IRRIGATION RESEARCH & EXTENSION COMMITTEE

2005

Grains Research UPDATE GRDC

FOR IRRIGATION CROPPERS

Barley – does it have a place in irrigated farming systems

Paper prepared by

NEIL FETTELL

NSW Department of Primary Industries
Condobolin

Tel: 02 6895 2099

Email: neil.fettell@agric.nsw.gov.au

IREC

C/- CSIRO Land and Water, Griffith
Private mail bag 3 Griffith NSW 2680
Tel: 02 69601550 **Fax:** 02 69601562 **Email:** irec@irec.org.au

Summary

- The demand for both malt and feed barley grain is expected to remain strong in the short to medium term.
- The deregulation of the malt barley market in NSW may present new opportunities, and malting quality is easier to achieve following easing of the colour requirements.
- Barley is not a traditional irrigation crop, probably because of its susceptibility to waterlogging and the lack of suitable varieties.
- Better layouts and the use of beds can overcome the waterlogging problems.
- Improved varieties are now available.
- Barley is a valuable rotation crop as it is not susceptible to many wheat foliar diseases (yellow spot, stripe rust, septoria), suffers less yield loss from root diseases, and competes well with weeds.
- Barley often matures earlier than wheat, an advantage in double cropping situations.
- Gairdner has proved to be the highest yielding malting variety, but is prone to high screenings if not managed correctly.
- Gairdner has inherently low grain protein concentration, particularly at high yield levels, and inadequate nitrogen nutrition will result in grain too low in protein for acceptance into malting grades.
- Baudin, from Western Australia, is a potential alternative to Gairdner with better grain size and lower screenings, but is more susceptible to leaf rust and mildew.
- Tantangara and Tilga are high yielding feed lines with Tantangara better suited to irrigation. Tilga can grow too tall and suffer from weak straw.

Why Consider Barley

Barley is not a traditional irrigation crop, probably because of its susceptibility to waterlogging on older irrigation layouts and the lack of suitable varieties. These constraints have been reduced by the widespread improvements in irrigation layouts and the release of new varieties. Improved structures, laser-levelling, permanent beds and better drainage systems allow faster water application and drainage rates resulting in less waterlogging. Newer, semi-dwarf varieties have higher yield potential and are less susceptible to lodging and head loss. The earlier maturity of barley compared to other winter crops can be advantageous in a double cropping system.

In recent years, both the malt and feed markets have given good returns. New varieties with higher yield potential are being released and the colour standards for malting have been eased. Barley can be valuable as a rotation crop with wheat particularly in no-till and stubble retention systems as it is not a host for most wheat foliar diseases. Its vigorous early growth allows it to compete well with weeds, needing lower herbicide rates and restricting weed seed set. It often needs fewer inputs than wheat.

Markets for barley

The NSW malting barley market consists of two classes:

1. Demand for unprocessed malting barley in Australia's grain export markets, principally China. The very price sensitive Chinese market continues to grow. Demand for Schooner in China remains strong, with increasing acceptance of both Gairdner and Sloop. This is the major market for NSW grain.
2. Demand by domestic maltsters to supply malt to domestic brewing customers. This market is relatively static. Schooner is the preferred variety in this market.

Schooner and Gairdner remain the preferred malting varieties for 2005 in southern NSW. There are smaller markets for varieties such as Franklin and Baudin, which are usually filled by direct contract.

Domestic feed barley demand is likely to remain steady with record numbers of cattle on feed and the continued requirements of the dairy and intensive livestock industries.

Variety performance

Few irrigated barley variety trials are conducted each year and so the following comments are based on dryland trials as well.

