Barley Agronomy and Industry Development for the Western Region

Summary
The barley industry in Western Australia (WA) is under a great deal of pressure to supply the market with a malting barley superior in quality to Stirling, the major variety since its release in 1981. Major competitors in the international malting barley market have released a series of improved malting varieties in that time. In the early 1990s, two malting barleys not bred in WA were accepted for commercial evaluation. This led to the production of Franklin barley in the high rainfall zone (HRZ) of the south coast and commercial evaluation of Harrington in the central, high rainfall areas. The market was then provided with low dormancy, high malting quality alternatives to Stirling. These two varieties, however, were suitable for the domestic market, but unsuitable for the export market due to poor grain size.

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**Conclusions**

**Agronomy research and management packages:**

As the international market becomes more and more discerning for quality, it is likely that varieties will be released that are far more narrow in their geographic adaptation. This will mean that management packages will become increasingly regional and variety specific. In addition to this is the cumbersome method of commercial evaluation that is the last step before the release of a new malting barley. Due to the large tonnage required for this evaluation, it places even more pressure on the need to properly evaluate any elite lines before they are considered for commercial evaluation.

**Technology transfer:**

Achievements of this project have demonstrated the value to the WA barley industry of statewide industry development supported by agronomic research. Resulting from this project has been a significant increase in the amount of technical and management information available to growers, agronomists and the industry and a greater understanding by growers of the importance of malting quality for the markets, thereby increasing the quality of the crop produced and stabilising the production of the crop. The value of this role and its ongoing nature has been clearly demonstrated.

**Physiology research:**

Basic research on plant physiology has a very important role to play if the full benefits of a breeding program are to be realised. To date, the potential benefits to local barleys that lie in international germplasm have only been touched on.

**Recommendations**

**Agronomy research and management packages:**

A long term role for the evaluation of local and interstate elite malting barley lines to quantify their various strengths and weaknesses in all major barley growing environments should be recognised. This information should be integral to the decision on which elite crossbreds will continue to commercial evaluation and furthermore provide the necessary data for management packages.

**Technology transfer:**

There is a continuing demand by the industry for more information on the production, storage and marketing of barley as new varieties are released, farming systems become more complex and improved technology becomes available. The rapid adoption and successful production of any new malting varieties is only possible if the best information is provided quickly and efficiently through a number of extension media. This is likely to be more and more via the internet.
Physiology research:
Basic research on plant physiology should be conducted in close collaboration with any breeding program. More work is required to fully understand the physiological factors underlying the stability of grain plumpness. Thorough assessment of the international barley germplasm in the major WA barley growing environments is essential to the long term success of the breeding program.

Outcomes

Expected Outcome (benefits)

Economic Outcomes
Understanding the influence of various management techniques on barley production can assist growers in manipulating quality and yield of product. This will have positive economic impacts on all levels of the grains industry including improved financial returns to barley growers, improving the reliability of supply of a quality product to domestic and export markets and increasing Australia's reputation as a reliable supplier of quality barley.

Environmental Outcomes
Grain growers can optimise the use of environmental resources to produce a quality crop by using best management cropping practices. The selection of management techniques to maximise water use efficiency (WUE), thereby reducing salinity related problems, correctly target N requirements to minimise nutrient run-off and acidification, and to improve crop land management through appropriate paddock and soil type selection will maximise grower profits and environmental outcomes.

Social Outcomes
Understanding the influence of various management techniques on barley production can assist growers in manipulating quality and yield of product. This will have positive economic impacts on all levels of the grains industry including improved financial returns to barley growers, improving the reliability of supply of a quality product to domestic and export markets and increasing Australia's reputation as a reliable supplier of quality barley.

Achievements/Benefits

Overview of Project Achievements

Background

This project had three clear priorities for research and extension:

1. Availability of alternative malting varieties to Stirling and management packages that would give clear guidelines for their successful production.
2. Statewide technology transfer that would improve communication at all levels of the barley industry.
3. Security of the industry in the long term by providing basic physiology research that would address two of the most important problems, grain size and colour.

1. Barley management packages and agronomy research

Barley agronomy research entails experiments that determine the most appropriate combinations of sowing date, soil type, plant density, nutrient supply, and occasionally, fungicide and growth regulator application for each variety in each region. Grain quality data and observations on plant morphology highlight the varietal strengths and weaknesses in each environment. In all, nearly 150 field experiments were conducted across the WA cereal belt over the five years of the project.

