



*Introductory  
guide to  
malting  
barley*

# Introduction



February 2001

## Dear levy payer,

The UK malting industry, from barley seed to beer mug and whisky glass, provides a good example of a well-linked food chain. The flow of information from maltings to plant breeders has allowed the UK to become a successful producer and exporter of both malting barley and malt.

Changes in consumer requirements need to be fed through to producers to ensure crops are produced which meet buyers' specifications.

HGCA supports the 'grain chain'. Funded by sectors of the industry, it is able to provide a wealth of support from topical, innovative research to latest market prices.

This introductory guide aims to forge even stronger links in the grain chain.

Yours faithfully

**Dr Paul Biscoe**  
Chief Executive,  
HGCA

**Ivor Murrell**  
Director General,  
MAGB

The MAGB was founded in 1827, and its membership today covers over 98% of UK malting. Its mission statement is 'to promote and safeguard the UK malting industry, so enabling it to fulfil its worldwide business potential'.

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The Home-Grown Cereals Authority (HGCA) has provided funding for some of the projects on which this booklet is based but has not conducted the research or written this booklet. While the authors have worked on the best information available to them, neither the HGCA nor the authors shall in any event be liable for any loss, damage or injury howsoever suffered directly or indirectly in relation to the booklet or the research on which it is based.

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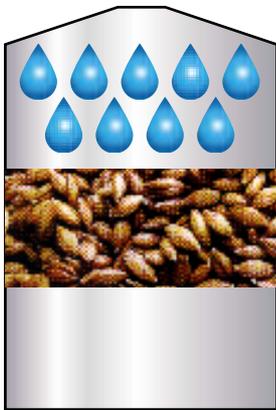
# The malting process

Barley has been malted for over 3,000 years. It is a natural process, the basic principles of which have changed little over hundreds of years. But only in the past 50 years have maltsters taken full control – thanks to a proper understanding of the biochemistry, suitable varieties and modern equipment.

The maltster's skill is to use natural ingredients to produce a wide range of malts which differ in flavour, colour and many other qualities.

*Barley, water, air and heat are all that is used to make malt.*

## Steeping



## Germination



## Kilning



Barley is soaked or 'steeped' in water in large vessels for about two days. This raises the moisture content to around 45%, which is sufficient to stimulate the embryo in the grain to grow and for the malting process to begin.

By the end of steeping rootlets have begun to develop.

Traditionally, germination took place on long malting floors, with grains turned frequently by shovel. Modern malting plants use mechanised systems. Automation allows strict control with low labour input.

During germination, the growing embryo needs food. Enzymes produced within the grain degrade some starch into sugars. The germination period is critical. The maltster aims to halt germination when sufficient enzymes have been produced, usually after 5 days.

Heat is then applied in a malt kiln (60-100°C) for 1-1½ days. The heat stops germination, develops flavour and colour, and produces a stable product.

Peat smoke can be used during kilning to impart characteristic flavours to malt for certain whiskies. Rootlets produced during germination are removed by sieving to leave finished malt ready for the customer. Rootlets are a valuable animal feed co-product.

Photos: ICB 'Malting Barley: The Heart of Beer and Whisky' (2000)

# 1 Market needs

## Background

### World markets for malting barley and malt

UK growers produce malting barley for UK and global markets. International demand is increasing:

- ◆ World beer production in 2000                      1,400 million hectolitres
- ◆ Anticipated beer production by 2005              1,585 million hectolitres
- ◆ Increased world malt demand                      400,000 tonnes a year
- ◆ Increased malting barley demand                520,000 tonnes a year

The outlook for the UK crop is positive but our focus must be on particular markets. The important growth areas are in the Far East, South America and Eastern Europe.

EU, including UK, continues to be a major supplier of malting barley and malt but competition from Australia, Canada and the USA is strong. HGCA is working with UK traders and maltsters to exploit market opportunities.

### UK maltsters

- ◆ Brewer maltsters buy and malt barley for their own use.
- ◆ Distiller maltsters buy and malt barley for their own use.
- ◆ Sale maltsters buy barley and sell malt into brewing, distilling and food markets at home and abroad.

### UK malt usage

The British are drinking more alcohol, but less as beer. In 1970, each person drank on average the equivalent of 12.5 pints of 100% alcohol. This is now 17 pints a year. Over the same period, beer consumption fell 18% to 216 pints a person.

There has been a significant swing to lager. In 1970, less than 10% of beer sales were lager. This is now over 60%. End-use significantly affects the types of barley required – especially grain nitrogen levels.

Lager beer requires higher nitrogen barley. Distillers, major buyers of malting barley and malt in Scotland, require lower nitrogen barley.

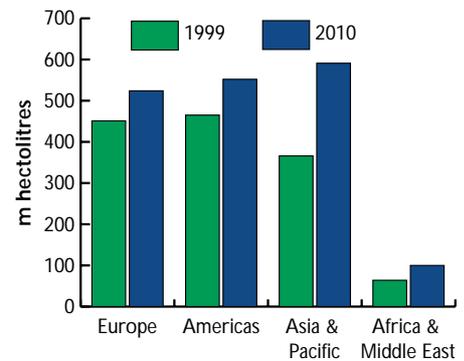
### UK malting barley production

Annual UK barley production is around 6.5 million tonnes, of which 2 million tonnes are used by the home malting industry. A further 100-400,000 tonnes of malting barley are exported each year. One of the UK's great strengths is that maltsters can source and use single varieties.

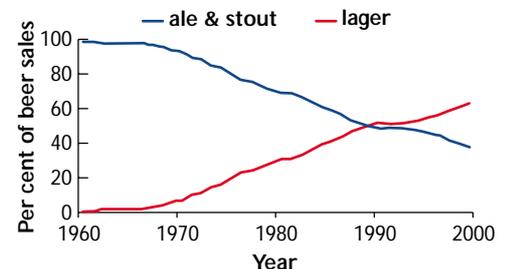
Scotland produces significant quantities of barley, 80% being spring-sown. Winter barley is more widely grown in England and Wales. In N. Ireland, 140,000 tonnes of barley are grown, but none is used by maltsters.

| UK barley production ('000 tonnes) and use in 1999/2000 |                  |                          |                  |                          |
|---|------------------|--------------------------|------------------|--------------------------|
|   | England & Wales  |                          | Scotland         |                          |
|   | Total production | Barley used by maltsters | Total production | Barley used by maltsters |
| <b>Winter barley</b>                                    | 2,890            | 704                      | 380              | 26                       |
| <b>Spring barley</b>                                    | 1,670            | 428                      | 1,460            | 843                      |

Source: HGCA and MAGB



World beer consumption  
Source: World Beer Report 2000, Plato Logic Ltd



Growth of lager consumption  
Source: BLRA Statistics



"Barley with too low or too high nitrogen will struggle to find a malting market."

Professor Geoff Palmer, Heriot Watt University

Growers must understand the market requirements, especially for nitrogen, if they are to achieve top returns.

## Issue

## Action

### Variety choice and end-use

Understanding the target market, choosing the right variety and managing it properly are critical.

- ◆ Establish a good working relationship with buyers and processors.
- ◆ Assess marketplace intelligence, eg MAGB and IGB (formerly IoB) information, HGCA export guide and Recommended Lists.

### Germination potential

Malt production depends on germination. Ideally all grains should have the potential to germinate, as measured by germination capacity tests. Maltsters also conduct germinative energy tests to check that dormancy has broken.

- ◆ Harvest grain at the right time and in good condition.
- ◆ Dry carefully, if necessary, to maintain germination levels of at least 97%.

