to climate variability by using crop simulation models.
2. identify and quantify the impact and suitability of management options to reduce the incidence of climate risks.
3. Evaluate existing forecasting systems for seasonal rainfall and temperatures.

Summary:

Rainfall variability and frost damage are the major sources of yield fluctuation in dryland crops in south-eastern Australia (SEA). Winter crop production in the region varied up to 7 fold as a consequence of climate variability, particularly drought and frost. Yield losses due to frost vary from 5 to 35% in New South Wales and from 5 to 50% in Victoria, depending on severity and timing. Although there are no accurate figures available on the value of production lost to frost, an extensive frost causing a direct yield reduction of only 5% on 1 farm in 5 in New South Wales, South Australia and Victoria would represent a financial loss of more than 34 million dollars p.a. at current prices.

Although climate variability is inherent in dryland farming, the management of climate risk in SEA grain farming systems can be improved significantly. In SEA, where the lack of reliable summer cropping alternatives reduces the options to spread risk, annual farm cashflow is more likely to be diminished in poor seasons. Furthermore, the many subsoil limitations and generally lighter soils mean that growers are less able to buffer their crops with stored soil water. In this poorly buffered system, growers face a delicate balance whereby early sowing would help to avoid moisture stress in spring but would increase the risk of frost damage at other critical stages.

This project is developing a Climate Variability Analyser (CVA) to facilitate the analysis of climate variables including number of frost days, heat stress, seasonal rainfall and the break of season for sowing, in conjunction with seasonal forecasting. CVA can be used to evaluate forecasting systems using cross validation and reliability plots. In NSW, a regular leafsheet named “Weather or not” is produced for farmers through the project.

Research Project Description

Project Title:

Decision support systems for avoiding frost damage through reliable prediction of time to flowering for wheat and barley in NSW

(Activity #410)

Principal Investigator:

Dr De Li Liu

Funding Sources:

NSW Department of Primary Industries and residual funds from a consultancy income from National Land & Water (Audit Theme 5, Project 4C).

Objectives:

To model plant production systems and associated processes and to conduct experiments to provide data to define particular parameters for functions used in the phenology models.

Summary:

Each year in Central and Southern NSW wheat farmers are faced with having to wait for planting rains and so the sowing opportunity varies from early April to late July. Subsequently, decisions on variety by planting time by frost risk are key decisions in the farming system. Data collected in this project over a number of years will greatly enhance our understanding of plant /environment interactions to assist in minimising such risks.

This project will conduct phenology trials (time of flowering) throughout central and southern NSW using the existing District Agronomist network. District Agronomists in conjunction with Technical Assistants (where available) will be responsible for securing land approximately (12m x 12m) and labour to conduct the phenology trial consisting of 5 planting times, 30 entries. 50 seeds will be supplied for each entry for each sowing time, which should be sown by hand in 1- metre rows with about 30 cm row spacings between entries. Once sown, emergence date will be recorded along with any other relevant observations. Later, full head emergence will be recorded for each entry together with planting time and minimum temperatures (on day of visiting site), using the max-min thermometer supplied.

At the end of flowering of all entries and sowings, all recordings of flowering date along with other observations will be made available to the project supervisor. This will be accompanied by the meteorological weather data (year of trial) from the nearest meteorological station for the period from planting to maturity ego (March – November).

Computer software will be developed to help farmers to select crop, variety and sowing dates, and to assess the risk of frost and estimate yield. The software will be based on the SOWMAN, a prototype developed based on an experiment conducted at Wagga Wagga. The software will be windows basis.

Research Project Description

Project Title:

Development of a climate change adaptation risk assessment tool in a GIS framework

(Activity #730)

Principal Investigator:

Dr De Li Liu

Funding Sources:

NSW Department of Primary Industries and the NSW Department of Environment & Climate Change (Project No. T06/CAG/004).

Objectives:

1. Understand the impacts of various climate change scenarios for specific agricultural sectors and geographical regions and identify risks and opportunities.
2. Inform the agricultural sector of the risks and opportunities that will need to be responded to over the next 5 -10 years to ensure viable agricultural industries into the future.
3. Define the agricultural and geographical areas most sensitive to climate change to inform and prioritise appropriate responses.
4. Inform the agricultural sector of the most appropriate adaptation responses to meet the challenges and opportunities presented by climate change.

Summary:

Understanding the risk profile of farmers and integrating this profile with their decision making has been one of the major impediments to the uptake of the current generation of climate risk management tools. Although this project will not address this issue directly, it will assess the impact of the range of reactions to the risk of climate change and integrate these into the possible range of adaptation strategies. The outputs from this tool will provide guidance on the adaptation strategies that are most likely to succeed.

A Geographic Information System (GIS) database of current agricultural production in NSW will be collated and form the framework for the development of the application. The project will then evaluate the range of models available for simulating wheat growth in Australia. An assessment on the best models to use for this exercise will be made against the following criteria:

- Ease of linking a stochastic weather data generator to create required input files.
- Ability to incorporate a range of management options linked with various adaptation strategies.
- Amount of validation and verification of model outputs for the range of geographical areas and management practices in a wheat production system.
- Ability to incorporate modelling output into a GIS framework or access to source code so that a seamless integration of model output into the GIS framework can be developed.

Once the modelling framework has been determined, a database of current management practices in the wheat growing areas across Australia will be developed. A GIS framework will be developed as the portal to the climate change outputs and the agricultural simulation models. Although wheat will be used as a case study for this project, the design criteria for the GIS framework and adaptation assessment tool will include the ability to easily incorporate any other agricultural commodity. The design criteria will also require that output from the GIS framework can be delivered through a variety of mediums including internet delivery through the climate change website being developed under strategy 1.3 of the NSW Greenhouse Plan (NSW Greenhouse Office 2005).

Research Project Description

Project Title

The response of annual and perennial pastures to lime application in arable duplex soils of SE Australia

(Activity #326)

Principal Investigator:

Dr Guangdi Li & Dr Mark Conyers

Funding Sources:

Project funded by the NSW Department of Primary Industries with financial support from Australian Wool Innovation (1992 – 1997 and 2004), the Grains Research & Development Corporation (1997 – 2002), Acid Soil Action (1997 – 2003), Meat & Livestock Australia (1994 – 1997) and Land & Water Australia (1994 – 1997).

Objectives:

1. Test whether applying lime is profitible for pasture and sheep production (wool and wool/meat enterprises).
2. Test whether perennial pastures are less acidifying than annual pastures.
3. Evaluate effects of lime and pasture types on wool quality.

Summary:

"Managing Acid Soils Through Efficient Rotations" is a long-term experiment commenced in 1992. It was designed to develop and demonstrate a sustainable agricultural system that is economically viable and environmentally effective to manage the highly acid soils in the high rainfall (550 – 800 mm pa) region of south-eastern Australia. With the completion of its second cycle in 2004, a new 6-year cycle started with a slight modification of the original design in autumn. The proposed new cycle are focused on pasture and sheep responses to lime.

The key features for the new cycle are:

- Perennial pasture system versus annual pasture system. There are two types of perennial pastures, one with phalaris, cocksfoot, lucerne and sub-clover mix, the other with phalaris, chicory, lucerne and sub-clover mix. There are two types of annual pastures, one with annual ryegrass and sub-clover mix, the other with annual ryegrass biserrula and serradella mix.
- Limed treatment versus unlimed treatment. Lime will be applied every 6 years as originally designed. Soil chemical data will be collected.
- Pasture and sheep will be managed to maximise pasture and sheep production without degrading wool quality.

At the completion of the project, we will be able to demonstrate a) whether applying lime is profitable on pasture and sheep production (for wool and meat); b) whether perennial pastures are less acidifying and more productive than annual pastures. The outcome from the proposed project will be a comprehensive information package which can be used as a guideline for the wool producers to manage highly acidic soils economically and sustainably in south-eastern Australia. Furthermore, the site will be an excellent demonstration site for extension purposes.

Research Project Description

Project Title:

Managing perenniality in permanent pastures to improve catchment hydrology

(Activity #331)

Principal Investigator:

Dr Brian Dear & **Dr Guangdi L**i

Funding Sources:

Project funded by NSW Department of Primary Industries with financial support from the CRC for Plant Based Management of Dryland Salinity.

Summary:

Deep-rooted perennial pasture plants can play an important role in alleviating environmental problems of rising watertable, dryland salinity and soil acidification in the wheatbelt of southern Australia. Lucerne is the most widely sown perennial legume in cropping areas because it can fix nitrogen and use more water. However, more extensive use of lucerne is restricted by a number of factors including soil acidity, waterlogging, animal health problems and its susceptibility to continuous stocking. A national field evaluation program within the CRC for Plant-Based Management of Dryland Salinity is focussed on identifying new deep-rooted perennial plants to use more water in the soil and reduce deep drainage to the ground water, and salt tolerant species to address environmental problems associated with dryland salinity within the cropping zone of southern and eastern Australia.

