Barley Varieties for Craft Beer

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Introduction

- Matching the right malting barley variety to a beer style is of great importance for all market sectors, including craft.

- The Australian barley industry is flush with malting barley varieties, but what are the right ones for good craft beer and what are the important aspects?

  - Balanced beer
  - Barley derived flavours and aromas
  - Brew-ability
  - Heritage barley varieties – more than just a good story
Balanced Beer

- Craft beer is known for being at the hoppy end of spectrum, both in terms of bitterness and hop aroma.
- In order for a beer to be balanced it is necessary for there to be adequate mouthfeel and body to balance out the bitterness and hop aroma.
- This mouthfeel is primarily derived from oligosaccharides of glucose of barley and subsequently malt origin.
- Craft brewers typically use 100% malt.
Balanced Beer

- However the amount of residual oligosaccharides in the beer is not only influenced by the proportion of malt in the grist, but also the fermentability of the malt used.

- Malt with a;
  - high fermentability = beer that is thin and has a low apparent extract, produces a dry beer
  - low fermentability = rich beer with good mouthfeel and a higher apparent extract, which is ideal for hoppy beers
**Balanced Beer**

- Malt fermentability is influenced by the diastatic power (DP) of the malt, which is effectively the sum of the activity of amylase family enzymes.

- These include $\alpha$ and $\beta$-amylase, limit dextrinase and $\alpha$-glucosidase.

- Additionally, the thermostability of one of the amylase enzymes, $\beta$-amylase, also influences fermentability.
Balanced Beer

Who’s using what?

Craft brewers – Medium fermentability

Australian mainstream – Medium fermentability

South East and North Asia – Medium to high fermentability

China – Mostly high fermentability
# Balanced Beer

<table>
<thead>
<tr>
<th>Barley Variety</th>
<th>Fermentability</th>
<th>Status</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clipper</td>
<td>Low</td>
<td>Superseded</td>
<td>-</td>
</tr>
<tr>
<td>Schooner</td>
<td>Low</td>
<td>Superseded</td>
<td>-</td>
</tr>
<tr>
<td>Gairdner</td>
<td>Medium</td>
<td>Accredited</td>
<td>Decreasing</td>
</tr>
<tr>
<td>Commander</td>
<td>Medium</td>
<td>Accredited</td>
<td>Steady</td>
</tr>
<tr>
<td>Westminster</td>
<td>Medium</td>
<td>Accredited</td>
<td>Steady</td>
</tr>
<tr>
<td>Compass</td>
<td>Medium</td>
<td>Under evaluation</td>
<td>Increasing</td>
</tr>
<tr>
<td>Flinders</td>
<td>Medium/High</td>
<td>Accredited</td>
<td>Increasing</td>
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<tr>
<td>Baudin</td>
<td>High</td>
<td>Accredited</td>
<td>Decreasing</td>
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<tr>
<td>Buloke</td>
<td>High</td>
<td>Accredited</td>
<td>Decreasing</td>
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<tr>
<td>Scope</td>
<td>High</td>
<td>Accredited</td>
<td>Steady</td>
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<tr>
<td>Bass</td>
<td>High</td>
<td>Accredited</td>
<td>Increasing</td>
</tr>
<tr>
<td>La Trobe</td>
<td>High</td>
<td>Accredited</td>
<td>Increasing</td>
</tr>
</tbody>
</table>
Balanced Beer

- Historical Australian barley varieties Clipper and Schooner had low levels of diastatic power

- Capable of producing beers with good levels of mouthfeel even with sugar adjunct

- These historical barley varieties were however found wanting in time as Australian barley varieties were used to service Asian brewing markets
Balanced Beer

- At this time Australia’s competitors, primarily from Canada, had successfully developed barley varieties with higher levels of DP

- In the face of shrinking market share and profit margins the Australian barley industry rallied

- Barley breeders began what was a two decade campaign to boost levels of DP to compete with Canada in Asian barley and malt markets
Balanced Beer

- Australian barley breeders were very successful in boosting DP levels, to the point where today fermentability levels are higher than some of the mainstream Australian brewers would like.

- In Australia we now effectively have two streams of barley varieties when it comes to fermentability; medium and high.

- Gone are the low fermentability varieties of yesteryear that would suit craft brewing.
Balanced Beer

- The second factor that influences the amount of body and mouthfeel of a beer is the ability of a key enzyme, β-amylase, to survive in the mash tun.

- Specifically this refers to the thermostability of β-amylase, which varies considerably between different barley β-amylase isozymes.

- Less thermostable = rapid denatured = more body.