### Appropriate nitrogen content

Nitrogen in barley is measured and traded on a dry weight basis. The recent swing to lager production highlights how different end-users have very specific nitrogen needs.

For instance, yeast performance in the brewing process may be reduced if the malt nitrogen level is too low. If excessively high, beer clarity and shelf life may be poor. Modern lagers with greater process control require higher nitrogen, but only up to certain levels.

- ◆ Establish barley buyer specifications.

#### Barley nitrogen levels for UK malts

| End-use                    | Grain nitrogen % | Market share |
|----------------------------|------------------|--------------|
| Cask-conditioned ale       | up to 1.55       | 5%           |
| Distilling                 | up to 1.65       | 30%          |
| Most UK & EU brewing needs | 1.55-1.75        | 40%          |
| Third country brewers      | 1.70-1.85        | 20%          |
| Other – food               | varies           | 5%           |

- ◆ Select suitable varieties for target markets and optimise crop management.

### Grain size and malt extract levels

The maltster needs grain with high carbohydrate extraction levels. Varieties with high malt extract potential and large grain size are preferred.

- ◆ Choose IoB-approved varieties from Recommended Lists.
- ◆ Aim for crops with large grain size – ideally minimum 85-90% of grains retained on a 2.5 mm sieve.

### Varietal purity and admixture

Contamination with other varieties or admixture creates serious problems when processing malting barley or malt.

- ◆ Choose certified seed, preferably of Higher Voluntary Standard.
- ◆ Handle post-harvest grain with care to ensure varietal purity and sample cleanliness:
  - 98% minimum varietal purity
  - 2% maximum admixture.

### Food safety and product assurance

Traceability and providing customers with assurances of grain hygiene are now absolutely essential in the malting, brewing and distilling sectors. The UK is a market leader in meeting such consumer demands. This can be used as a positive marketing tool.

- ◆ Join an approved scheme to provide buyers with independently verified evidence that grain has been produced safely and responsibly.

# 2 Marketing

## Background

### What to grow

Malting barley markets have very precise regional, varietal and quality requirements. Scottish and English maltsters' needs differ greatly. They can also change over time. The shift to lager consumption has raised the nitrogen levels which many maltsters seek.

### How to sell it

Farmers' opportunities to market malting barley to a maltster are usually via a trade partner.

Before harvest, most maltsters offer malting premium contracts to farmers, through merchants and co-ops. These contracts allow growers to agree a fixed premium over feed price for a proportion of their crop. Farmers can then opt to fix the feed element of the price at any time before the grain is moved. This gives farmers the benefit of meeting budget targets, while contracts give maltsters the benefit of securing a tonnage of barley ahead of harvest. Other contracts cover different pricing formulae.

Traditionally most malting barley has been sold between harvest and Christmas.

### Meeting contract requirements

Rejections can be expensive and disruptive, so it is important to understand the commitment to specifications when selling malting barley.

Increasingly, maltsters are focusing on closer supply relationships. Identity-preserved, variety-specific contracts give maltsters increased confidence in supply, and offer farmers the chance to develop a closer understanding of end-market requirements.

### Economics of growing barley

Malting barley production can be a profitable arable enterprise. In opting for the crop, growers need to take account of rotation, agronomy and markets. Potential returns must also be assessed, based on the particular farm. Gross margin data may help in producing a budget forecast and assessing how profitable the enterprise might be.

The relative profitability of malting compared with feed barley varies from year to year and from farm to farm.

A specific farmer should consider:

- ◆ the yield gap between winter malting barley and winter feed barley on the particular farm,
- ◆ the distance from the farm to the delivery point for the barley.

The actual yield difference can also vary from year to year. Newer malting barley varieties can outyield many feed varieties. Ex-farm prices depend largely on location. Malting barley is priced on a delivered basis, so the further the farm from the maltings the smaller the ex-farm price, and hence premium, will be.



*"Forward planning and price management are the way to ensure crops fetch best prices."*

Marie Skinner, Chairman HGCA Market Information committee and farmer

It is important to understand the commitment to specifications when selling malting barley.

Issue

Action

What to grow

The preferences of local maltsters are important. Low malting premiums will not justify haulage charges over long distances. Niche markets for malt provide additional options for growers.

- ◆ Speak to potential buyers.
- ◆ Establish local needs for varieties and quality.
- ◆ Research possible niche markets for varieties or different qualities.

How to sell it

Increasingly, maltsters are spreading their purchases through the season. Export markets also take barley through the season. Thus sales may be made over a longer period. This approach demands good storage conditions.

- ◆ Consider selling some of the crop pre-harvest if fixed prices meet budget.
- ◆ Maintain good storage facilities.
- ◆ Use fixed premiums to feed to gain control of price management.

Meeting contract requirements

Ex-farm grain contracts are becoming increasingly specific to meet the needs of users further along the food chain. Growers have to appreciate their commitments and be prepared for failure to satisfy these requirements.

- ◆ Study the contract, and its quality requirements.
- ◆ Prepare a strategy for possible rejections.
- ◆ Enquire about supply partnership schemes with local merchants and maltsters.

# Best practice for grain storage

- Prepare the store
- Cool the grain
- Dry the grain

Find out how to meet these three simple rules. Read **The grain storage guide** (1999).