There were 135 lines from 53 perennial species in 24 genera being evaluated across 4 States (NSW, VIC, SA and WA). These species were sown into general nursery, waterlogged soil nursery and acid soil nursery.

The general nursery sites were selected in the first phase of the evaluation programme to minimise the effects of soil factors on plant growth, such as soil acidity, waterlogging and low fertility. This was done to promote the establishment and survival of novel plant species, with which most participants had little or no previous experience. Lucerne tended to perform well at most sites. Species showing potential in the general nurseries will subsequently be evaluated on a range of soils where lucerne is less well adapted, in accordance with the initial objective of the programme. Waterlogged and acid soil nurseries are targeted for those more difficult soils.

Research Project Description

Project Title:

Developing new perennial legumes and herbs to reduce recharge in southern NSW

(Activity #330)

Principal Investigator:

Dr Jim Virgona & **Dr Guangdi Li**

Funding Sources:

NSW Department of Primary Industries and the CRC for Plant-Based Management of Dryland Salinity.

Objectives:

1. Assess and classify the potential for increased perenniality by examining the capacity for regeneration of native grasses (especially C4 – summer growing).
2. Investigate practical, low cost, management strategies (grazing, burning, fertiliser, herbicide) that will improve the perenniality in these landscapes.
3. Examine the impact of increased perenniality on critical hydrological characteristics that will allow application beyond the study catchments.

Summary:

This project is applicable to permanent pastures in high rainfall zone (550 – 700 mm) of southern Australia. It is targeted at land classes that are unable to be sown into exotic perennial species, such as lucerne or phalaris, because those areas are too acid and/or too infertile and non-arable. At the first phase of this project, a native grass survey of the relevant parts of the landscape was done to determine the potential for regeneration of native perennial species. This survey covered approximately 60 farm properties in three catchments, Murray, Murrumbidgee and Lachlan catchments.

In the second phase of the project, the focus was on devising management strategies for improving perenniality. The sites were selected to represent a representative range of botanical diversity. The target species were identified and investigated to determine characteristics important for regeneration, i.e., germination, phenology and seed production. Field experiments were conducted to manipulate botanical composition by grazing management, fertiliser management and/or weeds control by spray etc. Climatic factors and changes in soil water content were measured to calculate the water balance at each site.

The outputs that would result from the successful completion of this project are: a) Decision guidelines that would enable landholders to determine what areas have the potential to be improved and provide these landholders with management strategies to increase their native perennial grass component; b) Determination of the prevalence of native grasses in each catchment; c) Increased knowledge of native perennial grasses, their ecology and impact on soil water relations, and d) Suitable landscape management strategies to reduce impacts on salinity in terms of recharge and stream dilution.

Research Project Description

Project Title:

Improving the productivity and sustainability of rainfed farming systems for the western loess plateau of Gansu province, China

(Activity #324)

Principal Investigators:

Dr Guangdi Li, Dr Yin Chan, Dr Damian Heenan, Dr Gordon Murray & Gerard O'Connor

[Note: This is a collaborative project which is being led by Dr Bill Bellotti at Adelaide University]

Funding Sources:

NSW Department of Primary Industries, the Australian Centre for International Agricultural Research (ACIAR Project SMCN/1999//094), Adelaide University and the CSIRO Agricultural Production Systems Research Unit.
[Note: The project commenced in 2001 and was due for completion in December 2004. However, an extension has been granted till July 2005 and requests have been made for a further extension of 18 months.]

Objectives:

1. Develop conservation tillage cropping systems in Gansu, China. (NSW Department of Primary Industries has been mainly responsible for this objective).
2. Develop legume-cereal crop rotations.
3. Analysis of current and proposed new farming systems with the aid of system simulation models.
4. Building the capacity of Chinese staff in all research areas listed above.

Summary:

In the Loess Plateau of northwest China, poor endowment of natural resources and high population pressure combined with unsustainable agricultural practices, have resulted in widespread poverty and degradation of land and water resources. Severe erosion of topsoil is widespread resulting in siltation of the river system particularly the Yellow River and loss of agricultural land.

Two Chinese Institutions, Gansu Agricultural University and Gansu Grasslands Ecological Research Institute, combined with Adelaide University, NSW Dept of Primary Industries and the Agricultural Production Systems Research Unit to conduct this bilateral project with ACIAR funding. NSW Dept of Primary Industries has been mainly concerned with the first Objective.

The field research focuses on two contrasting sites, Dinxi with 400 mm average rainfall with spring wheat the dominant crop and Xifeng with average rainfall of 550 mm and winter wheat the dominant crop. Developing farming systems with reduced erosion potential is of paramount importance. As a result, conservation farming systems with no-till and stubble retention in the paddock are compared with traditional practices where stubble is used in the farm house for fuel and feed for livestock and soil cultivated and harrowed several times. At the lower rainfall site the effect(s) of plastic mulches are also being investigated.

Recently, a final review of the work in China has been very successful. Conservation tillage experiments were successfully established at field stations and more recently on farms. Local farmers around the trials have displayed much interest in the performance of the various treatments. No-till with stubble retention has yielded as much, if not better than, as traditional systems. The work in Australia on reduced early growth under no-till has not been conclusive.

Research Project Description

Project Title:

Acid soil tool – calculation of the payback period for lime application

(Activity #601)

Principal Investigator:

Dr Guangdi Li

Funding Sources:

NSW Department of Primary Industries and Australian Wool Innovation Ltd (AWI Project No. WP217)

Objectives:

To develop an acid soil tool for determining the pay back periods for lime application for annual and perennial pastures under different animal enterprises.

Summary:

The acid soil tool will be developed based on data from a long-term agronomic experiment, known as MASTER experiment, conducted in southern NSW in 1992-2006. MASTER experiment had 8 treatments with 3 main comparisons: a) Annual systems versus perennial systems; b) Continuous pasture systems versus pasture-crop rotation systems; and 3) Limed treatments versus unlimed treatments.

The acid soil tool will determine the pay back periods for lime application for annual and perennial pastures under different animal enterprises, including a self-replacing Merino flock, Merino wethers and prime lamb enterprises in comparison with cropping enterprise. This tool can be used as a guideline for wool growers for making decisions about lime use in the mixed farming systems in the 500-850 mm rainfall zone in southern NSW and northern Victoria.

Research Project Description

Project Title:

Farming systems research for crop diversification in Cambodia and Australia

(Activity #310)

Principal Investigator:

Dr Bob Martin

Funding Sources:

NSW Department of Primary Industries and the Australian Centre for International Agricultural Research (ACIAR Project No. ASEM/2000/109).

Objectives:

1. Identify and overcome constraints to the adoption of non-rice upland crops in Cambodia and non-cereal crops in north-western New South Wales by analysis of on-farm data and experimentation.
2. Develop simple diagnostic and analysis tools that farmers and advisers can use to monitor the performance of their crops and how they fit into the farming system.
3. Produce appropriately packaged technical and financial information.

Summary:

The overall goal of this project in Cambodia is to contribute to food security at household and national levels through the development of technologies and opportunities for the production of non-rice upland crops. In Australia the overall goal is to overcome the constraints to crop diversification and adoption of sustainable practices in north-western NSW.

In Cambodia, the focus crops are upland maize, soybean, mungbean, peanut, cowpea and sesame and in Australia the focus crops are dryland chickpea, faba bean and canola. We identify constraints to crop diversification by asking the farmer, taking samples and measurements from his fields, from literature and from scientific investigation. We survey farm households to understand the farming systems practised, utilisation of farm resources, and the potential for improving both yield and productivity.

Our field experiments draw on scientific knowledge and on consultation with extension workers. The focus of field research is: evaluation of varieties; resistance to insect pests and diseases; time of sowing and seeding rates; crop rotations; reduced tillage to conserve soil moisture and soil structure; and Rhizobium inoculation of the legume crops (Rhizobium bacteria form nodules on the roots of legumes and supply the plants with nitrogen fixed from the atmosphere).

Cambodia experiences a monsoonal climate with distinct wet and dry seasons. During the wet season, rainfall is extremely erratic and ‘mini’ droughts can occur at any time – exposing cash crop farmers to risk. The highly variable climate of Australia’s northern cropping zone also exposes farmers to risk. We are developing a spread-sheet based decision support system “Crop-choice”. Crop-choice will combine climate data, paddock data, scientific knowledge and economic and marketing information to help the farmer make more profitable and sustainable decisions.

The project is developing a diagnostic ‘tool kit’ that Cambodian advisers and farmers can use to reduce the risk of growing upland crops. These can be as simple as rain gauges, pH kits, push probes to estimate the depth of wet soil, and testing of seed viability. These kits will include photographs to assist with the identification of insect pests and diseases. We will also provide training to advisers on gross margin analysis (income – variable costs). The final products of the project will be a series of “Agfact” extension publications to enable the knowledge to be disseminated to farmers in areas beyond the study range.

