



Grains Research UPDATE NORTHERN REGION



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Sorghum row spacing, fallow cover and soil water accumulation

A well managed fallow in the northern Australian grain zone typically stores between 20 and 25% of fallow rainfall. Recent GRDC supported research in Central Queensland has shown that sorghum grown on wide rows led to 16-29% less soil water being stored in the subsequent fallow (Figure 1) and a lower average surface cover (Figure 2) at the end of that fallow than after a sorghum crop grown on narrower rows.

Researcher Richard Routley from the Central Queensland Sustainable Farming Systems project said that: "Wide and skip row configurations are commonly used in CQ sorghum production to promote yield stability – particularly in low yielding years - by maximising plant available water during flowering and grain fill (Figure 3). As a consequence, crop residue is concentrated in bands leaving inter-row spaces devoid of cover during the following fallow period. Reduced cover may cause increased runoff and soil loss, reduced infiltration and soil water storage, and may restrict planting opportunities in the future. Farmer observations also indicate inter-row areas can be difficult to 'wet up'.

Wide rows that lead to low cover levels can negatively influence both soil water accumulation and biology, with potential downsides for following crop yield. The value of reduced soil water accumulation for following crops needs to be balanced with the upside of enhanced yield stability in dry seasons from wider rows. As a rough guide, an extra

20 mm of plant available water at a water use efficiency of 10 kg grain / mm water, equates to around 200 kg of grain/ha. Extra fallow efficiency may also mean the difference between being able to sow the next crop or not.

Research into novel solutions such as cover crops in fallows, could find new ways to improve fallow efficiency in wide-row and conventional systems.

FURTHER INFORMATION:

Download an Update paper on this topic and water use efficiency presented at the Emerald GRDC Update July 2007 from www.grdc.com.au

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Project codes:
DAQ382,
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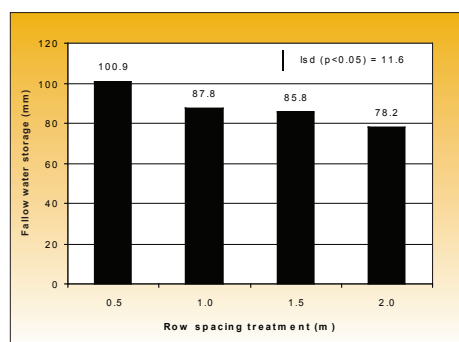


Figure 1: Effect of row spacing on fallow water storage between 29 Mar 05 and 26 Apr 06

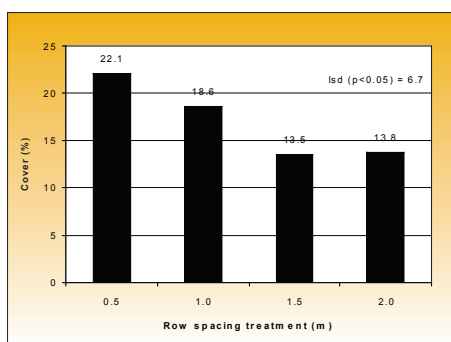


Figure 2: Average groundcover for each row spacing treatment at 12 April, 2006

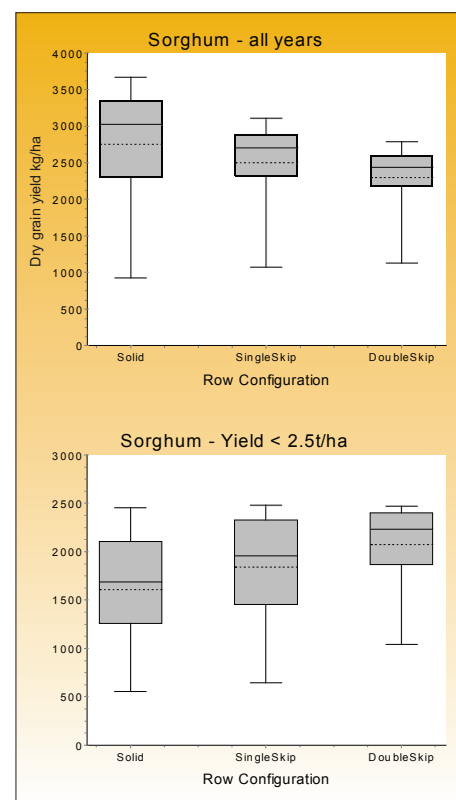


Figure 3: Effect of row configuration on sorghum yield at Emerald.

How aggressive should my cropping system be?

What is the most efficient use of a limited water supply – to sow regularly on less water, or less frequently with more stored soil water at sowing? An analysis of three cropping strategies – each with different start soil water triggers for planting was reported at the July 2007 Emerald Farming Systems Update by Richard Routley. The modelling looked at crop performance at Emerald from 1955 to 2006. As the aggressiveness of the system increased (ie less soil water needed to sow), total grain production increased, average crop yields decreased, average cover levels increased, Systems Water Use Efficiency (SWUE) (kg of grain produced per mm of rainfall) increased and a greater proportion of rainfall was used for transpiration rather than evaporation, runoff or drainage (see Table 1). “The modelled SWUE values broadly correlate with results obtained in field studies” said Richard Routley, and “Further analysis of the economic consequences of different levels of ‘aggressiveness’ is underway”.