**Free to levy payers, be sure to get your copy from HGCA.**



# 2 Marketing

## Malting sites in the UK

| Company                          | Address   | Telephone     | Size | Name on map                         |
|----------------------------------|---|---------------|------|-------------------------------------|
| Bairds Malt Ltd                  | Elliot Industrial Estate, Arbroath DD11 2NJ   | 01241 870431  | 2    | Bairds – Arbroath                   |
| Bairds Malt Ltd                  | Springfield Road, Grantham NG31 7SH   | 01476 562227  | 2    | Bairds – Grantham                   |
| Bairds Malt Ltd                  | Longman Industrial Estate, Inverness IV1 1SL  | 01463 221885  | 2    | Bairds – Inverness                  |
| Bairds Malt Ltd                  | The Maltings, Pencaitland, East Lothian EH34 5DQ  | 01875 340381  | 2    | Bairds – Pencaitland                |
| Bairds Malt Ltd                  | Station Maltings, Witham, Essex CM8 2DU   | 01376 513566  | 3    | Bairds – Witham                     |
| Bass Maltings Ltd                | Alloa Maltings, Castle Street, Alloa, Clackmannanshire FK10 1ET                         | 01259 722343  | 2    | Bass – Alloa                        |
| Bass Maltings Ltd                | 107 Station Street, Burton-on-Trent, Staffordshire DE14 1BZ                             | 01283 511000  | 2    | Bass – Burton                       |
| Bass Maltings Ltd                | PO Box 221, Wellington Road, Burton-on-Trent, Staffordshire DE14 2XG                    | 01283 511000  | 3    | Bass – Shobnall                     |
| Carlsberg-Tetley Brewing Ltd     | Mistley Maltings, School Lane, Mistley, Manningtree, Essex CO11 1HL                     | 01206 392145  | 2    | Carlsberg-Tetley – Mistley          |
| Chivas Brothers                  | Benriach Distillery, Longmorn, Elgin, Morayshire IV30 3SJ                               | 01542 783400  | 1    | Chivas Bros.                        |
| Crisp Malting Group Ltd          | Great Ryburgh, Fakenham, Norfolk NR21 7AS   | 01328 829391  | 3    | Crisp – Great Ryburgh               |
| Crisp Malting Group Ltd          | Norwich Road, Dereham, Norfolk NR20 3AG   | 01362 699408  | 1    | Crisp – Dereham                     |
| Crisp Malting Group Ltd          | Pirnow Street, Ditchingham, Bungay, Suffolk NR35 2RU                                    | 01986 892860  | 2    | Crisp – Ditchingham                 |
| Crisp Malting Group Ltd          | Portgordon Maltings, Portgordon, Buckie, Banffshire AB56 2BU                            | 01542 850345  | 2    | Crisp – Portgordon                  |
| French and Jupps Ltd             | Stanstead Abbots, Ware, Hertfordshire SG12 8HG  | 01920 871001  | 1    | French & Jupps                      |
| Highland Distillers              | Highland Park Distillery, Holm Road, Kirkwall, Orkney KW15 1SU                          | 01856 873107  | 1    | Highland Distillers – Highland Park |
| Highland Distillers              | Tamdhru Maltings, Knockando, Aberlour, Banffshire AB38 7RP                              | 01340 872101  | 2    | Highland Distillers – Tamdhru       |
| Kirkliston Malting Company       | Newliston Road, Kirkliston EH29 9DN   | 0131 335 3242 | 1    | Kirkliston                          |
| Morrison Bowmore Distillers Ltd  | Bowmore Distillery, School Lane, Isle of Islay PA43 7JS                                 | 01496 810441  | 1    | Morrison Bowmore                    |
| Morrison Bowmore Distillers Ltd  | Glengarioch Distillery, Distillery Road, Old Meldrum, Inverurie, Aberdeenshire AB51 0ES | 01651 873450  | 1    | Morrison Bowmore – Glengarioch      |
| Muntons plc                      | Cedars Maltings, Stowmarket, Suffolk IP14 2AG   | 01449 618300  | 2    | Muntons – Stowmarket                |
| Muntons plc                      | Flamborough Maltings, Bridlington, East Yorkshire YO15 1DY                              | 01262 426600  | 3    | Muntons – Flamborough               |
| Muntons plc                      | Dunnikier Maltings, Kirkcaldy, Fife KY1 2EF   | 01592 657100  | 2    | Muntons – Kirkcaldy                 |
| Pauls Malt Ltd                   | The Maltings, 20 Marsh Road Industrial Estate, Buckie, Banffshire AB56 4BY              | 01542 833740  | 2    | Pauls – Buckie                      |
| Pauls Malt Ltd                   | 24-25 Eastern Way, Bury St. Edmunds, Suffolk IP32 7AD                                   | 01284 772000  | 3    | Pauls – Bury St. Edmunds            |
| Pauls Malt Ltd                   | Victoria Street, Carnoustie, Angus DD7 7JR  | 01241 802000  | 2    | Pauls – Carnoustie                  |
| Pauls Malt Ltd                   | Glenesk Maltings, Hillside, Montrose, Glenesk, Angus DD10 9EP                           | 01674 830253  | 2    | Pauls – Glenesk                     |
| Pauls Malt Ltd                   | Albion Maltings, 47 Key Street, Ipswich, Suffolk IP4 1BZ                                | 01473 230537  | 2    | Pauls – Ipswich                     |
| Pauls Malt Ltd                   | Knapton Maltings, Knapton, Malton, North Yorkshire YO17 6RN                             | 01944 753000  | 2    | Pauls – Knapton                     |
| Pure Malt Products Ltd           | Victoria Bridge, Haddington EH41 4BD  | 01620 824696  | 2    | Pure Malt                           |
| JP Simpson & Co. (Alnwick) Ltd   | Monkhill Maltings, Ferrybridge Road, Pontefract, West Yorkshire WF8 2NU                 | 01977 702305  | 1    | Simpson – Pontefract                |
| JP Simpson & Co. (Alnwick) Ltd   | The Maltings, Moulton Road, Tivetshall St. Margaret, Norwich NR15 2AJ                   | 01379 674285  | 2    | Simpson – Tivetshall St. Margaret   |
| JP Simpson & Co. (Alnwick) Ltd   | Tweed Valley Maltings, Tweedside Trading Estate, Berwick-upon-Tweed TD15 2UZ            | 01289 330033  | 3    | Simpson – Berwick                   |
| Thomas Fawcett & Sons Ltd        | Eastfield Lane, Castleford, West Yorkshire WF10 4LE                                     | 01977 461000  | 1    | Thomas Fawcett                      |
| Edwin Tucker & Sons Ltd          | Tuckers Maltings, Teign Road, Newton Abbot, Devon TQ12 4AA                              | 01626 334002  | 1    | Tucker                              |
| United Distillers & Vintners     | Burghead Maltings, Burghead, Morayshire IV30 5XA  | 01343 832100  | 3    | UDV – Burghead                      |
| United Distillers & Vintners     | Glen Ord Maltings, Muir of Ord, Highland IV6 7UJ  | 01463 872000  | 2    | UDV – Glen Ord                      |
| United Distillers & Vintners     | Port Ellen Maltings, Isle of Islay PA42 7AJ   | 01496 302315  | 2    | UDV – Port Ellen                    |
| United Distillers & Vintners     | Roseisle Maltings, Roseisle, Morayshire IV30 5YP  | 01343 832100  | 2    | UDV – Roseisle                      |
| Warminster Maltings              | 39 Pound Street, Warminster, Wiltshire BA12 8NN   | 01985 212014  | 1    | Warminster                          |
| Wolverhampton & Dudley Breweries | Langley Maltings, Western Road, Langley Green, Birmingham B19 1EH                       | 0121 552 1371 | 2    | Wolverhampton & Dudley – Langley    |
| Wolverhampton & Dudley Breweries | Lichfield Maltings, Birmingham Road, Lichfield WS14 9BW                                 | 01543 262162  | 2    | Wolverhampton & Dudley – Lichfield  |

### Size code

- 3 over 80,000 tonnes of malt a year
- 2 10,000 – 80,000 tonnes of malt a year
- 1 under 10,000 tonnes of malt a year

*“Premiums need to reflect extra malting barley production costs and be reasonably consistent from year to year to encourage a strong home industry.”*

Teddy Maufe, farmer

Successful malting barley production depends on a clear understanding of maltster needs and matching production methods to location.



# 3 Winter or spring?

## Winter varieties

### The market

In England, the greatest demand is for higher nitrogen varieties for brewing lager.

### Rotation and site factors

Winter barley allows an early start to harvest.

Growing on the best wheat land is not essential, but crops grown on heavier soils can produce good malting samples. Good sites are free from high levels of cereal volunteers and grass weeds, low in soil mineral nitrogen and free of barley mild mosaic virus (BaMMV) or barley yellow mosaic virus (BaYMV). BaMMV more commonly affects malting varieties.

### Making your crop choice

Winter malting barley is mainly grown in England. These growers supply local maltsters. Relatively few growers in other parts of the UK select winter malting barley as a crop of first choice. This is probably because local markets are not available, rather than for any rotational reason.

There may be malting contracts for winter barleys in areas outside England, but growers should ensure their market before committing to the crop.

### Choosing a variety

Until the mid-90s feed variety yields were higher than those of most malting varieties. New winter barley varieties combine acceptable malting characteristics with excellent yields. The introduction of Fanfare brought about a dramatic change. Newer malting varieties can outyield some feed varieties, are stiffer strawed and have equivalent or higher hot water extracts than older malting varieties.

Crops sown after late November are both lower yielding and more lodging prone. A poorly developed root system makes plants vulnerable to frost heave over winter.

Recommended List scores allow growers to choose the best adapted malting varieties for local conditions. A high figure indicates that the variety shows the character to a high degree.