Research Project Description

Project Title:

Development of variety specific agronomy packages for NSW varieties

(Activity #491)

Principal Investigator:

Peter Martin

Funding Sources:

NSW Department of Primary Industries and the Grains Research & Development Corporation.

Objectives:

To develop specific management packages for newly released varieties of wheat (including durum), canola and lupins.

Summary:

Crop varieties typically differ in their responses to a range of agronomic practices like sowing time, seeding rate and row spacing. The number of varieties being released has increased over recent years. There were for example 22 wheat and 21 canola varieties released in 2007 for southern NSW sowing season 2008. There is a wide choice and a lack of agronomy information on the varieties to make a reasoned choice.

Farmers have recognised the need for variety specific agronomy information and also recognise that without optimising variety management they will not achieve the production and economic potential expected from new varieties. Farmers have been outspoken in recent years in their desire to have agronomic management work with new varieties to assist them in making variety choices and optimising management.

Development of Agronomy Packages for New Varieties for southern NSW (known as the Variety Specific Agronomy Packages (VSAP) Project) aims to develop variety specific management packages for wheat, canola and lupins in NSW. The focus of the research is to maximise the yield potential of varieties suited for NSW.

The VSAP project will achieve its aims by running sowing time, row spacing, nitrogen and seeding rate trials at a range of sites in NSW. Data from these trials will improve the information available to farmers when choosing the best varieties for their farming system.

Research Project Description

Project Title:

Murrumbidgee Grain & Graze

(Activity #390)

Principal Investigator:

Guy McMullen

Funding Sources:

Meat and Livestock Australia, Australian Wool Innovation, the Grains Research & Development Corporation and Land & Water Australia.

Objectives:

1. Increase long term profitability and sustainability of mixed farms in the Murrumbidgee catchment through adoption of whole farm feed budgeting with particular consideration to enterprise mix and protection of the natural resource base, particularly water use, ground cover and biodiversity.
2. Engage, through communication, extension and participation activities, at least 1500 producers in Murrumbidgee Grain & Graze activities between 2004 – 2008.

The project consists of 4 interlinked modules, as outlined below. The primary one in which NSW DPI is involved is the Research and Development Module (b).

Module (a) Landscape zone management: demonstrating natural resource management on farm

Increases in productivity and profitability can be made by more efficient utilisation of the whole farm feed production base. However these increases do not occur equally over the whole farm. Identification and management of more productive areas can generate greater profitability to allow sustainable management of less productive areas. This may include fencing off areas for biodiversity, salinity recharge, water quality or soil health outcomes. Farm-scale demonstrations of this type of 'zone management' in conjunction with local landholder groups can be used to highlight the synergies between improved productivity and protection of the natural resource base, instead of the competition for resource allocation between these factors. They can also be used to demonstrate return on investment in NRM activities which is a key criteria for farmers to adopt sustainable land management practices.

This project links to the Sustainable Agriculture programs of the Murrumbidgee Catchment Management Authority (MCMA). These programs include:

- National Landcare Program (NLP) project titled "Profitable farmers, sustainable systems, healthy landscapes" which involves the establishment of 12 focus farms to apply sustainability programs for different farming landscapes.
- The MCMA project (funded by the National Action Plan – NAP) titled "Developing and implementing BMPs for dryland cropping systems to achieve improved soil and water use", which will use the same 12 focus farms for measuring water use and ground cover throughout the crop and pasture phases.
- A specific NAP project devised by the MCMA to develop natural resource management outcomes parallel to the Grain & Graze objectives.

Use of the same focus farms (and co-operating landholder groups) by the MCMA projects and the Murrumbidgee Grain & Graze project will demonstrate whole-farm sustainability issues and ensure integration of relevant outcomes.

Whilst management changes for increased productivity are usually reasonably easy to measure (e.g., increased yield or liveweight gain) and therefore easier to justify the investment involved, improvements to the natural resource base are less tangible. For growers to adopt natural resource management principles, they need to be able to measure the changes through a series of practical sustainability indices that can be used on-farm. These sustainability indices for the Murrumbidgee region will be developed in the NLP project for use in Grain and Graze outcomes.

Module (b) Research and Development: increasing productivity with grazing wheats & long season annuals

Perennial pastures are a key element of mixed farming systems in the Murrumbidgee catchment, having achieved a high level of adoption as a result of successful, comprehensive research over the last 10 years. However whole farm feed profiles show that there are still gaps in this system in terms of feed availability and utilisation for both autumn and spring lambing/calving enterprises. Grazing wheats and long season annual legumes (from the NAPLIP program) have been identified as 2 management options that could be used in conjunction with perennial pastures to fill these gaps. Whilst

there has already been some adoption of these (particularly wheats), further research is required to ensure they are used efficiently.

With respect to grazing wheats and pasture mixes containing long season annual legumes, there is little information on seasonal dry matter production and forage quality. These are important parameters to have for the range of potential varieties to create feed production curves. Producers can use these curves to pinpoint periods when fodder will be adequate/inadequate/excessive to meet specific stock requirements. Whole farm fodder budgets (e.g., ProPlus) can then be used to determine if or when alternative feed strategies will need to be used. Constant monitoring of wheat dry matter and quality throughout the growing season will also enable the use of Grazfeed to model liveweight gains of different classes of stock at different periods, and compare them with the actual weight gains achieved on large scale plots. This model can be used to determine if feed on offer is adequate, or if alternative or supplementary feed sources are required to ensure livestock requirements are met at all critical stages. This information can then be used in the whole farm fodder budgeting process.

An understanding of water use and ground cover will provide valuable information on the sustainability of the grazing wheat and pasture system. Minimising accessions to the water table through adoption of high water using species will have positive implications for salinity prevention or management on-farm and in the Murrumbidgee catchment, as highlighted in the Murrumbidgee Blueprint referred to below. The water use efficiency of these species can be compared to those of perennial pastures identified in previous research (Dear et al.), to ensure the whole farm feed production system is contributing to improved water use. The identification of systems with high ground cover will also have positive implications on-farm and in the catchment, minimising the loss of nutrients and moisture in run-off, and organic matter through wind erosion. This has been a common problem with traditional dryland lucerne pastures.

In mixed farming systems, a profitable rotation is one that will contribute not only to fodder production, but also grain yield and quality. Determining grain recovery of grazing wheats will help growers select the most profitable option for their system, taking into account financial contribution to both the livestock and cropping enterprises.

Implementing known high water use and high ground cover systems will address one of Grain and Graze's key objectives of 'better water quality', as well as addressing the Murrumbidgee Catchment Authority's targets of 'benchmarking and improving water use efficiency values for crops', 'reducing accessions to saline susceptible areas' and 'develop targeted extension programs to increase groundcover'.

Module (c) Value adding Prograze for sustainable mixed farming enterprises in the Murrumbidgee catchments

At present, inefficient utilisation of the pasture resource results in levels of animal liveweight gain per hectare well below the theoretical potential. The profitability from the livestock enterprises of mixed farms in the Murrumbidgee catchment could be increased by improving the utilisation of this forage base with consideration to protection of the natural resource base. The principle challenge facing farmers in this region is coping with the seasonality of pasture production, in particular filling the winter feed gap and utilising the spring peak, whilst maintaining ground cover and optimising water use. Improving the management of the forage and natural resource base would in part be achieved through improving the skills of mixed farmers in grazing management, fodder budgeting and identification of key sustainability indices (developed in module a). Learning to create a feed profile would enable growers to identify feed deficits or surpluses relevant to their specific animal enterprises, then determine the most appropriate management strategy or combination of strategies to ensure more efficient utilisation. This may mean adopting new technology (e.g., long season annuals) to fill a specific feed gap and provide greater ground cover, or making changes to animal enterprises to better utilise current feed production (e.g., spring lambing). The successful PROGRAZE course would provide the vehicle for this, requiring some addition to the present documentation to further emphasise impact on natural resource issues such as biodiversity, ground cover and water use (using sustainability indices), as well as increasing its relevance to mixed farming enterprises. A physical farm survey would be undertaken at the beginning of the course and after 12 months to highlight changes in both whole farm feed management and natural resource management.

This module addresses the Grain and Graze outcome of 'confident and knowledgeable mixed farmers, making decisions and using management tools which sustain production and promote biodiversity'. It also addresses the Murrumbidgee Catchment targets of 'develop best practice grazing management systems with land managers' and 'develop targeted extension programs to increase groundcover'.

Module (d) Communication module: fact sheets (case studies) and field days

Many growers have already incorporated perennial pastures into their mixed farming systems, helping to alleviate feed budget shortfalls. Many have adopted various management strategies to suit individual enterprises mixes, ensuring feed supply meets livestock demand. Presenting these strategies as case studies, in one-page fact sheets disseminated to other growers, will help increase further adoption of these management strategies, as will dissemination of the original research findings to highlight other advantages such as water use, nitrogen input and disease carry over. Case studies where growers have been able to lock-up land for species preservation as a result of better feed utilisation elsewhere will also be highlighted, as will instances of reduced recharge from the use of perennial pastures.

