Irrigation scheduling of wheat under centre pivots

Water is a major limiting factor in the production of irrigated grain, and efficient water management is paramount for growers to achieve high yields and profits.

Practical advice on scheduling irrigations to take into account weather conditions and the needs of crops at specific stages is now available.

Specific irrigated grains information has been added to the WATERpak manual which cotton growers have used for some time, with assistance from the Grains Research and Development Corporation (GRDC).

GRDC's Manager of Extension and Grower Programs, Tom McCue, said that many growers are planting grain this year instead of cotton.

"With limited water availability in many areas and strong prices for grain, it's a logical option," Tom said.

"Growers need to be flexible and consider the best use of their resources each year, based on the conditions at the time."

The following extract from WATERpak uses trials in Finley, in southern New South Wales, to help illustrate some of the points about irrigation scheduling for wheat under centre pivots.

KEY POINTS

- Manage crops to meet daily water requirements.
- Where pre-sowing moisture is inadequate, centre pivots can pre-water without filling the profile.
- Wheat needs almost continual readily available water (RAW) in September and October.
- Soil water during the 10 days after flowering determines the grain size.
- Wheat needs water for at least six weeks after flowering has finished.
- Do not schedule by crop appearance – use soil moisture and weather.

WATER USE BY WHEAT

Wheat yield is influenced by water availability, along with factors such as varietal characteristics, time of sowing, soil fertility (chemical and physical), weeds and disease.

If most of the above factors are adequate to favourable, southern New South Wales wheat varieties are expected to produce 15–20 kg per hectare for each mm of water used by the crop. Water use by any crop is directly related to potential evapotranspiration (ETo).

TABLE 1: Average monthly ETo and estimated crop water use for Finley in NSW plus the mean monthly rainfall in the winter months at three sites in the region

Month	Av. ETo Finley (mm)	Kc	Crop water use (mm)	Mean monthly rainfall (mm)		
				Finley	Echuca	Moulamein
June	36	0.5	18	43	44	34
July	38	0.7	27	40	40	32
August	68	0.8	55	41	43	34
Total	**142**	**–**	**100**	**124**	**127**	**100**

If 100 mm of effective rain falls through the winter, optimum crop growth should occur with no moisture setbacks. In practice this seldom occurs as rainfall is seldom evenly spaced, and dry spells and frosty or windy weather reduce the effectiveness of the rain. Weeds also compete for soil water, and some soil water may move below the developing roots if the subsoil is dry.

TABLE 2: Potential water use by wheat in spring

Month	Av. ETo Finley (mm)	Kc	Crop water use (mm)	Mean monthly rainfall (mm)		
				Finley	Echuca	Moulamein
September	105	0.8	84	39	39	32
October	165	0.8	132	42	45	35
November 1–15	100	0.6	60	33 (whole month)	32	26
November 16–*	130	0.4	?	–	–	–
Total	**500**		**276**	**114**	**116**	**93**

* Moisture extracted from deep in the rootzone is usually sufficient to finish the crop.

Crop water requirements change during a season. To obtain maximum yield, manage crops to meet daily water requirements. To determine the daily water use of a vigorously growing crop, multiply daily potential evaporation (ETo) by a crop coefficient (Kc).

For an average cropping situation (assuming a wheat crop sown in late May which has a good plant stand, is adequately fertilised, is relatively free of weeds and disease, and there are no major soil constraints) the Kc factors to use with the daily ETo readings from CSIRO weather stations in southern NSW are shown in Tables 1 and 2.

The Kc figures are estimated as 0.7 in the initial growth stage, 1.15 during the peak growth stage and 0.25 at maturity.

As an example, Table 1 shows average monthly ETo and estimated crop water use for Finley in NSW plus the mean monthly rainfall in the winter months at three sites in the region.

SOIL MOISTURE PRIOR TO SOWING

Good pre-sowing moisture ensures an adequate plant stand and reduces the likelihood of crop growth slowing and stressing for moisture (losing yield potential) prior to the start of the irrigation season.

Every season is different. In some years there will be sufficient soil moisture to sow on time and for germination without the need for a watering. For southern NSW, a late pre-sowing irrigation of around 25 mm is a safe option with a centre pivot, and if needed another 12 mm can be applied to assist emergence. (On-farm storage may be needed in irrigation districts where water is not supplied during winter).

