

# **THE WINSTON CHURCHILL MEMORIAL TRUST**

## **CHURCHILL FELLOWSHIP 2002/2**

### **INCREASING WHEAT YIELDS IN HIGHER RAINFALL ENVIRONMENTS**

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Signed: AH Mayfield

Dated: 3 September 2003

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## INTRODUCTION

Wheat yields in higher rainfall regions in southern Australia have not increased to the same extent as in medium and lower rainfall regions. In contrast, wheat yield increases in Europe and New Zealand over the past 10 years have been spectacular.

This study tour was to meet the researchers, advisers and farmers who could explain and show how this is being done.

Specific aspects of this study were to

- understand the basis of nitrogen fertiliser and disease control recommendations for higher yielding wheat crops and how they are interpreted by advisers and farmers.
- examine other aspects such as drainage and pest control where relevant to our production systems.
- study new precision agriculture equipment and systems which could improve the efficiency of our use of crop inputs.
- learn of environmental restrictions on farming in these environments as possible indicators of future controls on farming here.
- see how research information is distributed to farmers through publications, field trials and at major cropping and machinery field days.

## ACKNOWLEDGEMENTS

I wish to gratefully acknowledge The Winston Churchill Memorial Trust for funding for a remarkable study tour of New Zealand and Europe. I am also very grateful to the many farmers, advisers and researchers who gave me a greater insight into increasing wheat yields in higher rainfall environments. I am also grateful to my wife Sue, for helping with organising the study tour and typing the report.

## EXECUTIVE SUMMARY

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### Fellowship objective

To investigate methods of crop management for high yields of wheat to ensure that growers have the best information for optimum economic crop production in higher rainfall regions of New Zealand, UK, Germany, Norway, France.

### Fellowship highlights

1. Delaying nitrogen applications, according to crop demand is likely to produce immediate benefits. The SIRIUS wheat calculator, developed by Dr Peter Jamieson, Crop & Food, New Zealand, is an excellent basis for developing this system here. Likewise, Roger Sylvester-Bradley at ADAS, Boxworth, UK provided valuable insight into crop nitrogen demands and appropriate fertiliser use.
2. The application of nitrogen within a field could be refined further using the in-field detection system or the Nitrogen Sensor, developed by Hydro at Dülmen, Germany. Paul Miller at Silsoe Research Institute is refining this system further.
3. A more sophisticated approach with fungicides, using mixtures and tailoring rates to specific situations, will also bring benefits. There is an excellent interactive fungicide recommendation program on [www.hgca.com](http://www.hgca.com).
4. Field testing programs and demonstrations of crop treatments at field days by the Morley Institute and Arable Research Centres, UK, Arvalis, France and the Foundation for Arable Research, New Zealand, were outstanding. There are many ideas from these programs which could be incorporated into local demonstrations and field days for farmers here.

### Dissemination

This will be through talks at farmer and adviser meetings and written articles.

By the end of August 2003 I will have presented key findings to two farm management groups (FM500), at a GRDC farmer conference (at Naracoorte) as well as at several other meetings. A poster display was prepared for the Annual Churchill Fellowship dinner in Adelaide.

Details of contacts and information on Precision Agriculture have also been passed onto the Southern Precision Agriculture Association.

A key researcher from New Zealand (Nick Poole, FAR) will be conducting crop information days in South Australia in August 2003, as a result of the visit to FAR.

A lot of detail will be used in the trial programs of the Hart Fieldsite Group - a major cropping field trial and demonstration site in South Australia.

In October 2003 I will take 26 farmers from South Australia on a study tour of farming on the Canterbury Plains of New Zealand using contacts from the Churchill Fellowship.

## PROGRAM

**25 November - 5 December, 2002**

### NEW ZEALAND

#### *Foundation for Arable Research*

- Nick Pyke (Chief Executive) & Anton Nicholls (Extension Agronomist)

#### *Crop & Food*

- Matthew Cromley (researcher - plant disease)

#### *Contract researchers*

- Bede McCloy (agronomy), Ian Harvey (plant pathology) & Murray Craighead (precision agriculture)

#### *Farmers*

- Jim McCartney, Stuart Wright, Colin Lill, Craige Mackenzie, Barry Austin, Eric Watson & David Fisher