### Yield and quality data and character ratings for example winter

|                              | Winter variety |  |
|------------------------------|----------------|--|
| <b>UK yield (t/ha)</b>       |                |  |
| With fungicide               | 8.20           |  |
| Without fungicide            | 6.37           |  |
| Standing power               | 7              |  |
| Shortness of straw           | 5              |  |
| Earliness of ripening        | 5              |  |
| Winter hardiness             | 4              |  |
| Resistance to ear loss       | Not measured   |  |
| Latest safe sowing date      | End-February   |  |
| <b>Resistance to disease</b> |                |  |
| Mildew                       | 8              |  |
| Yellow rust                  | 6              |  |
| Brown rust                   | 7              |  |
| Rhynchosporium               | 8              |  |
| Net blotch                   | 5              |  |
| Barley yellow mosaic virus   | No resistance  |  |
| Barley yellow dwarf virus    | Not measured   |  |
| <b>Quality</b>               | IoB-approved   |  |
| Malt extract potential       | 9              |  |
| Specific weight (kg/hl)      | 69.5           |  |
| 1000 grain weight (g)        | 48.0           |  |

## Issue

## Action

### Rotation and site factors

An increased interval between barley crops reduces soil-borne virus build-up in each field.

Virus affected crops have poor response to inputs, and lower yields and higher screenings.

- ◆ Avoid sequences of barley and do not grow winter barley more often than once every four years.
- ◆ Choose resistant varieties for fields infected with soil-borne mosaic viruses.

### Variety choice

Choice depends mainly on buyers' needs and agronomic characteristics for local conditions.

- ◆ Choose IoB-approved variety from the winter barley Recommended List to meet requirements.

Recommended Lists enable growers to choose the best malting varieties for their conditions and buyers' needs.

## Spring varieties

### The market

As with winter barley, there is demand for higher nitrogen spring barley. However, Scotland enjoys a strong demand for low nitrogen spring barley for distilling.

Spring malting barley costs less to grow than winter crops and usually commands a premium. However, yields are often lower.

### Rotation and site factors

Spring barley is not affected by soil-borne mosaic viruses. It will grow on a wide range of soils, provided they are well drained. It suits lighter soils with a pH of at least 6. Growing spring barley helps spread fixed costs and breaks the grass weed cycle.

Soil fertility impacts on variety choice. There is evidence that some varieties produce higher

grain nitrogen. Such varieties (eg Chariot) suit low nitrogen sites. High-yielding varieties (eg Optic) effectively dilute grain nitrogen and therefore suit more fertile sites.

### Making your crop choice

Practically all of the malting barley grown in Scotland is spring-sown. These producers mainly supply a need for low nitrogen grain.

English farmers deciding to grow the crop may do so for several reasons: mosaic virus will not be a problem; poor weather may have prevented successful establishment of winter crops; a spring crop may help in the rotation; a wider range of markets may be available.

Some growers may choose to grow both winter and spring varieties in order to spread drilling and harvesting workload.

### Choosing the variety

For some growers, spring varieties provide an option where autumn conditions prevent drilling winter varieties.

Varieties graded 9 are best for malting, but the industry also uses grade 8 varieties and may have particular requirements for varieties with even lower scores. Other agronomic characteristics can then be taken into consideration.

### and spring barley varieties

|  | Spring variety  |   |
|--|---|---|
|  | 6.97<br>5.65  | The data from the <b>UK Recommended Lists for Cereals 2001</b> (left) are for varieties Pearl and Optic for winter and spring respectively. A high figure on the 1-9 scale indicates the variety shows the character to a high degree.  |
|  | 7<br>6<br>4<br>Not measured<br>7<br>Not measured      |   |
|  | 7<br>8<br>8<br>3<br>Not measured<br>Not measured<br>7 | Caution - The ratings for quality and agronomic features are not directly comparable between winter and spring varieties. For example, spring varieties with a malt extract rating of 9 will yield a higher hot water extract than winter varieties with a similar rating. Usually IoB (next year IGB) approval is essential. |
|  | IoB-approved<br>9<br>68.9<br>45.3                     |   |

## Issue

### Rotation and site factors

Residual soil nitrogen influences malting specification. A low to moderate grain nitrogen % is unlikely if fields have received large amounts of farmyard manure or slurry, or were recently in grazed or heavily-fertilised grass.

## Action

- ◆ Assess which fields are best suited to growing malting barley, mainly on the basis of soil mineral nitrogen levels.

### Variety choice

Choice depends mainly on buyers' needs and agronomic characteristics for local conditions.

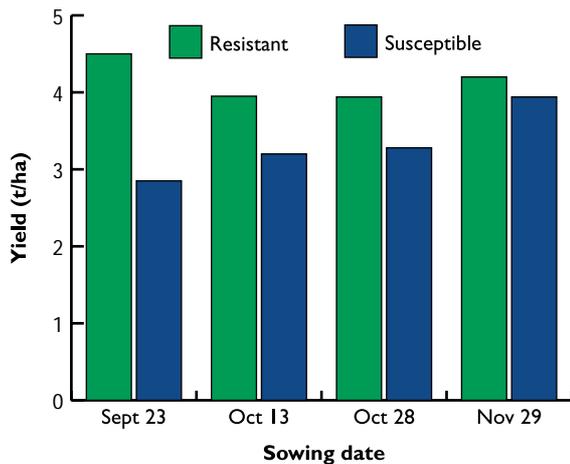
- ◆ Choose IoB-approved variety from the spring barley Recommended List to meet requirements.

# 4 Winter barley

## Background

### Barley soil-borne mosaic viruses

Later-sown susceptible varieties suffer less yield loss to virus infection.



Average yields of resistant and susceptible varieties sown on different dates at the BaMMV site. This shows how sowing susceptible varieties later minimises yield loss from virus infection.

Source: HGCA-funded trials 1994/95.

### Sowing date

The ideal drilling window for winter malting barley is from mid-September to mid-October in England. In Scotland, it is from the second week until the end of September. Early-sown crops tend to lodge less. Yield of crops sown from November onwards falls away rapidly. By December, spring barley is a better option.

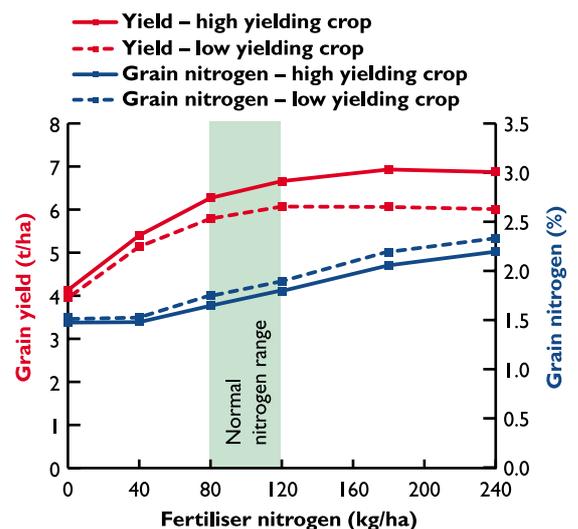
Sowing too early can increase nitrogen uptake during vegetative growth, which can lead to higher grain nitrogen. Early sowing also increases tillering causing high screening levels if dry weather hits crops on lighter soils.

### Fertiliser requirements

Nitrogen management should maximise yield yet keep grain nitrogen at acceptable levels. However, even with careful nitrogen management, the right variety is important. Malting barley can now be grown on a wider range of soils because of improved varieties, a better understanding of crop nitrogen use and increased demand for grain at 1.55 to 1.85% nitrogen. Soils with higher available water capacity (AWC) tend to produce lower % grain nitrogen.

High % grain nitrogen arises when there is insufficient dilution of nitrogen during grain filling. Drought (made worse by low AWC), virus and disease infections, or even manganese deficiency can cause this.