- It is these type of barley varieties that should be targeted by the craft industry.
Irreversible thermal inactivation of β-amylase in barley extracts incubated at 60 °C (Evans and Eglinton, 2009).
# Balanced Beer

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<th>Barley Variety</th>
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<tr>
<td>Clipper</td>
<td>Sd2L – Very low</td>
</tr>
<tr>
<td>Schooner</td>
<td>Sd2L – Very low</td>
</tr>
<tr>
<td>Gairdner</td>
<td>Sd1 – Medium</td>
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<tr>
<td>Commander</td>
<td>Sd1 – Medium</td>
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<td>Compass</td>
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<td>Flinders</td>
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<td>Baudin</td>
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</tr>
<tr>
<td>Buloke</td>
<td>Sd2H – Medium high</td>
</tr>
<tr>
<td>Scope</td>
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</tr>
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Balanced Beer

- The barley variety Schooner is well suited to the craft industry as it has the ideal combination of:
  - a low DP through low levels of amylase enzymes
  - the least thermostable version of β-amylase

- to produce rich beers with a high level of mouthfeel
Barley Flavour and Aroma

- Craft brewers have a particular interest in producing full flavoured beer
- Hop and yeast flavours are well defined
- Barley derived flavours and aromas are less well understood and been an area of interest in recent times
- Certain varieties, in particular heritage varieties such as Maris Otter, are prized by the craft beer industry for adding a certain flavour character to beers
Barley Flavour and Aroma

- Brewers have noted that this character is “hard to define”, but are steadfast in the belief that their beer benefits from the use of malt made from heritage barley varieties.

- As we develop a better understanding of barley flavour we may see the selection of barley varieties based on;
  - flavour that will complement the current craft beer styles, or
  - even see the development of craft beers that are more modestly hopped to accentuate barley flavours and aromas.
Barley Flavour and Aroma

- Flavours and aromas derived from barley through the Malliard reaction that impact on the sensory profile of the final beer are reasonably well understood

  Valine + Fructose → Malt flavour

- The area of barley flavour that has the interest of brewers recently are the more novel flavours and aromas from other pathways
Barley Flavour and Aroma

- Conventional barley breeding programs strive to produce new barley varieties that do not have flavour or aroma characteristics notably different from current barley varieties and hence produce rather bland worts and beers.

- A project at Oregon State University led by barley breeder Professor Pat Hayes is researching the genetic basis of barley characteristics which contribute to barley flavour and aroma of malt, wort and beer.
Barley Flavour and Aroma

- The aim of this work is to develop molecular markers for flavour and aroma to allow the efficient selection of barley variety for the craft industry

- Genetic material for this project has included
  - a diverse range of barley genotypes
  - varieties originating outside North America
  - obsolete North American varieties
  - breeding lines which had failed to be selected for commercial cultivation
  - progeny obtained from two different hybridisation experiments
Barley Flavour and Aroma

- The barley variety Full Pint has been developed and is described as having a sweet characteristic, but so far attempts to characterise the origin flavour have been unsuccessful.
Barley Flavour and Aroma

- Research in this area will be challenging due to the difference to malt quality, and potentially flavour and aroma production, that malting conditions can make.

- The level of malt modification can dramatically influence the level of a range of metabolites and hence impact on beer flavour and aroma.

- Thus researchers must contend with variation from growing environment, malting conditions and extent as well as the genetic component.
Heritage Barley –
More than Just and Interesting Story

- All beer benefits from having a story behind it, and for craft beer it’s almost a necessity

- Craft breweries and beers are often imaginatively named and the story of the brewery, its location or the raw materials to make the beer are often important

- Craft brewing also largely represents an artful approach to brewing where history and heritage can be of significance

- These values have seen the re-emergence of barley varieties from a bygone era and this is particularly so in the UK real ale arena
Heritage Barley –
More than Just and Interesting Story

- Heritage varieties may also address the requirement for balanced beer and flavour, or the appeal may simply come from their uniqueness

- Varieties such as Maris Otter and Chevalier have proved popular, but Australia has its own heritage variety, Schooner, which also helps produce a balanced beer and is known for its flavour

- Maris Otter is an example of a heritage barley variety that has been resurrected by Robin Appel and the real ale brewers of the UK
Heritage Barley –
More than Just and Interesting Story

- Modern barley varieties have been bred to improve disease resistance and tolerance to abiotic stress such as drought, temperature and salinity.