#### *Field days*

- Lincoln
- Rakaia

#### *Advisers*

- Graeme Jones, Pyne Gould Guinness, Gary Roe

**9 May - 12 June, 2003**

### EUROPE

#### *Rothamsted Research Institute*

- Peter Barraclough

#### *Silsoe Research Institute*

- Paul Miller, Ian Scottford

#### *ADAS Research Centre, Boxworth*

- Roger Sylvester-Bradley, Bill Clark

#### *Morley Research Institute*

- Jim Orson, Peter Riley

#### *Deloitte Touche (Cambridge)*

- Mark Hill, Paul Rix, Richard Crane

#### *Campden & Chorley Wood Food Research Association*

- Dhan Bhandari

#### *Arable Research Centres*

- Mike Carver

#### *Farmers (UK)*

- Mark Howard, Bicester
- Robert Salmon, Dereham

#### *Hydro-Agri*

- Barry Bull, Crop Manager, Norway
- Joachim Lammel, Jörg Jasper, Dülmen

#### *Landbo Centre Midt, Denmark*

- Neils Jakobsen, Viborg

#### *Arvalis, Boigneville, France*

- Damien Hanus, Valerie Leveau

#### *Farmers (Germany & France)*

- Dietrich Klöpffer, Minden
- Pierre De Contes, Evreux

#### *Cereals 2003 Field Days, Cambridge*

## DETAILS OF THE FELLOWSHIP

### Background

Wheat yields in higher rainfall regions of southern Australia have not increased to the same level of water use efficiency as in medium and lower rainfall regions.

Constraints on production unique to these higher rainfall regions include

- insufficient nitrogen fertiliser later in the growing season
- excessive disease on crop leaves
- slug damage
- waterlogging

Detailed research in northern Europe and the application of these findings by European farmers, especially on nitrogen timing and disease control has resulted in large increases in wheat yields there. These yields in Europe are now remarkably constant at 10t/ha in areas of more favourable soils and climate. New Zealand wheat growers discovered and applied the key elements of this research in the mid 1990s, lifting wheat yields spectacularly from approximately 6t/ha to over 12t/ha.

This Churchill Fellowship was planned to understand this research and its implementation in these two regions (northern Europe and New Zealand). In particular, I would be looking for aspects which could be implemented or researched further in Australia.

### Nitrogen nutrition

The most critical part of this system for increasing wheat yields is to apply nitrogen fertiliser according to the crop growth requirements and not as larger doses earlier, as is commonly done here. This delay in nitrogen application produces thinner looking crops, which at first seem at odds with producing high yields. But thinner crops allow more sunlight to lower leaves, which in turn produces more and bigger grains in each head. These higher yields do not come from very high numbers of heads per square metre, but from more grain (number and weight) per head.

The measurement of crop density used is green area index, the proportion of green plant area of ground area. The optimum green area index is 5.5 at heading. This is less than for many of the wheat crops grown in our higher rainfall regions.

An excellent UK publication "The wheat growth guide" lists the details of nitrogen application to achieve the most economic yield responses.

The SIRIUS Nitrogen Calculator, a computer model developed by Peter Jamieson (Crop & Food, Lincoln, New Zealand), is used as a guide to the optimum nitrogen use in wheat crops. Using this calculator wheat yields and protein were similar to those using standard practice, but at only two thirds the nitrogen rates. This program is now being used by many farmers in New Zealand. It is also now being used by a post graduate student here in field studies on the efficiency of nitrogen uptake.

Researchers and advisers in Europe and New Zealand do not commonly use any plant tests (such as % nitrogen in leaves) to decide if the wheat crop needs more nitrogen. So it was somewhat surprising to find out that over 110 nitrogen sensors were used by farmers in north Germany. There are none in Australia at present. This nitrogen sensor, developed by the fertiliser company Hydro, assesses the relative greenness of crops and alters the nitrogen fertiliser rate accordingly. This happens continuously as the tractor and fertiliser spreader move across the field. I met with the company

researchers and was shown how the equipment worked. Following my return there is now a lot of interest in this concept. With the assistance of the Grains Research & Development Corporation and Hydro, we plan to test this nitrogen sensor in Australia to improve the efficiency of nitrogen fertiliser across paddocks.

### **Disease control**

Maintaining healthy crop leaves with fungicide treatments is also a critical part of achieving higher yields in these environments. Much was learnt from researchers and especially crop advisers, who were very skilled at tailoring mixtures and timings for each specific situation. This information (on rates, timings and mixtures) can be used as these fungicides become available in Australia.

Detailed research, including that by the Morley Institute, showed that lower rates of combinations of fungicides was the most economic strategy. This is usually a mixture of an eradicant type (triazole) with a protectant type (strobilurin). Relying on just strobilurins alone has created resistance problems with two wheat diseases (powdery mildew and septoria tritici).

Timing of fungicides is critical. The first ( $T_1$ ) is when the third to last leaf is fully out. The second ( $T_2$ ) is when the last leaf is fully out. There may be a third application ( $T_3$ ) when the ear is fully out.

An organic farmer I visited in western France uses mixtures of up to three different wheat varieties to suppress leaf diseases without using fungicides. This was researched many years ago in the UK but is not practised by conventional farmers.

### **Pest control**

Control of slugs in Europe and New Zealand is primarily by ploughing and subsequent cultivations. Because of this, baiting is not usually needed. In contrast, in Australia, our direct drilling and stubble retention has increased slug problems. We could use some aspects of the European system, such as soil consolidation by rolling, to reduce slugs here.

The best early warning system for slugs was using crushed wheat under quarry tiles at a few places across a paddock.