Fact sheets will be used to disseminate results from the R&D module as they emerge to ensure a continuous information flow. They can be used as learning aids in Module c.

The communications module will also consist of regular updates, via field days and seminars to inform growers of results from the R&D trials. Sessions will also be held to demonstrate the use of Grazfeed to determine livestock performance of particular feed sources, as well as demonstrating and highlighting the use of whole farm fodder budgeting (ProPlus).

The communications module will help achieve the Grain and Graze outcome of 'confident and knowledgeable mixed farmers'. They will address the Murrumbidgee Catchment's targets of 'increase the adoption and extent of perennial pastures' and 'rotate cropping with perennial pastures'.

NB. Modelling the impact of mixed farming production systems on the natural resource base in the Murrumbidgee catchment will be undertaken during the project. It is understood this will be co-ordinated by the national Grain and Graze project using models identified by the management committee and initiated at a later stage.

Research Project Description

Project Title:

Barley Breeding Australia Northern Node

(Activity #504)

Principal Investigator:

Guy McMullen

[Note: This is a collaborative project with the Queensland Department of Primary Industries & Fisheries (QDPI&F) (David Poulsen – Breeder and overall project leader; Glen Fox – Grain Quality Leader; Greg Platz – Pathology Leader; Kym McIntyre – Industry Development Leader; and Emma Mace – Biotechnology Leader)]

Funding Sources:

NSW Department of Primary Industries, the Queensland Department of Primary Industries & Fisheries and the Grains Research & Development Corporation (GRDC Project No. DAQ00038).

Objectives:

1. Greater productivity, stability and market demand for barley in the Qld/NSW graingrowing, intensive livestock and malting/brewing industries through delivery of i) improved feed and malting barley varieties and ii) information for use in managing the value chain.
2. A highly effective research and extension team with the intellectual capacity and resources to deliver an integrated regional barley improvement program for Eastern Australia with national linkages.
3. Extension of agronomy, pathology and quality information to support decision making and market development in the graingrowing, intensive livestock and malting/brewing industries.

Summary:

This project is an integrated barley improvement program for the GRDC Northern Region. It combines coordination, breeding, pathology, quality and industry development. The strong linkage between the QDPI&F and NSW DPI developed for the existing Northern Barley Improvement Program will continue in this project.

Research Project Description

Project Title:

Developing agronomic solutions to improve barley yield and grain quality in the GRDC northern region

(Activity #594)

Principal Investigator:

Dr Guy McMullen

Funding Sources:

NSW Department of Primary Industries, the Grains & Research Development Corporation and the Queensland Department of Primary Industries & Fisheries.

Objectives:

Developing agronomic solutions and 'fine-tuning' agronomic practices and delivering them to growers so they can maximise their returns from barley production.

Summary:

The export and domestic demand for barley is forecast to increase significantly. Northern NSW and Queensland are well placed to capitalise on this increase in demand. Yet consistent production of barley that meets end use specifications has been a challenge. This variability in grain quality has been a crucial limiting factor in the expansion of the barley industry in the northern region. The recent release of Grout and Fitzroy, along with close-to-release varieties, from the northern and other nodes of Barley Breeding Australia provide great potential to significantly increase the total production and proportion of barley that will meet end use requirements. To realise this potential, the productive capacity of each variety needs to be optimised across the region.

This project is focussed on developing agronomic solutions and 'fine-tuning' agronomic practices and delivering them to growers so they can maximise their returns from barley production. The focus is not only on increasing grain yield, but also reducing one of the major constraints to barley production in the northern region, namely consistency of grain quality that meets market specifications. The agronomic information will be developed by undertaking replicated research and combining this with grower management surveys, paddock monitoring and re-analysing existing datasets to ensure researcher, adviser and grower knowledge is captured. Integration with other barley research and industry programs (e.g., breeding and industry development) and opportunistic collaboration with other research projects, such as farming systems projects and the SIP08 Subsoil Constraints project as well as industry grower group organisations (e.g., Northern Grower Alliance) will facilitate information flows between the research, grower and advisory sections of the barley industry. This explicit focus on communication will develop the networks and relationships required to ensure maximum adoption and appropriate implementation of agronomic management practices that will ultimately improve returns to growers.

Research Project Description

Project Title:

Diversification and intensification of rainfed lowland cropping systems in Cambodia

(Activity #646)

Principal Investigator:

Dr Guy McMullen

[Note: This is a collaborative project led by Prof. Shu Fukai of the University of Queensland]

Funding Sources:

The NSW Department of Primary Industries, the Australian Centre for International Agricultural Research (ACIAR Project No. CIM/2006/040), the University of Queensland, the University of New England, the Cambodian Agricultural Research & Development Institute and the Provincial Departments of Agriculture in Kampong Cham, Kampong Thom and Takeo.

Objectives:

1. Develop profitable double cropping options for a rice/non-rice (mungbean, soybean and peanut) system for the rainfed lowlands in three provinces.
2. Define the water requirements for non-rice crops, determine the best use of small amounts of stored water, incorporate water use into available lowland models and predict the level of risk under mainly rainfed conditions of the diversified cropping system.

Summary:

A priority for this project is to diversify some of the rainfed rice-based systems to higher value crops to increase family incomes. To-date, there has been little research effort to add non-rice crops to the rainfed lowland rice systems where 80% of the rice is produced. Cambodia has a distinct monsoonal rainy season (April – November) and dry season (December – March) when virtually no rain falls. Rice is normally harvested in November but some of the newer rice varieties mature earlier, use less water and provide a longer 'window' for growing another crop following the rice at the end of the rainy season.

The overall aim of the project is to increase the range of crops grown under rainfed lowland conditions by promoting non-rice crop technologies that provide sufficient water and high financial return to growers. The research will be done on on-farm and will identify the best soil-water environments for the non-rice crops and produce a robust set of agronomic and economic information on the viability and practice of growing non-rice crops in the lowlands. The field work in the project will be carried out in the provinces of Kampong Thom, Kampong Cham and Takeo.

Under the leadership of Prof. Bob Martin, Director Primary Industries Innovation Centre (PIIC), the NSW DPI team will provide assistance to the University of Queensland in the development of new lowland cropping systems with non-rice crops in Cambodia. The PIIC team is responsible for: (a) development of sound agronomy of non-rice crops for lowlands in Cambodia; (b) development of suitable machinery for the new lowland cropping systems (in collaboration with Mr Jeff Esdaile on ACIAR project CIM/2007/027); and (c) data analysis and modelling for estimation of probability of risks for inclusion of non-rice crops in a lowland cropping system.

NSW DPI agricultural scientists have the expertise and technology to assist developing countries such as Cambodia adopt farming practices that not only reduce poverty but reduce greenhouse gas emissions. Cambodian rice farmers burn their crop residues and cultivate excessively. This means that their soils are very low in carbon. Australia/NSW can contribute to sequestration of carbon in its farming systems but can have a much greater global impact by assisting developing countries to do the same.

Research Project Description

Project Title:

Whole farm salinity management strategies for cotton production in the Macquarie Valley

(Activity #374)

Principal Investigator:

David Mitchell

Funding Sources:

NSW Department of Primary Industries and the Cooperative Research Centre for Sustainable Cotton Production.

Objectives:

1. Identify crop, fallow and water management strategies, which will reduce the rate of deep drainage and shallow water recharge.
2. Assess whole farm salt balance strategies that limit the impact of using poor quality for irrigation water.
3. Use the information acquired in aims 1 and 2 to leverage funds from other funding areas by development of a detailed research proposal.

Summary:

All irrigation water contains salt, and when this water is added to the root zone to grow crops, the water is extracted by the plants and the salt is left behind. How irrigators manage the salt remaining in the rootzone will have a direct effect on the life of the irrigation enterprise. The only feasible way of managing this salt is by flushing the salt down the soil profile by application of more irrigation water than the plant needs. This extra water is called the leaching requirement and is related to the salt content of the irrigation water and the salt content of the rootzone soil.

If there is too much leaching (deep drainage), then a watertable may develop, but if there is insufficient leaching then salinity will occur. A balance is needed between excess water draining below the root zone and a build up of salts in the root zone. This balancing act requires development of management options at a whole farm level to manage salinity.

The evidence of deep drainage under irrigated conditions in the Macquarie Valley is contained in Brereton (1996) “Groundwater conditions for the irrigated lands between Narromine and the Macquarie marshes” which reported two groundwater mounds present in the Lower Macquarie valley, one north of Narromine and another south east of Warren. This evidence of salinity is combined with the very high salinity risk assessment of the Backwater–Boggy Cowal system in the “Salinity strategic plan for the central west catchment” (Humphries 1999, DLWC). This sub catchment encompasses the majority of the irrigated area south of the Macquarie Valley between Narromine and Warren.