During the course of this project, a series of statewide agronomy trials has culminated in clear production guidelines for a series of alternative malting varieties including Harrington, Schooner and Unicorn. It was also instrumental in the development of a production package and the early adoption of the new high rainfall barley, Gairdner. An indication of the success is the fact that the Gairdner production for malting has reached more than 200,000t in just three years of production. Forecasts for the 2002/2003 season are that Gairdner deliveries will total 400,000t.
Further to this, the agronomy program has been integral to the assessment of elite lines from the eastern states’ programs in the WA environment and a major source of data when decisions are being made on the suitability of elite lines for wide scale production in WA. The imminent release of two new malting quality lines, one for each rainfall zone, will be accompanied by detailed production packages provided by agronomy research in WA.

After the introduction of protein testing, the most common problem for barley growers was producing grain that was too high in protein. The widespread adoption of canola provided the opportunity for barley to be grown in disease free soil that was not over supplied with nitrogen (N). Field trials demonstrated that malting barley was the best economic option and since then barley has become the favoured crop following canola. In recent years, the protein issue has changed to the extent that there now are many crops being grown that exceed 5t/ha and are too low in protein.

The issue of having varieties that mature late enough to take advantage of early sowing opportunities has long remained unresolved. Detailed experiments with late maturing winter barleys sown in early April showed that it is likely that light limitations (solar radiation) in mid-winter are limiting the yield of early sown winter barleys. The grain yield of early sown winter barley was found to be equivalent to that obtained by mid-season spring barley sown in May.

In the past five years, the agronomy research program has been an invaluable source of information for improving the yield, consistency and quality of the WA malting barley crop, especially in the case of new alternative varieties to Stirling. Data generated from this research program have been communicated to the Western Malting Barley Council.

2. Technology transfer - barley industry development

The introduction of the Industry Development Officer role for the barley industry has had a significant impact on the production of higher quality barley from WA. Improved communication and cooperation between industry stakeholders, the prompt extension of results from barley agronomy and physiology research and the publication of reference information have resulted in:

1. The rapid adoption by growers of higher quality malting barley varieties as alternatives to Stirling.
2. Changes to agronomic practices that improve the quality and yield of barley grown in WA.
3. Improved grower understanding of the importance of grain quality to malt and beer quality.
4. Increased interaction between members of the WA barley industry.

This project has utilised a range of technology transfer methods to successfully achieve industry outcomes. These include the Grain Pool of WA newsletter Barley Brief (subsequently replaced by Talking Grain), Department of Agriculture AgMemo newsletter articles, press releases and newspaper articles, Farmnotes and conference papers, radio interviews and field day and Crop Update presentations.

A prime example of how these activities have achieved outcomes for the barley industry is shown by the highly successful extension activities associated with the release of the new malting variety Gairdner. Similarly, a management package for the privately released variety, Unicorn, was produced in 2000.

Another major extension campaign focused on the issue of grain protein. Over the past three seasons, extension on management strategies to target the right grain protein through paddock selection, fertiliser application and sowing time, has been conducted. In response to grower needs, the management tool 'Rite Nitrogen slide rule for Barley' was developed. This tool allows growers to estimate the fertiliser N needed by barley to meet any target yield and protein specification for any paddock. The slide rule can be used for both malting barley and shochu barley.

Other extension campaigns include management strategies to minimise screenings, the management of the diseases spot form net blotch (SFNB), powdery mildew and barley leaf rust, as well as reducing the risk of downgrading to feed classification from kernel discolouration and high grain moisture.

Grain quality is critical to malt and beer quality and processing efficiency. Growers are more inclined to change management practices to achieve quality if they know the effect on end-product quality. More than 180 growers and industry members have been trained in the management of malting barley, post farm-gate processing, and grain-malt quality through the Malting barley Quality and Grain Quality Courses (1998-2002). These one- and two-day training courses utilise the video 'Premium barley: Premium price' that was produced in 1999, private industry advisers, and visits to malthouses and breweries to reinforce the interaction between grain quality and processing efficiency. A national training program was also developed.

The TOPACTIVE Premium Quality Barley Workshop Program is a series of six half-day workshops aligned with the Rural...
Training Council of Australia aimed at improving growers' skills in growing and marketing quality barley. The national training program was developed through the GRDC funded project DAW690.

Involvement with grower groups has formed an important means of improving information flow. The barley monitoring package 'MaltCheck' was developed for the TOPCROP West grower groups. The formation of the grower group 'Southern Grain Growers' was facilitated with their focus on improving the productivity and profitability of grain production in the Albany Port Zone. Technical support has been provided to grower groups such as South East Premium Wheat Grower Association (SEPWA), Liebe and Mingenew-Inrin.

