Murray Valley farmers drive rice systems research

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- A group of Murray Valley irrigators is taking the lead in directing research and investigation into the issues most concerning local farming systems
- Water use efficiency and soil health have been identified as the two highest priority issues
- One demonstration showed that irrigation layouts where water was on and off wheat in 15 hours had a 1.3 t/ha yield advantage over slower draining situations
- Mustard was investigated as an alternative dryland crop, and it clearly demonstrated its superiority over canola in the very dry conditions of 2004

Increasing competition for irrigation water leading to higher prices and decreasing reliability of water supply have driven Murray Valley farmers to look at ways to develop and focus research to maximise productivity and efficiency on a whole-farm basis.

A meeting was held at *Billinudgel*, the property of rice discussion group leader Geoff Small and his wife Leanne, in September 2002 to draw out issues of concern to farmers in the Denimein and West Berriquin areas. Issues raised were common to all participants and, in order of priority to the group, they were:

- increased water use efficiency ($/ML) on a whole-farm basis
- soil management, as it affects yield and hence water use efficiency
- alternative crops in the rotation, particularly the need to replace pastures or make them more profitable
- stubble management – particularly for rice but also for other crops

A decision to develop a farming systems group with a vision to research and develop "more profitable and sustainable irrigated farming systems" was made and a small group volunteered to form a steering committee to direct research by local NSW Department of Primary Industries officers.

Geoff and Leanne became the major co-operators for a farming systems trial, which was designed to investigate the two issues identified by the group as their highest priority (ie WUE and soil health).

The rice farming systems comparison at *Billinudgel* has two major goals:

- to examine methods of improving the yields of crops other than rice in heavy clay, lasered contour layouts
- to examine the effect on soil health, yields and profitability of removing pasture from the rice rotation

Improving winter crop yields

A trial commenced in 2003, with wheat being sown in all bays in the block to establish baseline data. Soil water and crop monitoring in the first year identified waterlogging as a major constraint to achieving high yields in the block (see IREC *Farmers' Newsletter*, No. 166, pp 31–33, 'Improving winter crop yields in contour layouts'). Pipes have been installed so that each bay can be drained individually, making the block an excellent facility for assessing different techniques for improving drainage in a layout that is very typical of those in the district. Drought and lack of irrigation water have hampered progress towards this goal, but monitoring is continuing and results will be reported as they become available.

Direct drill evaluation

In response to the issues and raised by the committee and its subsequent suggestions, two demonstrations and one trial were conducted at the NSW DPI Murray Valley Field Station and on group members' properties in 2004. The trial was an evaluation of direct drill implements for sowing wheat into rice stubble and the results were reported in the *Farmers' Newsletter*, No. 169, pp 4–7, 'Evaluating direct drill implements for Murray Valley conditions'. The trial was aimed at addressing the issue of stubble management raised by the group and, in collaboration with Clive Kirkby (CSIRO Land & Water), was the focus of a very successful session at the Murray Valley Winter Cropping Field Day in 2004.

Two further demonstrations are reported in this article. The first was proposed by the committee because it felt that irrigators would be more inclined to upgrade their irrigation layouts if they had a better idea of the yield penalty from having slow draining layouts. The second demonstration was aimed at addressing the group's desire to look at alternative crops.

Waterlogging of wheat in spring

Preliminary investigation into waterlogging of wheat in spring began in 2003 at the Murray Valley Field Station but the site was found to be unsuitable for the purposes of this trial because of large cut and fill differences across the block. Nevertheless, some useful information was gained regarding irrigation scheduling on transitional red-brown earth soils and the benefits of nitrogen topdressing for high yields (see *Farmers' Newsletter* No.166, pp 28–30, 'Irrigation scheduling for top yields').

Site description

A more uniform site on the Field Station was selected in 2004, also a transitional red-brown earth, in a lasered contour layout with eight bays (0.7 ha each). The site is classified as suitable for growing rice one year in four and had been fallow since growing rice in 2002–03. It was re-lasered on 29 March 2004 to a 1:2500 grade and pre-irrigated 5–7 April.

Thirty millimetres of rain was received on 25 May and Chara wheat was direct drilled (100 kg/ha) on 31 May with 20 kg N/ha and 22 kg P/ha, as 110 kg/ha DAP. The crop was topdressed at the end of tillering with 46 kg N/ha, as 100 kg/ha urea and sprayed for stripe rust on 3 October.

Four irrigation treatments were applied to the site (Table 1). The crop received its first spring irrigation on 20 September and water was held on two of the bays for four days. The remaining six bays were watered and drained within the recommended 15 hours. Maximum temperatures during this time did not exceed 28°C.

The second irrigation began on 12 October. Water was held on two bays for five days and on another two bays for four days. The remaining four bays, including the two that had been waterlogged during the first irrigation, were watered and drained within 15 hours.

Results

There was no lodging, and no difference in crop growth or colour was observed between any of the treatments. Header strips taken on 2 December showed that the bays which were waterlogged for five days during the second irrigation yielded 1.3 t/ha less than all other bays (Table 1). Four days of waterlogging during the first irrigation did not appear to affect yields.