Historically in the Australian cotton production areas, salinity has always been seen as a localised issue that did not pose any major threat to production. However research over the last ten years, has begun to challenge this perception. Over the next ten years, salinity has the potential to have a significant effect on cotton production in the northwest. High-risk areas are the Macquarie, Lower Namoi and Bourke districts.

Gaps identified in current salinity research and extension activities include; monitoring of whole farm water and salt balance, linking of water quality to crop and salinity management, economic impact assessment and the development and promotion of BMP guidelines for cropping systems that minimise salinity. Specific water balance research is being planned within the Australian Cotton CRC, and this project aims to complement this work by focusing on salinity management and whole farm salt balance.

Methods

Five long term monitoring sites were established on major irrigated cotton growing soils in the Lower Macquarie Valley. Deep drainage and changes to salt store were determined for the five sites by solute mass balance (Slavich 1992, Willis 1995, Friend 2000, Weaver et al. 2004) (table1). Over the 2003 – 04 irrigation season deep drainage was higher under meander plain soils (red soils) than compared to the back plain soils (grey soils). There was an increase in the soil salt store over all sites. The highest increase in the salt store came from a site that used moderately brackish water. This site had an 3.5 t/ha increase in the soil salt store over one irrigation season. Soil cations were measured at the five sites which enabled the effect of irrigation on the exchangeable sodium percentage of the soil. From the initial analysis it appears that irrigation may increase the risk of sodicification on the meander plain soils. There does not appear to be such a risk on the back plain soils.

Future research directions

An additional post winter soil sampling has been completed. The soil will be analysed for EC and chloride. Additional data analysis will be undertaken particularly documentation of cropping history on the five sites.

Additional funding will be sought from CW CMA to continue the understanding of the salt and water dynamics under irrigated farming systems in the Macquarie Valley. Particular emphasis will be placed on establishing the effect of irrigation water on the sodium levels on the meander plain soils irrigated with lower quality water.

Detailed results of the study have been distributed to the five co-operators, and result summaries will be distributed amongst the cotton industry in the Macquarie Valley.

Research Project Description

Project Title:

Western Farming Systems Project – NSW Agriculture Component

(Activity #375)

Principal Investigator:

David Mitchell

Funding Sources:

The Grains Research & Development Corporation.

Objectives:

1. Enhance the economic and environmental performance of grain-based farming systems in the NSW northwest agro-ecological zone identifying opportunities for, and resolving constraints to, the implementation of more profitable and sustainable farming systems.
2. Evaluate the performance of new farming systems with respect to whole farm profitability; on farm ecological sustainability; and off farm environmental and community impacts.
3. Monitor changes in the knowledge, awareness, skills and attitude of key stakeholders, leading to an improvement in the performance of commercial grain enterprises.

Summary:

The project consists of two core sites; one at Cryon 50 km west of Walgett and one 10 km east of Coonamble. Three farming systems were established in 1996 at each site; continuous cropping, legume pasture to cropping, grass pasture to cropping.

In each of the three farming systems there were a number of cropping systems; for example continuous cereal, pulse/cereal, opportunity cropping. Most treatments were zero till, with all treatments were split plus or zero nitrogen.

The project uses participatory research methodology, this involves farmers, agri-business and research staff at all stages of the project. The project was started in 1996 and farmers, agri-business and research staff decided on the crop rotations as well as what depth of soil moisture was required to allow planting of the rotations. Parameters such as starting moisture and nitrate are measured as well as yield and grain quality.

Project participants meet regularly through the growing season to discuss the effect of crop choice, fertilizer and tillage on the yield, quality and gross margin of the faring systems.

The initial project aim was to provide an improvement in the performance of grain-based farming systems in the NSW northwest agro-ecological zone by 2003. A phone survey will be conducted that will interview approximately 200 grain growers in the area to assess the effect of the project on grain based farming systems. This will include a general (but quantifiable) advancement in the knowledge, awareness, skills and attitude of key stakeholders, leading to an improvement in the performance of commercial grain enterprises; and the development of new farming systems that are likely to deliver further advances in the performance of grain-based farms in the zone, during the period 2003 – 2010.

The gross value of production (GVP) of the grains industry in the Western Farming Systems district of northern NSW is around $200 million per annum. Results from the established research sites in phase I of the project showed increases in cumulative gross margins of up to 30 per cent by moving from continuous cereal to rotations including pulses or canola. This improvement is largely the result of reduced disease, increased nitrogen and water use efficiency leading to increased wheat yield and protein. Assuming an increase of 50 percent in adoption it is anticipated (based on results so far) that improved rotations and tillage practices will increase the GVP for grains in the WFS zone by up to 15 percent or $30 million per annum.

Research Project Description

Project Title:

Optimising the quality and yield of spelt and other specialty grains under organic production

(Activity #458)

Principal Investigator:

Robyn Neeson, Helen Allen, Dr Jeffrey Evans and Dr David Luckett.

[Note: This is a collaborative project with the Department of Natural Resources & Environment, Victoria and Grower Cooperators]

Funding Sources:

NSW Department of Primary Industries and the Rural Industries Research & Development Corporation (RIRDC UCS-38A)

Objectives:

Improve the supply and quality of organic spelt (*Triticum aestivum* var. *spelta*), Kamut® (*Triticum turgidum*) and cereal rye (*Secale cereale*) by selecting superior lines of spelt for organic production and developing a preliminary agronomic package for spelt production.

Summary:

With the increasing awareness of the link between diet and health, there is growing demand for specialty grains and their products within the health food sector. It is claimed that specialty grains such as spelt, cereal rye, and Kamut® exhibit superior nutritional attributes to other more common cereals such as wheat. It is these nutritional claims that have sparked the greatest interest, particularly in the health food sector. The greatest demand is for organically produced specialty grains; however, supply constraints are frustrating industry expansion. This is largely being attributed to low producer confidence due to lack of locally adapted varieties, relevant agronomic information and market irregularities.

This project aims to identify potentially new and more reliable cultivars of spelt that are better adapted to organic production. Greater confidence in organic production requirements and techniques for these grains will lead to a more sustainable organic grain industry that is better able to expand to its market potential. The project consists of 8 experiments which will be conducted in three areas: i. Genetics, ii. Crop Nutrition, and iii. Agronomy. The project will determine improved agronomic information on optimal sowing dates, sowing rates and P requirement to optimise the yield and quality of spelt, Kamut® (khorasan wheat) and cereal rye. This information will provide producers (organic and conventional) with alternative cropping and market opportunities for marginal cropping zones (soils of low nutrient capacity).

Outputs of the project will aim to improve the supply and quality of organic spelt by:
- Selecting superior lines of spelt for organic production
- Producing production guidelines for spelt production.

Research Project Description

Project Title:

Diseases of cotton VIII

(Activity #311/342)

Principal Investigator:

Dr David Nehl

Funding Sources:

NSW Department of Primary Industries and the Cotton Research & Development Corporation (CRDC Project No. DAN177C).

Objectives:

1. Monitor the distribution and importance of all diseases in cotton and identify environmental and cultural factors influencing the emergence or re-emergence of disease threats.
2. Continue to develop and/or evaluate control strategies for Fusarium wilt, Verticillium wilt, and seedling diseases of cotton, (e.g., seed treatment fungicides, induced resistance, rotation crops, biofumigation crops, cover crops, late sowing with BollgardTM).
3. Conduct investigations of host-pathogen-soil interactions contributing to the severity of soilborne diseases of cotton and identify features that might be exploited for disease control
4. Continue long-term field experiments on the role of pathogens, mycorrhizal fungi (VAM) and other soil organisms in the soil ecosystem (soil 'health').
5. Facilitate delivery and deployment of cotton disease management strategies that utilise available methods in a cost effective, integrated manner with the least impact on the environment.

Summary:

Cotton production in Australia is worth up to $1.3 billion in export income (in non-drought years). A number of diseases are currently of concern. Fusarium wilt of cotton now occurs on at least 74 farms in NSW and is spreading exponentially. If the current rate of spread continues, Fusarium wilt will be present on 90% of cotton farms in NSW by 2010. Black root rot of cotton increased rapidly during the 1990s and now occurs in all production areas of Queensland and NSW (except Menindee) and its distribution within and between farms continues to advance. Verticillium wilt of cotton declined during the 1990s with the widespread use of resistant varieties but is increasing again in some areas. Seeding disease is particularly severe in the cooler cotton regions of NSW.

Unless cotton diseases can be managed effectively, they have the potential to cause yield losses that threaten the profitability and sustainability of cotton production. The research proposed here will enable: further development and confirmation of disease management strategies; transfer of this information to growers for the more effective control of cotton diseases; collateral development of control measures in other projects; identify new disease threats if they arise; and the distribution and potential importance of diseases of cotton to be monitored. Controlling cotton diseases will have clear benefits to the long-term profitability and sustainability of the Australian cotton industry and associated rural communities.