A network of key advisers and development officers has been established. Contact was maintained through update meetings, training courses, field days, telephone and email. Extension activities of national application were discussed at quarterly phone conferences and annual meetings held between the Barley Industry Development Officers from the Northern, Southern and Western GRDC regions.

Cooperation between members of the WA barley industry has been further enhanced over the past five years. The Barley Development Officer has met regularly with the Grain Pool of WA, edited its newsletter Barley Briefs from March 1998 until its cessation in December 2000 and has prepared articles for its new newsletter, Talking Grain.

The Western Australian Barley Industry Extension Strategy 2002-2007 was written to provide strategic direction for the new GRDC funded project 'DAW00045 - Barley Improvement and Industry Development for the Western Region' to ensure that it meets the development needs of the WA barley industry beyond the completion of this project.

The appointment of a Barley Industry Development Officer to WA has resulted in a vastly improved level of communication at all levels of the barley industry.

3. Physiology research

While agronomy research is geared to providing short term solutions to problems facing the barley industry, physiology research aims to provide breeders with an understanding of the basic physiological processes responsible for any defects, and identify germplasm that may be useful in eliminating such defects. Two long term industry issues are poor grain colour (weather staining) and low grain plumpness (screenings) of current varieties.

An extensive screening of germplasm from interstate and overseas was conducted to identify lines with resistance to weather staining. Screening also took place at field sites in New South Wales (NSW) and Queensland (QLD). Two major sources of resistance to weather staining were identified from Canada and Japan. These were crossed to locally adapted lines and progeny selected which combined the weather staining resistance of the overseas lines with the plant type of the local varieties. Elite selections from these crosses have been passed onto the major barley breeding programs around Australia.

The morphological traits that may be associated with stability of grain plumpness were also studied in detail. High yielding varieties such as Franklin, Skiff and Gairdner can often fail to make the screenings standard for the malting grade. Progeny of crosses between plump and narrow grained parents were studied in detail at Esperance and Wongan Hills. Wide scale testing of these lines was also conducted for two seasons in conjunction with the local barley breeding program at eleven sites across the WA cereal belt. The study identified plant traits such as rapid rate of grain filling, low grain number per ear, long peduncle and ability to retain green leaf area (stay green) as being associated with the ability to reliably fill plump grain.

In order to exploit the most desirable traits from overseas germplasm, it is first necessary to assess introduced lines in the 'target environment'. A large number of lines representing barley breeding programs of Europe, Canada, South Africa, Mexico, Japan and the eastern states were tested at two southern sites and one northern site annually. This trial series identified potentially useful sources of resistance to the foliar diseases scald, mildew and SFNB, as well as lines of exceptional malting quality and boron tolerance. At the same time, it identified various weaknesses that may also be present such as weak straw, inappropriate maturity, screenings and pre-harvest sprouting. As such, it demonstrated the value of such a process of 'parent evaluation' to the strategic use of overseas germplasm in a breeding program.

The physiology research program has made major inroads towards solving two major problems that face the barley industry, grain colour and grain plumpness. Along the way it has shown the potential of some extremely valuable overseas lines.

The Barley Agronomy and Industry Development project for the Western Region has provided a wealth of research with
immediate application on-farm, rapid and effective transfer of information and valuable insights into the physiological basis of two important industry problems.

**Other research**

**Agronomy research and management packages:**
Evaluation of local as well as interstate elite malting barley lines should be conducted in all major barley growing environments. The problem of very high yields accompanied by protein levels that are far too low by industry standards requires more attention.

**Technology transfer:**
There has been a significant increase in grower access to computers and the internet. The development of a barley web site and computer compatible products would provide an excellent avenue for the dissemination of and access to the latest barley management information. Cropping systems have changed during the past 10 years with many growers aiming for higher yields and earlier sowing, but at the risk of greater disease pressure and a decline in soil fertility. The main reference book for barley production the 'Barley Book' was published in 1995 and will need to be updated to incorporate these changes in cropping systems and varieties.

**Physiology research:**
The issue of screenings in many high yielding varieties needs to be addressed via a physiological study aimed to fully understand the factors underlying the stability of grain plumpness. Assessment of the international barley germplasm in the major WA barley growing environments should be routinely conducted to monitor the progress of international competitors, as well as exploit desirable traits.

**Additional information**

**Publications**


**Attachments**

1. Additional information for project DAW550.
2. Rite Nitrogen slide rule for Barley - for GRDC.
3. Promotional brochures - Rite Nitrogen, TOPACTIVE Premium Quality Barley Program.
5. Australian Malting Barley Industry -breeding for elite barley varieties handout.
6. List of extension articles and activities.
7. Research activity log for agronomy trials.
8. Research activity log for physiology trials.