Key findings from field studies indicate:

- Short fallows can be efficient or inefficient, but there is no such thing as an efficient long fallow.
- The practice of waiting for a full profile before planting is self defeating in a CQ environment.
- Maintaining the soil surface in a condition conducive to infiltration maximises fallow efficiency.

FURTHER INFORMATION:

Download an Update paper on this topic presented at the July 2007 Emerald Update from www.grdc.com.au or contact Richard Routley 07 4983 7429 richard.routley@dpi.qld.gov.au

Project codes: DAQ382, DAQ00049

Table 1: Effect of soil water threshold for planting on stored water use efficiency (SWUE) and other system performance indicators for years 1955-2006 at Emerald

System Planting Threshold	mm PAW	Conservative 150	Moderate 100	Aggressive 50
Number of crops		35	45	72
Crops/yr		0.69	0.88	1.41
Total grain produced	t/ha	141	172	197
Average yield	t/ha	4.04	3.82	2.73
Average cover	%	40%	49%	55%
SWUE	kg/ha/mm	4.55	5.53	6.32
% rainfall ending up as:				
Transpiration		21%	26%	32%
Evaporation		56%	55%	55%
Runoff		18%	16%	11%
Drainage		5%	3%	2%

Sorghum rust and yield loss in Southern Queensland

In southern Queensland, rust (caused by the fungus *Puccinia purpurea*) usually develops on grain sorghum as the plants approach physiological maturity, so it has been assumed that rust has little impact on the yield of grain sorghum.

However, in a GRDC supported PhD study undertaken through the University of Southern Queensland, Ms Jodie White found that yield losses (3-13%) occurred in two grain sorghum hybrids despite low levels of rust severity (3.0-3.4%). The ability of rust to cause yield loss appears to depend on the initial background rust levels and the timing of infection in relation to crop growth stage, rather than final rust severity at physiological maturity.

From controlled environment experiments, Ms White also identified that:

- At least 2 hours of leaf wetness was needed for infection, and that rust severity (pustules/cm²) increased as the period of leaf wetness increased up to 24 hours,
- Rust developed at temperatures between 16°C and 28°C, with the optimum temperature at 20°C,
- An incubation period of 16 hours in darkness was optimal, with rust developing in the range 0-24 hours of darkness,
- Young plants (2-6 leaves fully expanded) were more susceptible than older plants (7th leaf expanded onwards) irrespective of the susceptibility of the genotype, and
- Rust severity increased as the concentration of rust spores increased.

In three years of field trials, yield losses of two grain sorghum hybrids were determined by comparing the yields

of unsprayed plots, with plots regularly sprayed with oxycarboxin (a fungicide which selectively controls rust). Other diseases (including ergot and leaf blight) and insects (particularly sorghum midge), were controlled in all plots with applications of selective fungicides and insecticides.

Yield losses of 3%, 8% & 13% were recorded in 2003, 2004 & 2005 respectively, with the differences being attributed to the dynamics of rust development. The results when combined with environmental data, suggest that at least in the Gatton region of southern Queensland, field conditions and particularly cooler temperatures and longer periods of leaf wetness late in the sorghum season, (February and May) are conducive to rust development in grain sorghum. The background levels of rust during the early stages of crop development also play a major role in the dynamics of rust development in southern Queensland.

Ms White also identified four pathotypes of the rust pathogen (*Puccinia purpurea*) in the 29 isolates that she had collected from grain and forage sorghum and Johnson grass (*Sorghum halepense*) in eastern Australia. In the only other study of its type in the world conducted over 30 years ago, researchers in Hawaii identified just two pathotypes, which were different from the Australian ones (6 known pathotypes world wide). The discovery of sorghum rust pathotypes has significant implications in breeding for rust resistance. Reliance on field screening of sorghum lines and hybrids from only one locality may not be a true indication of their resistance in other geographical areas, due to possible differences in the pathotype mix between separate rust populations. The most prevalent pathotype (13 of the 29 isolates) was widespread, being found in central and southeast Queensland and in New South Wales, but not in north Queensland. It is possible that Johnson grass and other weed sorghum species play a significant role in the biology of sorghum rust in Australia, as a source of rust for infection of grain and forage sorghum, and in the evolution of pathotypes of the pathogen.

Fungicide application is not economically viable for commercial grain and forage sorghum producers.

Once a sorghum crop is infected with rust there is little a grower can do to combat the infection. The knowledge that rust can reduce yields should be a motivating factor to reduce potential sources of infection such as Johnson grass and volunteer sorghum.

FURTHER INFORMATION:

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Project code: GRS 70

Developments in soil biology – inoculants

Inoculants could be the fourth wave of agricultural innovation to improve yields and profitability in the last

50yrs behind fertilizer, pesticides and plant biotechnology. Micro-organisms in the form of inoculants, applied to the seed or soil to improve crop nutrition, disease bio-control and general growth enhancement could provide the next major advances to Australian cropping systems” says Sanford Gleddie of Philom Bios Australia (PBA).