- **Gairdner** has performed particularly well across the southern region, the long term data (Table 1) showing a yield advantage of about 8% over Schooner. It has excellent malting quality, and although a semi-dwarf variety it can grow quite tall. It is slower to flower than Schooner and so best suited to early and main season planting and to favourable conditions.
- **Long** term results indicate Gairdner will often fail to meet grain size specifications for malting quality, particularly in stressed environments (Table 1). Retention values for Gairdner average 69% while screenings average 4.9%, compared to 78% and 2.8% for Schooner.
- **Gairdner** does have inherently 0.5–1.0% lower grain protein content than Schooner, and this can be magnified by its higher yield potential. Some eastern farmers failed to achieve malting quality due to excessively low grain protein content in 2001.
- **Tilga** and Tantangara remain as high yielding feed varieties. Tilga is best suited to dryland areas.
- **Baudin** is a malting quality variety from Western Australia. It is seen as a Gairdner alternative with better grain size, lower screenings, quicker maturity and shorter straw. It is very susceptible to leaf rust and powdery mildew and growers need to plan a disease strategy and organise a market outlet.
- **Cowabbie** is another possible Gairdner alternative, released as feed but with the possibility of upgrading to malt quality, aimed at the southern part of the State. It also has better grain size than Gairdner and good straw strength. Flowering time falls between Gairdner and Baudin and it is less susceptible than Baudin to leaf rust, leaf scald and powdery mildew.
- **Tulla** is an acid soils-tolerant, semi-dwarf feed variety with good grain size, straw strength, and disease resistance and yields similar to Tantangara on non-acid soils.
- The Victorian program is testing VB0105, a Franklin derived malting line we have tested widely in NSW agronomy trials as a potential Schooner replacement. South Australia is placing major emphasis on CCN resistance with the lines WI3804 and WI3586, neither of which look to have a major place in NSW.
- **Unicorn** is a very quick maturing variety which may have a place for late sowing but is susceptible to shattering and requires careful management.

Table 1. Across sites and years analysis for yield and screenings for main season trials (sown after 15 May). Yields are for 1997-2003 and expressed as a percentage of Schooner. Screenings and retention are % by weight and are from 1999-2003 trials.

Variety	Yield as% Schooner (no. trials)	Retention (%>2.5 mm)	Screenings (%<2.2 mm)
Baudin	107 (6)	71	4.6
Binalong	110 (62)	-	-
Gairdner	108 (77)	69	4.9
Mackay	108 (39)	-	-
Schooner	100 (77)	78	2.8
Tantangara	106 (78)	68	4.5
Tilga	112 (78)	65	5.4
Tulla	107 (57)	68	4.5

Flowering time is the most important factor in adapting a crop to an environment. Many barley varieties respond to day length as well as to temperature, and so their maturity rankings can change with latitude. Development pattern also has a strong influence on grain number per ear in two row barleys. Figures 1 and 2 show ear emergence dates and time from sowing to ear emergence for five barley varieties sown on four dates in 2003.

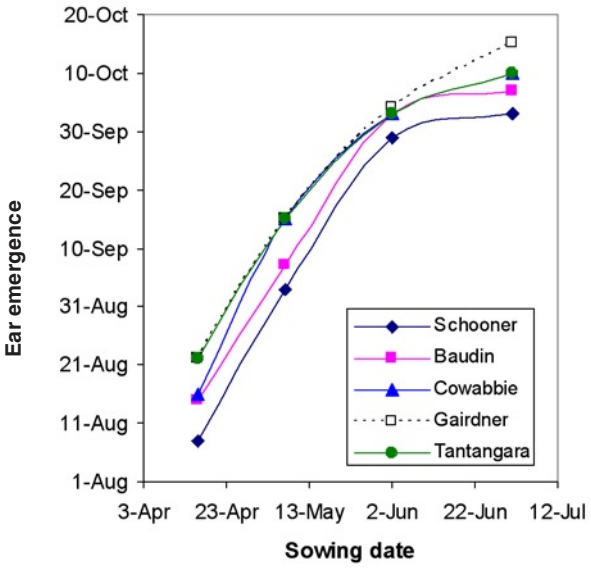

Figure 1. *Ear emergence dates for five barley varieties sown at four sowing dates, 2003*