The basic P and K needs of malting barley are no different to other winter cereals. Regular sampling will track soil levels and crop needs.



High yielding crops with large grains tend to have low % nitrogen in grain. Where poor nutrition or disease leads to small grain, high % nitrogen can result.

Source: HGCA Project Report 70.



"Many growers are still not able to detect soil-borne virus. It's so often confused with trace element deficiency."

Dr Mike Carver, ARC

Soil-borne mosaic viruses pose a great challenge to winter barley growers and can make crops uneconomic.

## Issue

## Action

### Variety choice

Variety performance varies regionally. Selecting the best variety for a location depends on:

- market requirements
- yield potential of site and variety
- main disease threats
- lodging risk.

- ◆ Identify end user quality requirements (Section 1).
- ◆ Consult winter barley Recommended List for:
  - grain quality features.
  - agronomic characters, eg disease resistance, straw strength, and earliness of ripening.
- ◆ Avoid varieties susceptible to early season, wet weather diseases (eg Rhynchosporium and net blotch) in regions where they occur each year.
- ◆ Identify added lodging risk by taking into account soil mineral nitrogen status and select varieties with good standing power.

### Barley soil-borne mosaic viruses

An increased interval between barley crops slows virus build-up in infected fields. Virus affected crops have poor response to inputs, lower yields and higher screenings. Leonie is currently the only malting variety provisionally approved with resistance to soil-borne mosaic viruses. It can be sown early to reduce lodging risk and so produce high yields.

- ◆ Avoid long sequences of barley.
- ◆ Sow resistant varieties on fields infected with soil-borne mosaic viruses.

### Optimising sowing

Barley is less hardy than wheat. Very early September sowings produce over-lush crops prone to damage in winter and early spring. Late November sown crops are low yielding, more lodging-prone and their smaller root systems are more vulnerable to frost heave over winter.

Spring barley sown in November can be at greater risk from winter damage. It becomes a viable alternative from mid-December onwards, giving high yielding crops with better premiums and export potential.

- ◆ Avoid early sowing and excessively thick crops over winter, particularly in 'frost pockets'.
- ◆ Sow more lodging-prone varieties in late September. Plan a good PGR programme if sowing is delayed.
- ◆ Roll crops to reduce slug activity and frost heave, if soil conditions allow.
- ◆ Avoid sowing winter barley after early November, except in mildest areas.
- ◆ Review spring/winter barley mix if sowing is regularly delayed.

### Fertiliser requirements

During the growing season, the crop can use:

- nitrogen released from soil reserves by mineralisation
- fertiliser nitrogen and nitrogen released from any applied manure.

Leaching or losses to the atmosphere reduce available nitrogen.

April applications may give good yields and quality, but there is an increased risk of higher grain % nitrogen, particularly in a dry spring.

- ◆ Use soil mineral nitrogen analyses and total soil nitrogen supply figures to plan nitrogen inputs to achieve the market specification.
- ◆ Apply all nitrogen fertiliser before the end of March, or before mid-April in Scotland.
- ◆ Ensure other nutrients (P, K, S and Mn) are adequate for full potential yield.

# 4 Winter barley

## Background

### Barley yellow dwarf virus

BYDV is introduced by autumn flights of aphids. Timely aphicide sprays have traditionally been used to prevent significant virus infections that threaten both yield and malting quality.

Imidacloprid seed treatments provide sufficient systemic activity to prevent early autumn BYDV infection. Aphicides are advised when crops are sown very early or seed rates are below 100 kg/ha.

Early destruction of volunteer cereals, grass weeds and grassland scheduled for cultivation is necessary. This breaks the so-called 'green bridge' from which BYDV-carrying aphids fly into new crops.

### Weed control

Most malting barley is grown on lighter soils where the main grass weed is annual meadow grass. As heavier, higher AWC soils come into production black-grass and herbicide resistance become issues too. The WRAG guidelines outline the best strategies currently available, including cultural control measures.

Broad-leaved weed control is straightforward in barley and there is a wide range of products to choose from.

### Lodging control

Choosing the right variety is important to control lodging. Plant growth regulators (PGR) can provide insurance against lodging and loss of quality. Weaker strawed varieties and higher premiums can justify use of more than one application and/or more expensive and effective products. These should be used according to label instructions to avoid impairing malting quality.

### Disease control

The main diseases are leaf blotch (*Rhynchosporium secalis*), net blotch (*Pyrenophora teres*), and mildew (*Erysiphe graminis*). Brown rust (*Puccinia recondita*) can become severe early in spring and during grain filling. Eyespot can sometimes lead to lodging and yield loss.

Resistance to DMI fungicides has occurred in net blotch, although it has not worsened over the past three years. It also occurs in *Rhynchosporium* and occasionally in yellow rust and mildew. Careful use of established and new products is helping prevent widespread occurrence and maintain fungicide efficacy in the UK.

When used in mixture with a triazole, strobilurins can enhance control of *Rhynchosporium*, net blotch and brown rust. Cyprodinil controls *Rhynchosporium* and eyespot well.

The use of strobilurin fungicides on winter malting barley (and to a lesser extent on spring malting barley) has increased dramatically within the last two years. Strobilurins have markedly improved the level of disease control achievable. This has led to very high yield responses in many crops. The strobilurins also can have crop growth effects, which are independent of any disease control effects. Crops treated with strobilurin typically yield more and mature later than crops treated with other fungicides. This has raised concerns about the possible effects on grain quality.

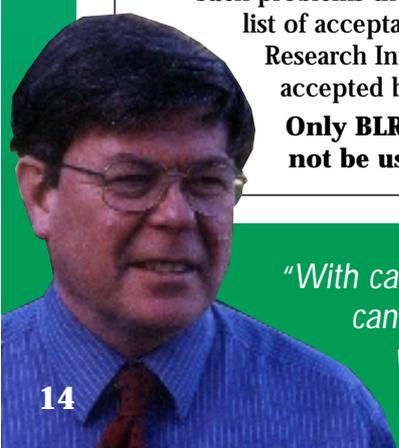
Evidence to date suggests that:

- ◆ because better disease control is achieved, grain samples are generally improved,
- ◆ grain nitrogen levels in strobilurin-treated barley crops are generally unchanged, or reduced slightly,
- ◆ quality at harvest may possibly be lower if harvesting is delayed,
- ◆ less residual nitrogen may be left in the soil, so nitrogen rates for following crops may have to be raised.

### Agrochemical use on malting barley

Agrochemicals used on malting barley can affect the brewing process and the flavour of the beer produced. To avoid such problems the Brewers and Licensed Retailers Association (BLRA) carries out detailed testing and publishes a list of acceptable chemicals. This list is available from most merchants and consultants, or from Brewing Research International. The **UK Pesticide Guide** (updated annually) also indicates whether a chemical is accepted by BLRA.

**Only BLRA-accepted chemicals may be used on malting barley. Some accepted fungicides must not be used after ear emergence.**



"With careful nitrogen management heavy land growers can reliably achieve good yields of malting quality winter barley."

John Garstang, ADAS

Winter barley will require much higher investment in crop protection than spring barley.

Issue

Action

**BYDV control\***

BYDV threatens all winter barley crops. Prophylactic aphicide use is environmentally undesirable. The introduction of imidacloprid seed treatment may help limit such use.

- ◆ Consider using an insecticidal seed treatments to protect against early transmission of BYDV.
- ◆ Spray aphicides later in autumn, if necessary, especially on crops sown early or at low seed rates.