Research Project Description

Project Title:

Improving lucerne performance for acid soils

(Activity #332)

Principal Investigator:

Dr Brendan Scott

Funding Sources:

NSW Department of Primary Industries and the Cooperative Research Centre for Plant-Based Management of Dryland Salinity (Part of CRC Project No. RE310 (P3 SP5 Auricht)).

Objectives:

Significantly increase the area of lucerne in the dryland farming regions of Australia by improving performance on acid soils. This to be achieved by:

- Developing a screening method for selecting lucerne plants tolerant to acidic soils containing aluminium.
- Selecting plants which outperform existing options in acid soils.

Summary:

Lucerne is currently the only perennial legume proven to restore a hydrological balance in the dryland agricultural regions of Australia (average annual rainfall, 300 – 550 mm). Lucerne is adapted to the climate and farming systems of much of this area, however performance of existing cultivars is seriously impaired in strongly acidic soils. Acidity impacts on a number of aspects of lucerne performance covering both the plant, the nodulating strain of Rhizobium, and the symbiotic relationship between the two. There may be scope for improvement.

The opportunity exists to select lucerne plants which exhibit better root growth in acidic soils with toxic concentrations of aluminium, and to use these plants to produce improved cultivars. Commercial release of improved cultivars will see wider use of lucerne and important benefits from this deep rooted species in the use of deep soil moisture. Another part of this project, based in WA and SA, is seeking improved rhizobia for lucerne when grown on acidic soils.

The project is linked to the SARDI lucerne breeding effort and the NSW Agriculture breeding effort at Tamworth.

A method of screening was developed using annual Medicago species. The method of screening was to grow plants for 3 days on floating rafts in a tank on a laboratory bench. A nutrient solution was used and pH was maintained at 4.3 by daily correction. After3 days the plants were exposed to a "pulse" of Al at 75 mM of Al. This exposure had the potential to kill the growing point of the root. Roots were then stained, rinsed in deionised water and placed in new "recovery" nutrient solutions at 10 mM Al. After 3 more days in the "recovery" solution the roots were inspected and new unstained root growth was measured. The results of the seven day solution culture screening test have been compared to the growth of annual Medicago in an acidic soil. About 60% of the variation in the glasshouse soil experiment was accounted for by the 7 day laboratory screening test. The screening method was then applied to lucerne populations.

The screening test has been used on 11 cultivars and breeders lines of lucerne, and plants selected for their root growth under aluminium stress. Between 2 and 4 % of plants have been selected within each line, then transplanted into pots and later transferred to the breeding programs in Adelaide and Tamworth. Seed from the selected plants was compared to the original unselected population in the 7 day test. Selection improved the root growth under the conditions of the test in all four populations compared. This demonstrated that the character was heritable, and could be used in a breeding program. While the test has not been evaluated in soil with lucerne, our experience with the annual medics suggests that we have improved the aluminium tolerance, and hence acidic soil tolerance, of lucerne.

Research Project Description

Project Title:

An assessment of the economic impacts of NSW agriculture research and extension: Conservation farming and reduced tillage in northern NSW

(Activity #344)

Principal Investigator:

Fiona Scott & Dr Bob Farquharson

Funding Sources:

NSW Department of Primary Industries.

Objectives:

This assessment of research, development and extension (R, D &E) in conservation farming and reduced tillage (CFRT) in northern NSW was conducted as part of a systematic process of evaluating the economic, social and environmental impacts of five major research, extension and education programs. The CFRT program was a key area of investment by the former NSW Agriculture. A systematic evaluation process enables the NSW Department of Primary Industries to set research priorities, allocate resources and to demonstrate that it uses research (and/or extension) resources in ways that enhance the welfare of the people of NSW. This evaluation has been conducted by economists who were not part of the CFRT program, who have made an objective and independent evaluation.

Summary:

Our approach has been first to describe qualitatively the economic, social and environmental impacts of the investment in the research, development and extension of conservation farming and reduced tillage. We examine the share of public and private funding in the investment. We then attempt to quantify as many impacts as practicable to arrive at a common measure of economic performance, such as the benefit-cost ratio (BCR).

This analysis evaluates the investments by the former NSW Agriculture in these programs from the late 1970s to 2002. In assessing the 'with' and 'without' technology scenarios, key outputs from research, development and extension activities and communication strategies used are described to give credence to claims about the contribution of NSW Agriculture, and to assumptions about the rate and extent of adoption of the technology.

"No till" includes maintenance of stubble cover during fallows, sowing into an undisturbed seedbed, and weed control via herbicides. "Conventional tillage" involved up to six cultivations during the fallow period to control weeds. "Reduced tillage" is usually defined as fewer cultivations than conventional tillage and also incorporates weed control via herbicides during the fallow. Reduced tillage forms the majority of fallow weed control, via herbicide and cultivation just before sowing the next crop.

In general the estimated financial results showed a healthy return to NSW taxpayers of funds invested in the conservation farming and reduced tillage program. When benefits of no till only to 2002 were considered, the results showed an estimated net present value (NPV) of $78.4 million and a benefit cost ratio of 4.1:1. When reduced tillage is included, the net present value rises to $205.4 million with a benefit cost ratio of 9.0:1.

Additional analysis with projected adoption figures to 2020 for no till only showed a mean benefit cost ratio of 11.4:1 and a net present value of $302 million with 90% of benefit cost ratio values falling between 7.9:1 and 14.9:1. Adding in the estimated benefits from reduced tillage to 2020 increased the estimated mean benefit cost ratio to 20.5:1, with a mean net present value of $568 million.

Publication:

Scott, J.F. and Farquharson, R.J. (2004), An Assessment of the Economic Impacts of NSW Agriculture Research and Extension – Conservation Farming and Reduced Tillage in Northern NSW Economic Research Report No. 19, NSW Department of Primary Industries, Tamworth.

Research Project Description

Project Title:

Permanent beds for irrigated rice-wheat and alternative cropping systems in north-west India and south-east Australia

(Activity #388)

Principal Investigator:

Geoff Beecher, **Rajinder Singh** & **John Thompson** .

[Note: This a collaborative project with CSIRO Land & Water (Dr Elizabeth Humphreys) and the Punjab Agricultural University, India (Dr Y. Singh)]

Funding Sources:

NSW Department of Primary Industries, Australian Centre for International Agricultural Research, the Grains Research & Development Corporation and the Cooperative Research Centre for Sustainable Rice Production (Project No. CRC 2001-06).

Objectives:

1. Identify potential benefits of permanent beds over contour layout.
2. Evaluate alternative irrigation methods for rice based cropping systems on beds.
3. Identify cropping flexibility options with permanent beds and different irrigation systems.

Summary:

Permanent beds are an alternative layout for growing rice, compared to the traditional flat bed system. This project is investigating the use of permanent beds to improve the productivity, profitability and sustainability of irrigated rice-wheat (RW) cropping systems in north-west India, and the cropping systems in the rice-growing areas of southern Australia. Permanent beds (a paddock layout where the cropped zone and the irrigation furrows are distinctly and permanently separated) are a radical change from conventional flooded and puddled rice systems traditionally used on a flat layout. These traditional systems can be detrimental to the growth of post-rice crops, and consume enormous amounts of energy in terms of tilling the land when switching between crops.

There may be significant advantages from growing rice on raised (permanent) beds. Raised beds greatly improve surface drainage for both rice and other crops in a rotation, leading to improved plant establishment and yield of crops grown after rice. There is also increased crop flexibility due to the ability to grow more plant species that are sensitive to waterlogging. Water use efficiency from a permanent bed cropping system and potential for double cropping with this system should be increased while the groundwater recharge should be decreased.

As part of this project team, I do economic analysis to estimate the potential financial, economic, environmental benefits arising from converting to this new rice farming system and look at the costs of conversion to permanent beds from different existing irrigation layouts. I also estimate the returns on the R&D investment in this research by incorporating the total costs involved in research and extension and the flow of benefits from the new technology.

Research Project Description

Project Title:

Maximising returns from water for Australian vegetable crops

(Activity #391)

Principal Investigator:

Mark Hickey & **Rajinder Singh**

Funding Sources:

Horticulture Australia Limited.

Objectives:

1. Describe crop types, major irrigation systems used and systems performance.
2. Identify irrigation problems that effect yield and quality.
3. Identify major constraints to production e.g., salinity, water access and quality.
4. Analyse the impact of different irrigation technologies and management strategies that help to improve productivity and environment.

Summary:

In Australia all of the 132,000 hectares of vegetable crop worth in excess of $1.8 billion is irrigated. Currently there is a transition from flood/furrow irrigation (where the crop is surface irrigated across the total soil surface or by furrows between permanent beds) to drip irrigation (where the crop is irrigated by use of plastic tubing which has drip emitters located frequently along the tube which may be located on the surface or buried in the cropping bed). This is occurring across perennial and annual horticulture in most irrigated regions. The aims of this research project are to analyse the existing irrigation delivery and management options together with scoping of the new technologies to assess their applicability to the vegetable industry.