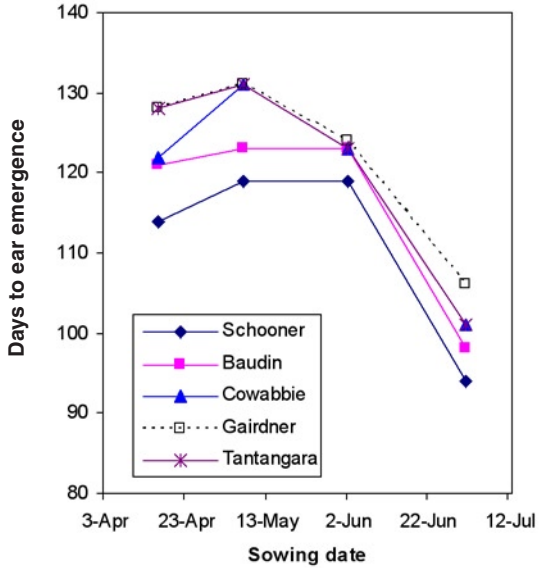

Figure 2. *Days from sowing to ear emergence for five barley varieties at four sowing dates*

Schooner was the quickest to flower at all sowing dates; Baudin was generally next quickest followed by Cowabbie and Tantangara while Gairdner was the slowest. The ideal ear emergence date will vary with season, being a balance between achieving sufficient biomass by flowering and the risk of frost. Based on frost risk, an acceptable ear emergence period for western NSW might be between the 20th and 28th of September. If so, Schooner should be sown in the last week of May or very early June whereas Gairdner should be sown at least two weeks earlier. If sowing is delayed until the end of June, Schooner is able to dramatically reduce the time to ear emergence whereas Gairdner is not.

Nitrogen nutrition

Protein content is a major determinant of malting quality. High protein concentrations reduce malt extract. In dryland areas, keeping below the 12% upper limit can be difficult, as the nitrogen levels required to obtain maximum yield result in grain proteins of about 11%. At low to moderate yield levels, only a small amount of additional nitrogen will rapidly increase grain protein and screenings. Figure 3 shows the effect of nitrogen fertiliser on grain plumpness for Schooner and Gairdner sown at two dates at Condobolin. There is a steady decrease for each variety at each sowing time, and the slope of the lines is similar. However, retention was lower for Gairdner than Schooner for both sowing dates, and lower for the June than the May sowing. The allowable limit for malting is 70%.

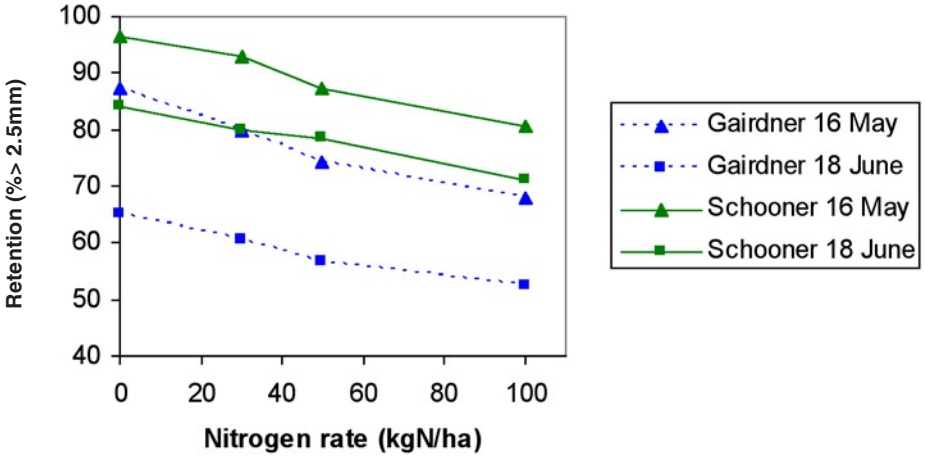

Figure 3. *Effect of fertiliser nitrogen on retention (plump grain) in Gairdner and Schooner at two sowing dates at Condobolin.*

Negative yield and grain quality responses were also seen in 2004, hardly surprising given the dry conditions. Results from our highest yielding site, Alectown, are shown in Figure 4. A deep nitrogen soil test at sowing showed that there was 130 kg of mineral nitrogen in the top 60 cm and this was sufficient for an average yield across varieties of 4.2 t/ha. Additional nitrogen fertiliser, as little as 15 kgN/ha, decreased yield and plump grain and increased screenings in all varieties. However, even at the highest nitrogen rate Schooner was above the 70% retention limit whereas any nitrogen pushed Gairdner below this level.