**Weed control\***

Brome and black-grass can be particularly costly to control, especially on heavy soils. Current herbicides are generally more effective and safer on wheat.

Volunteer cereals affect sample quality and can lead to rejection.

Herbicide resistance is an increasing problem in black-grass and wild oats. Rotational and cultural control is the key.

Lower nitrogen rates used for malting barley make the crop less competitive than more heavily fertilised cereals.

- ◆ Avoid growing malting barley crops where grass weeds are severe.
- ◆ Control severe grass infestations elsewhere in the rotation.
- ◆ Use stale seedbeds to reduce volunteer cereals.
- ◆ Consider growing spring barley to give extra time to clear troublesome weeds in autumn.
- ◆ Follow the **Revised guidelines for preventing and managing herbicide-resistant grass weeds**, WRAG (1997).

**Lodging control\***

Lodged malting crops lose yield and quality. Lodged crops can have a wide range of grain moisture content making drying difficult.

- ◆ Select stiff strawed varieties that suit your buyer.
- ◆ Select appropriate PGR programme according to risk of lodging and immature grains.

**Disease control\***

*...with varieties*

Importance of disease resistance varies with season, location and annual disease patterns.

More costly fungicide programmes are needed for varieties with low Rhynchosporium and net blotch resistance in wetter western areas.

Brown rust can be severe during grain fill. Good resistance lessens risk to yield and quality.

*... with fungicides*

Fungicide programmes are usually needed in addition to varietal disease resistance. Simple T1 (GS 30/31) and T2 (GS 39) programmes are effective in most situations.

Resistance to certain fungicides has been confirmed in populations of Rhynchosporium, yellow rust and mildew. This resistance has not yet reached levels that cause significant reductions in product efficacy, although resistance to DMI fungicides is causing concern.

Although there is resistance to strobilurins in wheat mildew, no resistant barley mildew populations have been found.

- ◆ Grow disease resistant varieties to reduce threat of severe epidemics in high risk areas.
- ◆ Budget for effective fungicide treatment according to likely variety response.
- ◆ Consider reducing rates when growing varieties with high disease resistance.
- ◆ Check late disease does not affect final stages of grain filling where T1+T2 programmes used.
- ◆ Consider a T3 'ear' spray on susceptible varieties if disease control at T2 has been inadequate.
- ◆ Use mixes of products with different modes of action.
- ◆ Avoid repeated low dose treatments if trying to control established disease.
- ◆ Follow the **Guidelines for preventing and managing fungicide resistance in cereal pathogens**, FRAG-UK (2000) for efficient strobilurin use (no more than 2 sprays a crop) to help maintain efficacy.

\* For information on BLRA-accepted agrochemicals, see opposite.

# 5 Spring barley

## Background

### Sowing date and seed rate

Optimum sowing date ranges from late January to end-February in the south and east of England, and from late February to end-March in Scotland. A further option in England is late autumn sowing which can give high yields. Sowing after the optimum incurs a yield penalty of 30-50 kg/ha/day. Grain quality is impaired too.

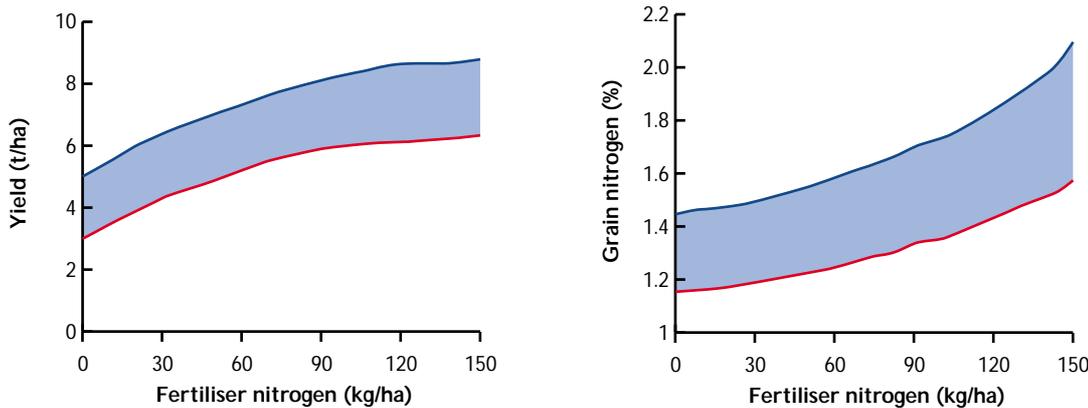
Under good conditions optimum seed rate will be 300-375 seeds/m<sup>2</sup>. Early sowing or adverse seedbeds may reduce percentage establishment, but early crops tiller better.

| Seedbed \ Date | Good    | Moderate              | Poor                  |
|----------------|---------|-----------------------|-----------------------|
| Early          | Optimal | Increase by up to 20% | Increase by up to 50% |
| Normal         | Optimal | Increase by up to 10% | Increase by up to 20% |
| Late           | Optimal | Optimal               | Increase by up to 10% |

Optimising seed rate for sowing date and seedbed conditions.

### Fertiliser requirements

Nitrogen affects both yield and quality. Generally, 120 kg/ha is the maximum for nitrogen fertiliser. Nitrogen requirements fall by 1 to 2 kg/ha/day from the start of the optimal sowing date. Malting premiums are unlikely if grain nitrogen content exceeds 1.85%. Thus a balance must be struck between low yield and high grain nitrogen, exceeding buyers' requirements, as the graphs below illustrate.



The range of yield and grain nitrogen % responses to applied nitrogen fertiliser.  
Source: SAC field trials.

A wet winter can reduce soil nitrogen supply and pre-dispose crops to low nitrogen grain. Timing nitrogen application to spring crops is more straightforward than for winter crops. Spring crops have a compressed growth period, so leaching risk is low.



*"Under current market conditions, spring malting barley represents an attractive option on many soil types."*

Charles Bradfield, Masstock Farm Consultancy

**Issue**

**Action**

**Variety choice**

The right choice must be based on the requirements of buyers.

Grain quality and agronomic characteristics must be related to local conditions:

- ◆ high disease pressure
- ◆ risk of lodging.

Ear loss can reduce yield:

- ◆ in windy or exposed sites, eg coastal areas
- ◆ where harvest is delayed.

In late harvesting areas early maturity helps secure quality and a market. In delayed harvests, susceptible varieties may suffer stem brackling causing harvest difficulties and yield loss.

Other issues to consider are splitting or skinning, and dormancy.

- ◆ Identify end-user quality requirements (Section 1).
- ◆ Consult spring barley Recommended List for:
  - grain quality
  - agronomic characters, eg disease resistance, straw strength, and earliness of ripening.
- ◆ Assess risk of splitting or skinning.

**Site and rotation**

Soil residual nitrogen influences malting specification. A low to moderate grain nitrogen % is unlikely to be achieved if the field has received large amounts of farmyard manure or slurry, or if it was recently in grass that received large amounts of fertiliser. Low soil nitrogen is not so critical for:

- ◆ early-sown crops
- ◆ high yielding varieties
- ◆ crops grown for a higher grain nitrogen % market.

- ◆ Ensure your location, facilities and expertise suit spring malting barley.
- ◆ Assess which fields are best suited to growing malting barley.
- ◆ Choose fields with low soil nitrogen to produce low grain nitrogen.
- ◆ Consider desired grain nitrogen % in relation to soil nitrogen status.
- ◆ Match varieties to suit high or low yielding situations.
- ◆ Identify risks to quality at exposed sites or where harvest is likely to be delayed.

**Optimising sowing**

Sowing date affects establishment, crop development and even final quality. Optimum date to secure yield and quality varies across the UK. It is generally between late winter and early spring in England and early spring in Scotland.