The economic analysis will conduct in-depth case study gross margin analysis into 5 key crops (lettuce, sweet corn, broccoli, carrots and greenhouse cucumber) selected from the major production regions of Australia and conduct a benefit/cost analysis of conversion from existing systems like furrow and overhead sprinklers to more efficient irrigation systems, like drip irrigation.

Research Project Description

Project Title:

Management of Fusarium diseases and common root rot of cereals in the northern cropping zone

(Activity #345)

Principal Investigators:

Andrew Verrell, Dr Steven Simpfendorfer & Dr Kevin Moore

Funding Sources:

NSW Department of Primary Industries and the Grains Research & Development Corporation.

Objectives:

1. Development of management packages for reducing losses to Fusarium diseases in cereals.
2. Extension of management options to support growers to understand and manage crown rot, common root rot and Fusarium head blight.
3. Strategic support to durum, bread wheat and barley breeding programs.

Summary:

Crown rot caused by the fungus *Fusarium pseudograminearum* is the most serious constraint to winter cereal production in northern NSW. Although it is more common in the northern cropping belt, it can occur throughout all mainland cereal-growing areas and is estimated to cost the Australian grains industry $56 million per annum. Common root rot, caused by the fungus *Bipolaris sorokiniana* is estimated to cost growers $22 million per annum. These pathogens are endemic in the northern cropping system and the diseases therefore must be managed in such a way so as to reduce losses. Crown rot is the primary target of this project but is frequently found in association with common root rot. The experiments therefore aim to assess the effects of management on both diseases.

Much of the information on the management of crown rot has traditionally arisen from field observations and monitoring activities, as opposed to replicated field experimentation. This appears to have limited the understanding by growers and scientists of the interaction of crown rot with components of the cropping system. A previous project examined crown rot in a cropping system context. Around 2.5 hectares of replicated experiments at the Tamworth Agricultural Institute are being used to examine the effects of crop rotation, fallow and stubble management, grass weeds and the interaction of nitrogen and soil moisture on crown rot and common root rot. In all trials the effects of management on crown rot are examined in terms of its key components of survival, infection and yield loss. Crown rot and common root rot are present in all trials and have been measured since 2000. This information will form the basis of a prototype decision support package to assist growers in the Northern Region to understand and manage crown rot.

This project will extend and further develop previous research to refine the management of crown rot in northern NSW. The rotation experiment is phased to allow assessment of the long term effects of the major winter and summer break crops on crown rot and common root rot. The fallow/stubble management experiment is designed to examine long term interactions of treatments with these two diseases. Both trials will be reviewed at the end of the 2005 season to consider splitting to capture varietal or nitrogen rate interactions. The project will focus further on the role of grass weeds in the carry over of the crown rot pathogen and explore the effect of the timing of herbicide application on disease levels.

The project team will continue its extension effort in supporting growers and agronomists in understanding and managing crown rot, Fusarium head blight and common root rot. Targeted on-farm management work plus annual evaluation and monitoring of disease risk in paddocks will also provide a valuable tool for extension. Collaborations with Dr R Hare (NSW Agriculture) and Dr M Turner (Univeristy of Sydney) will evaluate durum and bread wheat lines incorporating sources of resistance to Fusarium diseases.

The project also aims to provide a better understanding of the mechanisms of resistance to crown rot by examining the role of toxins in whitehead formation, clearly defining the role of zinc, and extending the water by nitrogen research to capture interactions with different varieties. Findings from the project will be regularly used to refine and update a decision support package for the management of crown rot in the Northern Region.

Serious outbreaks of Fusarium head blight (FHB) caused by Fusarium graminearum occurred in wheat crops on the Liverpool Plains of northern NSW in 1999 and 2000 with yield losses ranging from 20 – 100% and major downgrading in quality. However, the economic significance of FHB is magnified by the possibility that infected grain can also contain toxins such as deoxynivalenol (DON). Moist and warm weather during flowering favour infection. The risk of FHB has

reduced the confidence of farmers in growing durum wheats in this region but also poses a threat to bread wheat and barley production.

This project aims to evaluate selected commercial and advanced durum, bread wheat and barley cultivars grown in the Northern Region for their susceptibility to FHB on an ongoing basis. Ratings will be incorporated into a management document and sowing guides to allow growers to select varieties under varying risk situations. The project will also provide strategic support to Dr Hare's durum breeding program based at TCCI to evaluate material targeted for the incorporation of resistance to FHB. The project further aims to identify promising findings on the management of FHB in the USA and other countries (e.g., chemicals and application techniques, biocontrol agents) and evaluate their efficacy under Australian conditions. Findings from the project will be regularly extended to growers and used to update management information for FHB in the Northern Region.

It is envisaged that this project will benefit the northern grains industry by increasing cereal yields through improved understanding and management of crown rot, FHB and common root rot by growers. An improved understanding of the mechanisms of resistance to crown rot and a broadening of resistance to Fusarium diseases in durum and bread wheat will further reduce losses to these diseases. This information is particularly relevant to current durum varieties which are highly susceptible to both Fusarium diseases. Improved management and resistance to Fusarium diseases should restore confidence in growing durum varieties and lead to increased plantings in the Northern Region.

Research Project Description

Project Title:

More profitable chickpeas through disease management – northern region

(Activity #346)

Principal Investigators:

Andrew Verrell & Dr Kevin Moore

Funding Sources:

NSW Department of Primary Industries and the Grains Research & Development Corporation.

Objectives:

1. Refinement and delivery of variety specific Aschochyta management packages for chickpea growers in the Northern region.
2. Quantify the potential importance of chickpea Botrytis Grey Mould in the Northern Region as a pre-requisite to developing management packages and setting breeding priorities.
3. Education and training of growers and agronomists in managing chickpea diseases. On-farm surveys to identify emerging problems and set breeding and pathology priorities.

Summary:

Growing chickpeas in the northern region needs to be more cost effective. Whilst up-coming chickpea varieties are less susceptible to Aschochyta they still require management, and they are all still susceptible to Botrytis Grey Mould. Phytothora root rot continues to be a major threat in the north.

The project will: refine existing Aschochyta packages to match economic constraints for current varieties and develop strategies for new ones; develop a Botrytis package; improve fungicide efficiency; explore novel control measures for Aschochyta, Botrytis and Phytothora; continue surveys to detect emerging problems; and progress grower agronomist training.

The work will be based at Tamworth using facilities and methods developed by GRDC projects.

Expected outcomes are; increased adoption and profitability of chickpeas; variety specific disease management packages and identification of new priorities for breeding and disease management.

Research Project Description

Project Title:

Integrated disease management in northern no-tillage systems using precision agriculture

(Activity #620)

Principal Investigator:

Dr Andrew Verrell

Funding Sources:

NSW Department of Primary Industries and the Grains & Research Development Corporation (Project No. DAN00116).

Objectives:

1. Develop precision agriculture strategies aimed at reducing the impact of disease on no-tillage systems.
2. Conduct on-farm monitoring.
3. Extend the project findings and practices to growers and agronomists.

Summary:

Plant diseases are a major constraint to grain production in the northern region of NSW and, whilst progress is being made using traditional methods of disease management (e.g., varieties, crop rotation, fungicides), precision agriculture (PA) has the potential to provide growers with a tool to rapidly and cost effectively reduce the impact of diseases. PA uses GPS technology to accurately steer tractors and ground engaging tools ensuring repeatable accuracy of ± 2.5cm. Previous research by NSW DPI has shown that PA can reduce crown rot in wheat through precision row placement techniques. Sowing wheat into the inter-row space is now being evaluated commercially by grower groups.

The new project will look at whether PA technology can reduce the impact of plant disease in cropping systems. Under no-tillage systems inoculum is not evenly distributed across the paddock but tends be concentrated in the old rows and standing crop residues. Leaving this inoculum undisturbed, and planting into the inter-row space (which should have less inoculum) thus presents a management tool for reducing disease risk in subsequent crops.

This project will benefit the northern Australian grains industry by providing new PA techniques to manage disease within the cropping system. This will increase confidence and profitability in pulses, particularly chickpeas, and the brassicas. This would then see an increase in the winter crop area in the Northern Region sown to pulses and brassicas and this will in turn provide substantial benefits to cereal production in terms of disease management.

Research Project Description

Project Title:

Direct and indirect measurement of deep drainage in north western NSW cracking clays

(Activity #385)

Principal Investigator:

Richard Young

Funding Sources:

NSW Department of Primary Industries and the Grains Research & Development Corporation (Project No. DAN 00059).

Objectives:

1. Develop the capability to predict the 'on-farm' financial and hydraulic consequences of land use change on a range of cracking clay soils and climate regions in north-western NSW.
2. Assess the impact of salts leached by deep drainage on groundwater.
3. Devise management practices to reduce the leaching of salt stored below the root zone of crops and pastures.