Low grain protein can also be a problem as most markets now require barley above 10%. Japanese malt markets have a preference for 11% protein. The minimum for malting grade has therefore been increased to 9.5%. Due to both the inherently low grain protein content of Gairdner and the higher yielding environments where Gairdner is being grown, appropriate N management for this variety is essential to avoid excessively low grain protein levels. For dryland Schooner crops, if more than 100kg nitrate N per ha is present at sowing additional fertiliser N increases the risk of excessively high grain protein levels. However, higher levels of nitrate N will be required for Gairdner production under irrigation.

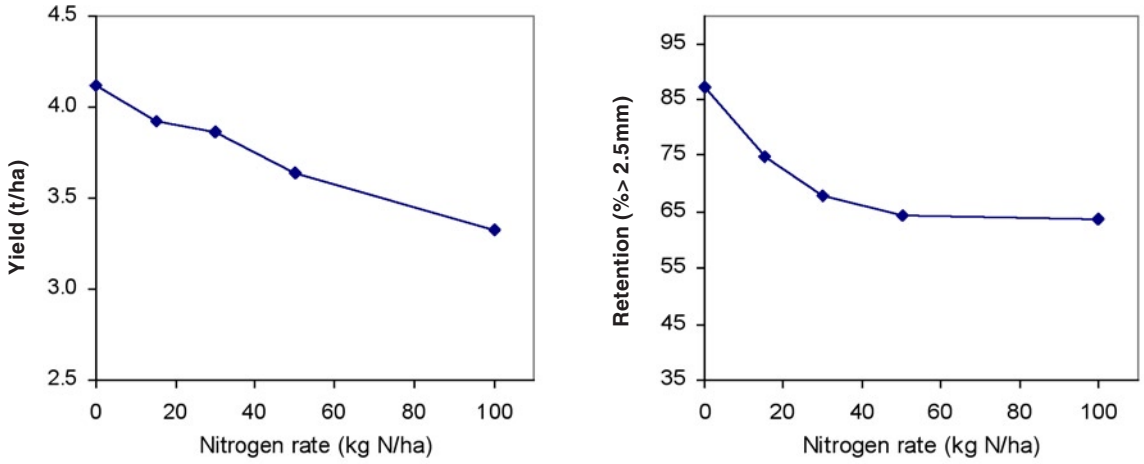

Figure 4. *Effect of nitrogen fertiliser on yield and retention at Alectown, 2004. Values are the mean of four varieties.*

Seeding rate

Higher seeding rates have been advocated in wheat as a way of reducing the number of higher order tillers and hence maintaining grain size and reducing screenings. This can be dangerous in barley and particularly in Gairdner. In a series of trials across NSW, the yield and grain quality of existing varieties and lines close to release are being compared. Nominal seeding rates from 20 to 100 kg/ha are being used, equating to a range of 40 to 200 seeds/m2. In 2004, there was a wide variation in establishment percentage, reflecting difficult planting conditions, with site averages ranging from 50 to 95% of seed producing a plant. Establishment percentage also decreased with seeding rate at most sites, and the average decline is shown in Figure 5. Values declined from 90% at the lowest seeding rate to 65% at the highest.

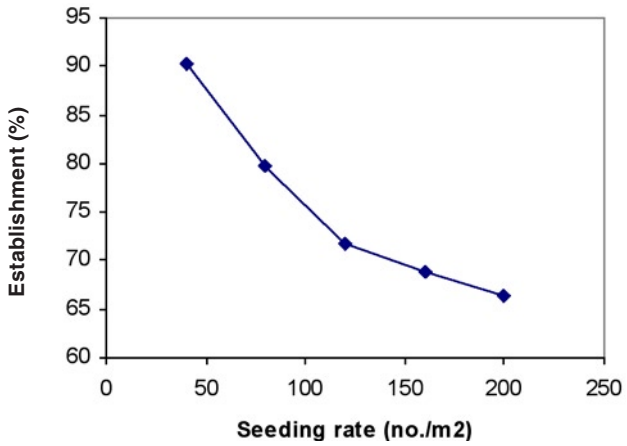

Figure 5. *The response of plant establishment (as a percentage of seeds sown) to seeding rate in 2004. Values are the mean of all varieties at 10 sites.*