Seed rate needs to be considered in relation to sowing date and seedbed condition.

- ◆ Aim for optimum sowing date.
- ◆ Increase seed rate in poor seedbeds, especially when sowing early.
- ◆ Increase seed rate where conditions are likely to reduce establishment.
- ◆ Reduce seed rate where conditions or variety may result in good tillering.

**Fertiliser requirements**

Nitrogen rate depends on sowing date, but all applications should be completed by early tillering.

- ◆ Apply no more than 120 kg/ha fertiliser nitrogen, under most circumstances.
- ◆ Split nitrogen according to sowing date:
  - up to one third in seedbed, top dress in March for January/early February sowing
  - half in seedbed, half at second or third leaf stage up to late March sowing
  - all in seedbed from April onwards.

# 5 Spring barley

## Background

### Weed control

Weed control in spring barley benefits grain quality, harvestability, and subsequent crops. Spring barley in a rotation breaks the build-up of many winter crop weeds and acts as a cleaning crop.

There are many products for broad-leaved weed control. The most common options are broad-spectrum, eg sulfonyl ureas. Specific products may be added if difficult weeds are present in high numbers.

The crop should be examined for specific weeds escaping routine treatments so that seed bank build-up can be reduced.

Wild oat control is important. A range of herbicides suit different growth stages of crop and weed.

Dose reductions are possible given good growing conditions and crop vigour, moderate weed densities and the right growth stages.

Glyphosate may be used, pre-harvest, for late weed growth or to aid harvest. However, check with customers that the treatment is acceptable.

### Lodging control

Straw strength has improved markedly in spring varieties and malting crops use less nitrogen fertiliser, reducing lodging risk. PGRs may cause smaller tillers to be retained. This leads to reduced thousand grain weight as well as increased screenings and immature grains.

In barley the middle internodes tend to be weak and PGRs applied at second node or later are more likely to be effective.

### Disease control

Choice of fungicide and product mixtures depends on the main disease risks – mildew, Rhynchosporium, net blotch, rusts and leaf spotting. Yellow rust is rarely a threat to current varieties.

Seed treatments offer good control of leaf stripe and loose smut but give insufficient protection against foliar diseases.

Many malting varieties have low resistance to Rhynchosporium. Varieties scoring less than 8 are likely to need protection. Mixtures based on cyprodinil provide effective protection at the first spray. This fungicide will also offer the best control of eyespot. Fenpropimorph mixed with cyprodinil offers additional control of Rhynchosporium and mildew.

Many varieties have a high rating (9) for mildew resistance on the spring barley Recommended List. Where spraying is needed on more susceptible varieties, quinoxifen offers effective protection, while morpholine or spiroxamine achieve effective knockdown.

Strobilurin fungicides will only offer protection where mildew strains are sensitive. A later treatment at GS 45 will minimise green leaf area loss from disease or physiological spots. Trifloxystrobin or azoxystrobin, combined with a triazole, also offer effective protection against net blotch.

#### Considerations for disease control

- ◆ High disease levels on winter barley can put pressure on spring crops.
- ◆ Best timing for first application is GS 31-32, but Rhynchosporium or mildew may need earlier treatment if present at tillering.
- ◆ If fungicide and herbicide are applied together make sure it's not too early for optimum disease protection.
- ◆ Base early fungicides around cyprodinil.
- ◆ Base later fungicides at GS 37-45 around strobilurin fungicide.
- ◆ Effective disease control will always require a fungicide mixture.

### Leatherjackets

Crops sown after grass are at risk from leatherjacket attack. Pre-ploughing treatments can be more effective than those applied once damage appears. However, it is often better to monitor emerging crops and only spray when necessary. Bare patches in emerging crops may signal damage.



*"UK barley grower skills and UK maltsters 'know how' can help build our market share, as we all compete on more equal terms in the world market."*

Trevor Wright, Simpsons Malt

## Issue

## Action

### Weed control\*

Pre-emergence treatments should only be considered in early-sown crops or where meadow grass is a serious problem.

Early control offers best chance to cut herbicide costs, but spraying too early may miss late emerging weeds. Early application is more likely to reduce costs than improve crop yield.

- ◆ Wait until crop has at least 3 leaves and weeds are at 2-4 leaf stage before spraying. Control is usually best at GS 23-33.
- ◆ Monitor weeds present and note numbers of difficult or competitive weeds.
- ◆ Monitor the growth stages of crop and weeds.
- ◆ Assess cost-benefit of the treatment options.

### Lodging control\*

Often control is not required. It is important where variety, site conditions or agronomy create lodging risks.

#### Key risk factors:

- ◆ moderate to high fertility from previous crop
- ◆ high frequency of heavy rainfall after flowering on water retentive soils
- ◆ a thick leaf canopy or forward crop (eg early-sown or high seed rate).

- ◆ Grow varieties with stiff straw.
- ◆ Assess lodging risk. Only treat with PGR if necessary.
- ◆ Use a product containing 2-chloro-ethyl phosphonic acid or trinexapac-ethyl.
- ◆ Consider a small reduction in nitrogen rate to vulnerable crops.

### Disease control\*

No single fungicide provides effective control of all diseases.

Typically a two-spray programme is used, but adjusted according to early disease pressure and the need to protect green leaf area later in the season.

Fungicide mixtures including a strobilurin, applied twice give cost-effective disease control. Strobilurin fungicides should not be relied upon for mildew control due to the risk of fungicide resistance.

Crops under stress during wet and cold springs or if rooting is poor are at most risk of leaf spotting and Ramularia. Thin or poorly tillered crops are also at risk.

- ◆ Use Recommended List variety disease ratings to build a cost-effective spray programme.
- ◆ Apply first fungicide spray at late tillering to early stem extension (GS 24-32).
- ◆ Apply early spring application if mildew or Rhynchosporium pose a significant threat before mid-tillering.
- ◆ Consider protectant fungicide at flag leaf emergence to improve green leaf area retention.

\* For information on BLRA-accepted agrochemicals, see page 14.

# 6 Harvesting and storage

## Background

### Storage

The **grain storage guide** \* addresses grain storage in general. Refer to it for more detail. This section focuses on the specific challenges malting barley presents from harvest into storage:

- ◆ physical damage during harvesting and handling
- ◆ dormancy, to which some varieties are genetically prone, is affected by location, weather and harvest conditions
- ◆ several pests can attack grain, yet few pesticides can be used in stores or on grain and only phosphine can be used to fumigate grain
- ◆ maintenance of stringent quality requirements.

Undried grain at more than 15% moisture content should not be stored for more than one week without cooling and/or aeration. Moist grain stored for any length of time can become contaminated with toxins from moulds, which can render grain unsaleable.

### Drying

Without great care, drying can ruin malting potential. It is impossible to give accurate drying temperature guidelines to cover all situations: variety, initial moisture content, type of dryer, throughput speed and/or dwell time etc. Many merchants and maltsters recommend that raised temperature drying is left to their professional skills.

### Dormancy and malting barley

Once dried, malting barley is normally cooled rapidly to prevent insect attack.

Storing at a raised temperature until full germinative energy is achieved can break dormancy. But this is a high-risk strategy allowing insect infestations to build up rapidly. Monitoring of temperature and presence of insects is required during this critical period, as well as careful cooling system management. Again, many merchants and maltsters recommend this approach be left to their professional skills.

### Pests

A wide range of insect pests can attack malting barley, even if grain goes into store in excellent condition. Mites are potential pests in damp barley. Secondary insects can infest grain stored in unhygienic conditions.