The difference observed between the 4- and 5-day treatments appears to have been caused by the high temperatures on 12 and 13 October in conjunction with the waterlogging. This interaction did not occur in the other treatments, as shown in Table 2. Caution is needed in drawing conclusions from a non-replicated trial such as this, but the adverse effects of high temperatures on waterlogged crops is in line with both grower experience and evidence in scientific literature.

Summing up

Wheat appears to be relatively tolerant of up to four days waterlogging in early spring on this soil type. However, when high temperatures (>30°C) coincide with spring irrigation in slow draining layouts, yield losses of more than 1 t/ha are possible. This may be an underestimate for crops on heavy

Table 1
The effect of four different irrigation treatments on Chara wheat yield and quality, 2004

Time taken to get water on and off the bay		Yield	Protein	Grade
First irrigation	Second irrigation	(t/ha)	(%)	
15 hours	15 hours	6.7	10.0	ASW1
15 hours	4 days	6.8	9.5	ASW1
15 hours	5 days	5.5	9.3	ASW1
4 days	15 hours	6.8	9.6	ASW1

Table 2
The combined effect of waterlogging and high temperatures at the second irrigation

Date	Temperature			Timing of the second irrigation		
	Max	Min	Avg	15 hours	4 days	5 days
12 Oct	34.4	12.9	23.3	water on		water on
13 Oct	36.5	14.8	26.6	water off	water on	↓
14 Oct	28.2	10.9	17.4		↓	
15 Oct	20.6	6.4	13.4			
16 Oct	19.2	2.9	11.2			
17 Oct	20.2	5.4	12.7		bay drained	bay drained
Yield t/ha				6.7	6.8	5.5

clay soils with slower internal drainage, though this requires further investigation.

Growers with crops in slow draining layouts often delay spring irrigations to minimise the risk of reducing yields through waterlogging and lodging if rain falls shortly after watering. However, this increases the risk of high temperatures coinciding with irrigation as there are, on average, three days in October when maximum temperatures at Deniliquin are greater than 30°C, compared with almost zero days in September.

It should be apparent that the odds of achieving good yields are improved if irrigation layouts can be watered on time and then drained within 15 hours. The 1.3 t/ha yield loss shown in this demonstration clearly highlights the costs of not improving irrigation layouts to this standard.

A potential replacement for canola

Research has clearly shown that mustard can out-yield canola in drier environments and can yield up to 50% more in low yielding situations. True canola-quality mustard varieties are currently being bred at Horsham in Victoria and seed increase is being fast-tracked.

Two small demonstrations were sown on the Murray Valley Field Station in 2004 to show the potential for mustard as a replacement for canola in the western Murray Valley where shorter seasons and hot, dry conditions in spring can limit canola yields. Canola (var. Oscar) and a breeding line of condiment mustard were sown on 13 May into pre-irrigated land at rates calculated to provide 60 plants/m2. Seed was broadcast with 24 kg P/ha and 28 kg S/ha, as 250 kg/ha single superphosphate and then lightly harrowed in. The soil at the MVFS site was too dry to germinate the seed, so the crops were watered up using a sprinkler. Neither crop received any further irrigation.

In the demonstration, mustard showed the following advantages over the canola:

Figure 1 *Mustard (right) showed higher tolerance to heat and drought than canola, with better yields in two demonstration blocks in the hot dry conditions of 2004*

- more vigorous seedling growth and quicker time to full ground cover
- higher tolerance to heat and drought – tensiometer readings on 23 September showed that the soil water potential was similar under the two crops (55 kPa) and the canola was visibly water stressed whilst the mustard was not
- greater shattering resistance – both crops were direct headed and hot, windy conditions prior to harvest resulted in excessive pod shattering in the canola
- pest resistance – there was almost no pod loss due to pests (parrots, mice) in the mustard, whereas the canola suffered significant pod loss at both sites

The plots were harvested on 25 November, with the mustard yielding 0.6 and 1.0 t/ha and the canola 0.2 t/ha and zero harvestable yield at the two sites respectively. This result clearly demonstrated the superiority of the mustard under the very dry conditions experienced in 2004. In essence, the canola crops failed whereas the mustard, had it been of canola quality, would have been profitable as an oilseed crop at canola prices.

Conclusion

Farmers have the best knowledge of their own farming systems, so their active involvement in determining *what* problems are looked at and *how* they are looked at, has given the farmers in this group ownership of the research outcomes of the trial and demonstration work. This has meant that outcomes are directly relevant and it is hoped that this will lead to greater adoption of the findings from the trials that are conducted.

For the researchers involved in the project, the key benefit has been an increased understanding of the farming systems being studied and confidence that the issues being examined are real problems for the group. Involvement by the group in the rice farming systems trial at *Billinudgel* will also help to ensure that methods and solutions are practical.

Whilst neither of the demonstrations reported in this article were designed as replicated trials, they have provided useful information for the group. The potential increase in winter crop (and pasture) yields from improving drainage times in irrigation layouts was clearly demonstrated. If realised, this sort of yield increase would pay for the cost of upgrading a layout well within the lifetime of that layout. The potential for canola-quality mustard to replace canola in marginal areas and dry years was also clearly demonstrated. It must be noted that mustard does not out-yield canola in good conditions but when commercial quantities of seed are released, it will provide a real alternative in rotations in the western Murray Valley.

Further information

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