Pre-watering with a centre pivot does not have to fill the soil profile, unlike surface irrigation where this is unavoidable. But it is still useful to know how much water is in the soil if it is full.

Average cropping soils in southern NSW can hold up to about 130 mm to 0.9 m. But about 88 mm of plant available water (PAW) is in the top 0.6 m (effective rootzone) and about 42 mm of this is readily available water (RAW).

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Pivots can accurately deliver daily water requirements to crops.

Spring water use

Wheat needs almost continual RAW in the effective rootzone in September and October to produce high yields. Soil water prior to head emergence helps determine head size and the number of florets to be fertilised (number of grains). Soil water during the 10 days after flowering determines the size of the grains.

Wheat needs water for at least six weeks after flowering has finished. It uses water at the same rate as pre-flowering for about 25 days after full flowering, and then the rate of use declines during the next 17 days or so.

Spring irrigation scheduling

Judging when to irrigate by crop appearance is a poor guide. If the crop is showing signs of moisture stress, then much of the yield potential has already been lost.

Assessing soil moisture is a better guide. When assessing soils, auger down to at least 0.5 m, not just to shovel depth. If you can make a ball of soil from clay or clay loam but it will not ribbon, then RAW has already run out.

Soil moisture monitoring instruments are the most accurate guides. Weather based scheduling is a satisfactory alternative and a back-up. Make use of the ETo readings from the CSIRO or other weather stations.

As a late May sown wheat crop should finish flowering in the first week of October in southern NSW. Table 2 shows average expected water use for moderately good wheat crops (around five tonnes per hectare) if the crop has RAW throughout the spring.

Note that the Kc should be increased by 0.1 for crops with well over five tonnes per hectare yield potential, and by 0.2 if aiming for an eight tonnes per hectare crop. ■

Old but precise

When Victorian Mallee farming brothers Albert and George Oliver built their own four-wheel-drive articulated tractor in 1977 there was no way they could foresee that in 2008 they would be sitting in the cabin, hands off the wheel, watching it steer across their paddocks with two cm precision.

The 79 year old twins, who still work every day on the farm near Manangatang, have readily adapted to GPS technology and marvelled at its benefits. They defy the stereotypical view that older people find it difficult to cope with modern electronic equipment.

Albert's son, Peter, had seen the potential for applying better technology to their cropping operation and approached Jim Castles from gps–Ag who is based at Ouyen. Jim takes up the story.

"I had only been with the company a month when Peter rang. It sounded routine and I arranged a visit. He then said "the only thing is that we're putting it on a home built tractor". I thought to myself, yeah, right!

"My training had told me that our Autofarm systems would fit anything, so I said yes, we can do it. It actually turned out to be pretty straightforward and no more expensive than any other tractor."

George Oliver's son, Kevin, operates a Ford New Holland 9680 as the second large tractor on the family's 4850 hectares of owned and leased country. The cousins decided to equip both tractors with identical A5 Autofarm RTK two cm systems that rely on base stations at either end of the spread.

Jim Castles says both stations are available to other farmers in the area using gps–Ag gear. "We're creating a network right across the Mallee."

Peter Oliver has seen major advantages with the systems. "It really takes the pressure off at night and when you are working in dust. But the real benefit is what you save by avoiding overlap. In one paddock of 260 hectares, we saved eight hectares. It's costing us about $200 per hectare – that really adds up. Just in that one paddock we were $1600 ahead.

The brothers' tractor has worked for 30 years and over 14,000 hours. Power comes from an 8V 71 Series GM diesel putting out around 315 hp at 2100 rpm. It drives through a 13 speed Fuller transmission via a drop box which splits the power between two massive Sherman tank differentials.

It's never been weighed but George Oliver estimates it would go at least 15 tonnes, possibly closer to 20. "It certainly doesn't need any ballast."

"It took us about a year to finish the project – about six months scratching stuff together and another six months to actually build it. We had the cabin built in Ballarat but did everything else ourselves."

Stories about the old tractor abound. The brothers once decided to find the tractor's top speed. George said they got it up to almost 90 km per hour and still had a gear left but weren't game to use it! ■

The Olivers with the 1977, 315 hp home built tractor now sporting two cm precision steering. Albert (second left) and George (second right) still do 90 per cent of the sowing while their respective sons, Peter (left) and Kevin, spray ahead and keep up the seed and fertiliser.