Philom Bios Australia is a joint venture company formed by the GRDC and Philom Bios Inc Canada to develop a range of emergent inoculant technologies from research partners in Australia and overseas, including ANU, CSIRO, Flinders University and SARDI.

“There are a number of external drivers for new inoculant technologies”, says Mr Gleddie.

- Fertiliser prices will continue to rise.
- Fertiliser use will be increasingly restricted due to environmental concerns (greenhouse gases, surface and ground water contamination).
- Pesticide use is being increasingly restricted, with few new chemical actives being developed.
- Adoption of agronomic practices (direct seeding, one-pass seeding and fertilising, early seeding & Integrated Pest Management) have increased the importance of rapid crop establishment and early vigour.
- Farmers are increasingly bottom line focused, evaluating returns on investment. Inoculants have the potential to be one of the highest return on investment input categories.

Crop nutrition

“In pulses, nitrogen (N) fixing inoculants can supply up to 80% of crop requirements -increasing yields and input savings. N fixing rhizobia inoculants for legumes, including new granule formulation products for application in-furrow, are being tested across Australia and are due to be commercialised in 2008. In the future, inoculation of non-legume crops with non-symbiotic nitrogen-fixing diazotrophic bacteria such as *Azotobacter*, *Azospirillum* & *Acetobacter* species, could have the potential to supply some (10-30kg N/ha) of a non-legume crops nitrogen requirements.

“Phosphate (P) is a primary limiting nutrient in many Australian soils, with P often tied-up in the soil and unavailable to plants. Phosphate solubilising inoculants based on *Penicillium* fungi that make otherwise unavailable soil P available for plant uptake, are commercially available in North America for legumes and non-legumes. PBA is screening phosphate solubilising micro-organisms in wheat, canola, pea and chickpea field trials across Australia. Some of these could be on the market by 2009,” said Mr Gleddie.

Disease bio-control

“Bio-control inoculants could be used alone or in combination with seed treatment pesticides to control a range of root and crown diseases. Bio-control micro-organisms can control disease by producing antibiosis compounds, hyper-parasitism, production of cell wall degrading enzymes, or by triggering systemic resistance pathways in the plant. Numerous potential bio-control

inoculant micro-organisms are under evaluation in field trials across Australia.

Growth enhancement

“Growth enhancement inoculants can induce numerous biochemical pathways in plants to trigger a range of growth responses and stress tolerances. Research seeks to isolate the most effective growth-promoting micro-organisms for application to seed or soils as inoculants,” said Mr Gleddie.

FURTHER INFORMATION:

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Dealing with a diminishing workforce

Australia’s booming mining sector has had a detrimental effect on the agricultural labour force, stripping workers out of farms to more lucrative returns than agriculture can provide. Ronald Thompson, a Western Downs Farmer and 2006 Nuffield scholar, looked at this issue from a global perspective. After 5 months abroad, 15 countries and hundreds of discussions, Mr Thompson’s Nuffield report lists a number of issues and solutions for Australian agriculture to combat a diminishing workforce. Some of his key findings are:

- Importing labour is a short term solution to a larger industry wide problem.
- Re-education to reignite the connection to the land will benefit agriculture.
- The family farm needs to be maintained to retain that connection.
- Bio fuels are an essential part of moving agriculture forward.
- An increase in funding or tax breaks for agricultural R&D is needed to retain Australian expertise.

Key recommendations include:

- The need for a business focus in farming.
- Better systems for the intergenerational transfer of farms.
- Vertical integration to maintain product ownership.
- Realise overseas labour as a talented global workforce.
- Recognition of the deep seated attachment to the land.
- Positive promotion of agriculture through education.
- Biofuel and renewable energy implementation.
- Increase R&D funding.

FURTHER INFORMATION:

**For Ronald Thompson’s and other Nuffield scholars’ full reports see the Nuffield website:
www.nuffield.com.au/report_f/report1.html**

Handout on managing sodic subsoils online

A new handout on the identification and management of sodic subsoils in central western NSW farming systems is now available as a download from the Central Western Farming Systems website. Also available to download are research results compendiums dating from 1998 through to 2004/5. More recent research compendiums can be ordered for a small fee.

FURTHER INFORMATION: <http://www.cwfs.org.au>

**Visit Australia’s Grains Research Web Page
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Diary dates

Trangie NSW (DPI Research Station) Tue 26 Feb 08 (Growers)

Dubbo NSW (Dubbo RSL) Wed & Thu 27 & 28 Feb 08 (Advisers)

Coonamble NSW (Bowling Club) Fri 29 Feb 08 (Growers)

Meandarra Qld (Bowling Club) Tue 4 Mar 08 (Growers)

Goondiwindi Qld (Goondiwindi Community Centre) Wed & Thu 5 & 6 Mar 08 (Advisers)

Roma Qld (Club Hotel) Friday 7 Mar 08 (Growers)

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A more detailed list of diary dates can be found at: www.grdc.com.au

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