### **Precision agriculture**

The use of precision farming systems, such as vehicle guidance and variable rate seed and fertiliser, is greater in Australia than in these other countries. This is because of our larger paddocks, greater profitability and strong research, extension and industry support. However, there are several advances we could try here. One is the nitrogen sensor mentioned previously. Another is a device for sampling and measuring the protein content of wheat during harvesting. The third is a more advanced electromagnetic sensor (geocarta) to detect and map changes in soil across a paddock. Contact details and publications from our Southern Precision Agriculture Association were passed on to similar organisations in the UK and France to foster ongoing exchange.

## **Environmental restrictions**

The environmental restrictions on crop inputs (such as fertiliser and chemicals) are increasing due to the proximity of farming to waterways and to pressures from the large populations in Europe.

For example, in Denmark farmers can use only 90% of the economic nitrogen rates. Also all chemicals have an environmental index rating and the maximum allowed is 2.0 per crop.

The Mid Term Review of the European Union stipulates that subsidy payment to farmers is contingent on them meeting environmental standards. Many farmers now have a 6m grass verge between their crops and waterways or hedges to increase feeding sites for birds and other animals and to reduce chemical contamination of waterways. They are also now encouraged to leave small areas of wheat crops bare for nesting sites for skylarks. All this reduces the farm's productive capacity and increases the time the farmer spends on reporting on these regulations.

Farmers in Australia need to ensure their practices are not detrimental and that they are proactive in adopting environmentally sound farming practices rather than having regulation forced upon them.

## **Distribution of information**

In Europe and New Zealand there are excellent advisory service industries for farmers. Aspects of these could be used to improve these services in Australia.

At major agricultural field days at Boigneville, France and Cambridge, UK there were excellent displays of agricultural production research using well laid out trial plots and clear posters. There were also leading researchers at these sites at all times to explain results in greater details. I exchanged contact details with many of these to follow up if I need further details of their research programs.

There are also smaller groups such as Arable Research Centres and the Morley Institute that do research for farmer clients. Their information distribution is through regular fax bulletins (for strategic decisions during the growing season), and more detailed articles and reports and as well, farmer meetings and field days.

Several of these researchers have had a big influence in improving crop production in New Zealand. In Australia, through collaboration of FAR in New Zealand, we are now seeing the benefits of this research here.

I was approached by several experienced researchers and advisers in Europe about job opportunities in Australia. I am sending them details of job opportunities in Australia. If this is successful we will then have this cropping expertise right here for much longer than we have currently with visiting researchers and advisers.

Even without this, the contacts with leading researchers, advisers and farmers made while in Europe and New Zealand will be on-going.

## **References**

HGCA, UK - *The Wheat Growth Guide*. 32pp.

HGCA, UK - *Wheat disease management - 2003 Update*. 8pp.

HGCA Project Report No. 267 - *"Precision farming" of cereal crops: a five-year experiment to develop management guidelines 2002*.

## **Websites**

[arvalisinstitutduvegetal.fr](http://arvalisinstitutduvegetal.fr)

[www.hgca.com](http://www.hgca.com)

## CONCLUSIONS

Nitrogen fertiliser management is a key component of increasing wheat yields in higher rainfall regions. By delaying the timing of application until after the end of tillering the conversion of nitrogen into grain yield is more efficient and lodging problems are less. There is considerable expertise in Europe and New Zealand we can use to help us improve our nitrogen management. Using the Nitrogen Sensor will add a further refinement to this by supplying more nitrogen fertiliser to areas of the crop with the greatest need and less to the areas with the least need.

The second major component is attention to detail with foliar disease control. This is by knowing the best combinations of fungicides to use for specific diseases and at specific growth stages. There are many detailed publications and expert advisers to assist us with these decisions. There is an excellent summary of fungicide efficacies on [www.hgca.com](http://www.hgca.com)

There are many experienced researchers and advisers who would be excellent speakers and trainers for advisers and farmers in Australia. These could be keynote speakers at GRDC Adviser and Farmer Updates as well as at major field days. They could also be invited to conduct detailed training workshops.

Environmental and other regulations can restrict the efficiency of farm operations and reduce the profitability of farm businesses. This is especially in areas of high populations and where the economic contribution of farmers is either minimal or not well recognised.

## RECOMMENDATIONS

1. Crops research should be conducted locally to test the concept of delayed nitrogen application on uptake efficiency and grain yield of wheat.
2. The Nitrogen Sensor should be imported and trialled to test if it can accurately detect varying nitrogen status of wheat crops and that differentially applying nitrogen fertiliser is economically worthwhile.
3. Information on fungicide efficacy from the UK be made available to farmers in higher rainfall zones.
4. Experienced advisers and researchers from the UK and New Zealand be invited to speak with farmers and advisers in higher rainfall wheat cropping zones in Australia. Also, key advisory publications from the UK on crop management should be made available to farmers and advisers here.
5. Farmers need to be actively involved in formulating any environmental regulations and policies so that the interests of farmers is respected. Farmers also need to continue to publicise their professional approach to their businesses and the contribution they make to society.