- Breeders have done an excellent job of greatly improving these aspects and the paddock yield to ensure that barley remains competitive with other broad acre crops.
Heritage Barley –
More than Just and Interesting Story

There is however some anecdotal evidence that some of the newer barley varieties are

- more challenging to malt
- more difficult to get consistent results in the brewery from in terms of
  - brewing process and
  - beer quality

Thus the suggestion that heritage varieties are better-rounded and easier to malt and brew
Heritage Barley –
More than Just and Interesting Story

- Subsequently craft brewers around the world have widely adopted Maris Otter

- Its popularity is based on;
  - “brew-ability”
  - flavour, and of course
  - the great story behind the variety
Heritage Barley –
Maris Otter – A Case Study

- Maris Otter was bred at the Plant Breeding Institute in Cambridge, England, and released for commercial cultivation in 1965

- Maris Otter performed so well that it was one of the first winter barley varieties to be considered equal in malting quality to traditional spring malting barley
Heritage Barley – Maris Otter – A Case Study

- During the late 1960s and early 1970s, it was grown on a large scale, but production declined from the mid-1970s onwards as new varieties which produced higher yields in the paddock were introduced.

- However, its superior malting and brewing properties were greatly appreciated by maltsters and brewers.

- Some brewing companies paid premium prices to have it grown and malted under contract for their own use.
Heritage Barley – Maris Otter – A Case Study

- In the mid-1990s, the Maris Otter Consortium was established to market Maris Otter.

- By the turn of the twenty first century brewers of real ale in the UK have come to believe that beer brewed from Maris Otter malts was generally superior in flavour.

- However most brewing scientists were of the opinion that the varietal characteristics of barley had little or no influence on the flavour of the malt made from it.
Heritage Barley – Maris Otter – A Case Study

- The Maris Otter Consortium obtained funding for a comparative study of the flavour-related properties of malts of Maris Otter and other barley varieties

- carried out at Brewing Research International in 2006 and repeated in 2007 in order to confirm the results, which had been doubted by some

- This work verified the existence of varietal differences in the flavouring characteristics of barley malt, as well as the superiority of Maris Otter to the other varieties studied

- Beer made from Maris Otter malt was described as having nutty, roasted, sweet type flavours
Heritage Barley – Maris Otter – A Case Study

- Anecdotally there is a certain brew-ability to Maris Otter that allows craft brewers to reliably turn out quality beer time and time again.

- Brewers like Maris Otter as it is easy to handle and has been described as forgiving in the brew house.

- Similar comments have been made about some of Australia’s heritage varieties, such as Schooner.
Heritage Barley – Maris Otter – A Case Study

Maris Otter purchases by maltsters

% Winter Barley Purchases (England)


0 2 4 6 8 10 12 14 16
Heritage Barley –

Is Schooner Australia’s Maris Otter?

- There are negative aspects to using an English heritage variety such as Maris Otter in Australia, including:
  - large “food” miles
  - the cost of that freight
  - the cost of subsidising farmers for the lower barley yield
  - preference for a local product
Heritage Barley –
Is Schooner Australia’s Maris Otter?

- The Australian barley variety Schooner has a similar story to Maris Otter and perhaps a similar role to play in Australia as Maris Otter has in the UK.

- Schooner was bred by Associate Professor David Sparrow, who is widely regarded as Australia’s greatest barley breeder.

- Professor Sparrow was a plant breeder at the Plant Breeding Institute at Cambridge and helped breed Maris Otter.
Heritage Barley –
Is Schooner Australia’s Maris Otter?

- Professor Sparrow was appointed Australia’s first full time barley breeder at the University of Adelaide in 1960

- The variety Schooner was released in 1983 and named after Professor Sparrow’s great love of sailing and reflected the type of sailing ship used to transport barley in a bygone era

- Schooner dominated the Australian barley industry through the eighties and nineties
Heritage Barley –
Is Schooner Australia’s Maris Otter?

- Like Maris Otter, Schooner was well regarded by farmers, maltsters and brewers in its day

- The tonnage grown has dramatically reduced as superior varieties from a yield and DP perspective came on the market

- The variety is however prized by the Japanese shochu market for its **flavour**

- Pressure from shochu makers saw Schooner persevere for many years longer than would be expected, however it is now almost gone, requiring a “Maris Otter style revival” to bring it back
Heritage Barley –
Is Schooner Australia’s Maris Otter?

- Schooner has;

- a story behind it, harking back to brewing days of old
- low levels of DP
- the type of β-amylase present has low thermostability
- produces a rich beer with appropriate mouthfeel to balance hoppy craft beers
- flavour
Heritage Barley –
Is Schooner Australia’s Maris Otter?

- Schooner is in a similar situation to Maris Otter regarding barley yield in the paddock

- Schooner’s yield is around:
  - 18% lower than the leading malting barley variety in the premium barley growing area close to malting plants in South Australia and
  - over 20% lower than the highest yielding barley variety in that region

- A premium would translate to less than one cent per bottle
Heritage Barley –
Is Schooner Australia’s Maris Otter?

- With the craft industry’s focus on beer with mouthfeel and flavour and its desire to brew with malt that is reliable and predictable we may yet see a Schooner revival
Coopers Maltings
Thank you