Summary:

This research will deliver profitable and well planned farming systems for a range of soil and climatic environments in north-western NSW. It will facilitate rational and informed decision-making by CMAs leading to reduced saline discharge and reduced stream salinity levels. Informed and rational decision making will also lead to stabilisation of unproductive and fragile landscapes. Higher water use efficiency is the key to farm management designed to minimise mobilisation of salt and excessive deep drainage.

We are investigating the amounts of deep drainage and salt movement under cropping systems, perennial pastures and remnant native vegetation in north-western NSW. It is attempting to answer the question: how much deep drainage occurs under cropping compared to native vegetation in cracking clay soils and does it do more good than harm? Deep drainage may have positive as well as negative impacts on ecosystems downstream.

This project is relevant to farmers and extension agronomists, policy makers within government, Catchment Management Authorities (CMAs) and users of groundwater. We are collecting data on the water and salt balances, hydraulic characteristics and behaviour of black and grey cracking clay soils (Vertosols) under pastures and crops. These data will be used to validate simulation models such as the Agricultural Production SIMulation model (APSIM) that predict the consequences of changes in land management and practices.

Deep soil cores are being taken from farmers' paddocks with a history of cropping or sown pasture and from areas of remnant native vegetation. Changes in the chloride concentration down the soil profile are used to estimate historic or long-term deep drainage. Chloride concentration is used as an indicator of water and solute flow rates through the soil.

APSIM, once verified against experimental and survey hydrology results and farmer yield information, will be used to test land use scenarios that might reduce salinity risk, increase water use efficiency and maintain or increase profitability. The results of this project will enable policy makers and CMAs to use decision support systems such as LUOS (NSW Department of Natural Resources' Land Use Options Simulator). Farmers and advisers will have access to software (or hard copy summaries) similar to APSRU's 'Whopper Cropper'. Whopper Cropper is an easy-to-use computer program designed to provide crop management advisers with the latest technology in cropping systems modelling and seasonal climate forecasting.

Research Project Description

Project Title:

Direct measurement of deep drainage below the root zone

(Activity #386)

Principal Investigator:

Richard Young

Funding Sources:

NSW Department of Primary Industries and Grains Research & Development Corporation (Project No. DAN 00059).

Objectives:

1. Refine the capability to predict the 'on-farm' financial and hydraulic consequences of land use change on cracking clay soils in north-western NSW.
2. Devise meaningful and credible management strategies for profitable farming systems with acceptable impacts on the farm resource base and the wider environment.
3. Assist in the development of scheduling practices for subsurface drip irrigation by characterising the patterns and rates of wetting of the soil profile.
4. Explore the use of electrical imaging as a hydrological research and irrigation scheduling tool.

Summary:

The efficient use of water, with minimal loss from deep drainage and soil evaporation and a reduced impact on the environment, is becoming more critical for both irrigated and rainfed agriculture on the cracking clay soils of the Liverpool Plains and north western NSW. Inefficient water use not only cuts into profit, it can also lead to environmental damage – for example, rising water-tables and dryland salinity.

With this project we are quantifying the pattern of soil wetting, both laterally and to a depth of 5 m, and the soil water balance under crops, fallows and perennial pastures. A site of 4 ha has been established on a deep alluvial cracking clay (grey Vertosol) on the NSW Department of Primary Industries Liverpool Plains field station, Breeza.

Tension lysimeters (stainless steel trays inserted into the soil to which a suction equal to that in the surrounding soil is applied) are being installed at depths of up to 5 m to measure deep drainage and solute movement below the root zone. The pattern of soil wetting will be measured in three dimensions using electrical imaging, neutron scattering and an array of moisture probes and tensiometers. Detailed and extensive characterisation of soil hydraulic properties is in progress.

The data will be used to validate models of crop production and water balance using the Agricultural Production SIMulator (APSIM) and to determine the proportion of soil solutes (salt, agricultural chemicals) mobilised by major wetting events and to refine the design and management of subsurface drip irrigation in cracking clays.

Research Project Description

Project Title:

Collaborative recharge validation project – northern NSW site

(Activity #387)

Principal Investigator:

Richard Young

[Note: This is a collaborative project with the University of Technology, Sydney and the Department of Natural Resources (Dr Mark Littleboy – statewide Principal Investigator)]

Funding Sources:

Formerly funded by the State Salinity Strategy and now possibly the Natural Heritage Trust and National Action Plan via the NSW Department of Natural Resources.

Objectives:

1. Provide data on the hydrology and production of agricultural activities, forests and native vegetation to validate simulation models used to predict end of catchment outcomes of land management options for CMAs.
2. Assist in devising meaningful and credible land management strategies to reduce salt mobilisation and stream salinity levels.

Summary:

Data are being collected at sites near Quirindi in the Liverpool Plains catchment and other sites at Baldry, Wagga and the Hunter Valley to validate various inputs to the Catchment Scale Salt Balance Model-CATSALT and the Land Use Options Simulator – LUOS. This software is used to provide predictions of salt balance from simulated land use scenarios to help find the best choices to combat salinity in the Murray Darling Basin. Insights from these studies identify the likely trade-offs in the balance between achieving targets to reduce salinity and providing water for domestic, agricultural and industrial use.

This project is a collaborative effort between hydrologists, hydro geologists, modellers, foresters and agronomists from the Department of Natural Resources, NSW DPI and the University of Technology, Sydney. The water balance and productivity of an eight year old ironbark plantation is being compared with native pastures and remnant native vegetation.

We are using a range of methods to measure or estimate the components of the water balance. These include direct measurement of grassland evapotranspiration using the Bowen ratio method which uses the gradient of temperature and vapour pressure deficit to calculate evapotranspiration. Transpiration by trees is being determined by measurements of sap flow, soil water both intermittently by neutron scattering and logged continuously with ‘theta' moisture probes. Fluctuations in groundwater under each land use are recorded continuously.

We will also use environmental isotopes to determine from whence and when trees obtain water. This could be recent rainfall stored in the soil, not-so-recent rain stored in groundwater or the regolith (loose uncemented mixture of soil and rock particles that covers the Earth's surface).

Research Project Description

Project Title:

Mobilisation of 100 tonnes of salt/ha under cropping in north western NSW – a threat to agricultural and natural ecosystems? I & II

(Activity #534 / 535)

Principal Investigator:

Richard Young

Funding Sources:

NSW Department of Primary Industries and the National Action Plan for Salinity & Water Quality.

Objectives:

Determine the best way to manage water and salt stores under rainfed cropping on cracking clay soils (Vertosols) in north western NSW so that the large existing soil salt stores pose a minimal threat to agricultural and natural ecosystems and to stream and groundwater resources.

Summary:

The aim of these two projects is to determine the best way to manage water and salt stores under rainfed cropping on cracking clay soils (Vertosols) in north western NSW so that the large existing soil salt stores pose a minimal threat to agricultural and natural ecosystems and to stream and groundwater resources.

The project outputs will be field knowledge and suggested practices for the management of sustainable cropping systems on Vertosols that will reduce mobilisation of salt stores and their discharge into fresh groundwater, streams and associated flood plains and wetlands. The Namoi, Gwydir-Border Rivers and Central West CMAs are supporting this project, and all three CMAs have stated the need for information on salt stores and the threat they may pose to groundwater and river systems.

Our argument is that most of the possible damage has been done already to these semi-arid landscapes by continuous conventional farming over the last 20 – 50 years. However, with new conservation farming systems, the potential for deep drainage and salt mobilisation is far greater because of the increased capture and conservation of rainfall. This raises the question: is this potential for deep drainage and mobilisation of substantial salt stores a threat to the viability of agriculture, surface and groundwater quality, remnant native vegetation and associated biodiversity, wetlands and other fragile landscapes?

Under investigation are the alluvial clay landscapes in the Warren, Coonamble, Walgett, Mungindi and Burren Junction areas of NSW. To achieve the aims of the project we will:

- Estimate size of salt stores and extent of historic deep drainage under farmers' cropping paddocks and native vegetation;
- Investigate the hydrology of the underlying alluvium, determine the depth to the water table under cropped and adjacent landscapes from existing bore records and by sampling existing non-artesian bores; and, where necessary, determine depth and nature of alluvial aquifers by drilling and installation of observation bores;
- Predict the water use, deep drainage rates, consequent mobilisation of salt, and the economic yield of alternate cropping and crop-pasture systems;
- Determine, as far as possible, the most likely time and place of discharge into river systems or deeper fresh water aquifers if deep drainage from leaky land uses is not controlled;
- Conduct scenario simulations to test the outcomes of alternative management practices;
- Develop a sequence of land management practices that might, for example, leach salt below the root zone of most crops and pastures and then keep it there by a combination of response cropping and judicious pasture phases;
- Collaborate with farmers and agronomists in the investigation areas to determine current problems relating to near surface salt stores and to test model outputs and proposed management practices.