Yield and grain plumpness data for four of the sites are shown in Figure 6. Yield responses were similar across the sites, even though average yields varied from 2 to 4 t/ha. In all cases there was a big response up to 80 seeds/m^2 and a small but continuing response to higher rate. This probably reflects the 2004 seasonal conditions at these sites, where stress around flowering was followed by milder conditions through grain-filling. At some more severely stressed sites, yield decreased at the highest rates. Grain size, as indicated by retention, decreased at most sites as seeding rate was increased. At Alectown, this was largely due to Gairdner. Schooner and Cowabbie were much more stable in grain size. Based on results over a number of years, populations of 70–110 plants/m^2 are likely to be a good compromise for yield and grain quality for dryland crops. For fully irrigated crops where the risk of screenings is less, an even stand of about 200 plants/m^2 is desirable.

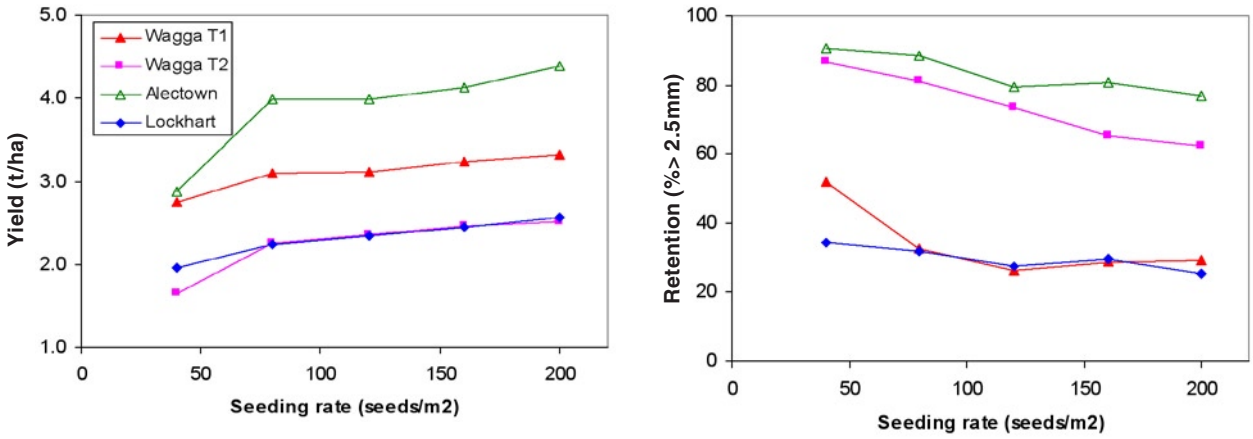

Figure 6. *Effect of seeding rate on yield and retention (plump grain) at four sites in 2004. Values are the mean of four to six varieties at each site.*

Irrigation management

For maximum yield and acceptable quality, barley should be grown on medium fertility paddocks, with layouts capable of being watered and drained in 8–12 hours maximum. The soil profile at sowing should be at about 70% of field capacity, which may require a pre-watering depending on the cropping sequence. A deep soil nitrogen test or early tissue tests should be used to determine the need for additional nitrogen and this should be applied before the end of tillering. Irrigation before flowering (ie before ear emergence) is desirable with the aim of ensuring grain set and the maintenance of green leaf area. Further irrigation during grain-filling should ensure that soil water content is maintained above 60% of field capacity until the soft dough stage. While barley often matures earlier than other cereals, premature drydown will limit grain yield and increase screenings.

With good management, target yield for a fully irrigated crop should be at least 6 t/ha. If limited water is available, the timing of irrigation and the levels of other inputs should be carefully considered or grain quality may be compromised.