Rats and birds cause physical damage and contamination if poor proofing allows entry to the store. Mice can live and breed within stores and cause similar damage.

Poorly stored malting barley may be downgraded to feed or become unsaleable.

### Records and passports

Good management practice should include keeping records detailing variety, field, harvest date, weather and moisture content at harvest, temperature of dryer operation, dwell time (if appropriate), moisture content ex-dryer and pesticide treatment.

Any agrochemicals used on malting barley, both on the growing crop and on harvested grain, as well as in grain stores, must be on the BLRA list (page 14).

Barley sold off-farm should always be accompanied by its own "grain passport", which should also provide details of any agrochemical treatment. Each load delivered should be identifiable until added to a larger bulk.

**Check with the buyer and end-user for advice on aspects to be recorded.**

\* Free to levy payers from HGCA

*"Germination remains the most critical standard."*  
Robert Leachman, SCATS Grain Ltd

# Grain in the store needs as much management as the crop in the field to secure a first class malting sample.

## Issue

## Action

### Handling at harvest and drying

Grains are easily skinned by rough threshing and in harsh conveying systems.

Varietal segregation is absolutely vital; even field segregation might be advisable in some seasons. Accurate records of how segregated lots are handled during harvest and early storage are important at sale time.

High-temperature continuous flow, or batch dryers, can damage or even kill some grains.

- ◆ Adjust combine to minimise damage.
- ◆ Where possible, use rubber belt conveyors.
- ◆ For information on safe drying temperatures, refer to **The grain storage guide** and your dryer handbook.
- ◆ Avoid overheating during drying.
- ◆ Test outflow grain temperatures immediately on exit from the dryer.
- ◆ Avoid too long a dwell period.
- ◆ Adhere to dryer manufacturer's settings.

### Preparing the store\*

Thorough preparation is vital for malting barley to:

- ◆ remove any infestations already in the store, eg insects, mites and often mice
- ◆ keep rats and birds out of stores.

Some insecticides, labelled for use in grain storage, must not be used on surfaces that will contact barley. This is very restrictive in flat stores, bins and silos.

- ◆ Thoroughly clean store structure and fixed equipment using brushes, scrapers, vacuum cleaners or high pressure washing - dismantle if necessary.
- ◆ Destroy sweepings.
- ◆ Only use an insecticide approved by the malting industry for fabric if traps detect insects or mites.
- ◆ Proof store against rodents and birds.
- ◆ Remove debris and harbourages.

### Storage strategy\*

The best way to avoid serious insect build-up is to quickly cool the grain after drying.

- ◆ Dry to below 15% moisture content.
- ◆ Cool grain as quickly as possible.
- ◆ Ideally store between 10°C and 15°C.

### Monitoring during storage

#### Temperature

It is vital to monitor barley temperatures. Surface grains can absorb radiated heat from roof and walls, and increase infestation risk.

#### Insects and mites

Since there is also a high risk of insect attack, monitoring for insect activity is important. Traps include: "PC Trap", "Bug Pit" and probe traps.

- ◆ Monitor and record bulk temperatures. Use a hand-held digital probe.
- ◆ Use traps to detect insects and mites.
- ◆ Monitor surface and deeper bulk.
- ◆ Check traps weekly even when bulk grain temperature falls below 15°C.
- ◆ Occasionally (monthly during winter) check surface samples for mites. Sample to check germinative capacity and moisture content.

\* For information on BLRA-accepted agrochemicals, see page 14.

# Further reading

HGCA has funded many projects concerned with malting barley. The following list includes relevant HGCA and other more general publications:

## The malting process

Project Progress 4 – Malting, brewing and distilling research to add value (free)

Project Reports (at cost) 23, 63, 66, 98, 100, 117, 184, 211, 218, 220 and 238

**Malting Barley** – the Heart of Beer and Whisky, Institute of Brewing (2000)

## Section 1: Markets

Nix, J (2000) **Farm Management Pocketbook**, Imperial College at Wye

**Farm management handbook 2000/2001**, SAC (2000) £14

## Section 2: Marketing

*(Available from HGCA Crop Marketing department)*

**mi bulletin** (weekly price and crop information) – £50 a year

**mi prospects** (in-depth analysis of UK and world cereals) – £40 a year

**mi oilseeds news** (in-depth analysis of UK and world oilseeds) – £30 a year

*(All of the above are available for £95 a year by post or £50 by e-mail/web)*

**Quality survey – wheat and barley** – annually in November – free to levy payers

Historic **cereal statistics** are available free of charge to all subscribers to the **mi bulletin**

**Barley export growers' guide 1999/2000** (1999)

## Section 3: Winter or spring?

**UK Recommended Lists for cereals 2001 – a summary guide to varieties**, HGCA (2000) free

**Theme Review: Barley quality**, HGCA (1994) free

**Crop management options**, HGCA (1999) free

**Cereal Variety Handbook**, NIAB (2000) £45

**SAC Cereal Recommended List for 2001**, SAC (2000) £5

## Section 4: Winter barley

Topic Sheet 23 – Soil-borne mosaic viruses in winter barley (free)

Topic Sheet 41 – Appropriate fungicide doses for winter barley (free)

Topic Sheet 42 – Rhynchosporium control programmes (free)

Project Reports (at cost) 20, 48, 49, 58, 59, 65, 70, 97, 119, 123, 127, 132, 139, 180, 186, 191, 215, 223 and 227

**Revised guidelines for preventing and managing herbicide-resistant grass weeds**, HGCA/WRAG (1997) free

MAFF (2000). **Fertiliser Recommendations for Agricultural and Horticultural Crops**. 7th Edition (RB 209). The Stationery Office

**The UK Pesticide Guide 2001**, BCPC Publications (2000) Tel: 0118 934 2727

**BLRA List of Accepted Agrochemicals**, BRi (2000) free

## Section 5: Spring barley

Topic Sheet 20 - Growing spring malting barley

Project Reports (at cost) 179 and 199

## Section 6: Harvesting and storage

**The grain storage guide**, HGCA (1999) free to HGCA levy-payers, otherwise £25

**Moisture meter guidelines**, HGCA (2000) free

Topic Sheet 7 - Integrated grain storage strategies (free)

Topic Sheet 8 - Effective phosphine fumigation of grain (free)

Topic Sheet 16 - Bulk storage drying of grain and oilseeds (free)

Topic Sheet 26 - Sampling grain on-farm (free)

Topic Sheet 34 - Mycotoxins in stored grain (free)

Project Reports (at cost) 61, 84 and 138

# Contacts

## **BLRA – Brewers and Licensed Retailers Association**

42 Portman Square  
London  
W1H 6BD  
Tel: 020 7486 4831  
Fax: 020 7935 3991  
E-mail: mailbox@blra.co.uk

## **BRI – Brewing Research International**

Lyttel Hall  
Nutfield  
Surrey  
RH1 4HY  
Tel: 01737 822272  
Fax: 01737 822747  
E-mail: bri@brewingresearch.co.uk

## **FAC – Federation of Agricultural Co-operatives** (see NFU)

## **GAFTA – Grain and Feed Trade Association**

Gafta House  
6 Chapel Court  
Chapel Place  
London  
EC2A 3DQ  
Tel: 020 7814 9666  
Fax: 020 7814 8383  
E-mail: post@gafta.com

## **ICBD – International Centre for Brewing and Distilling**

Heriot Watt University  
Riccarton  
Edinburgh  
EH14 4AS  
Tel: 0131 449 5111  
Fax: 0131 449 7459

## **IGB – Institute and Guild of Brewing** (formerly IoB – Institute of Brewing)

33 Clarges Street  
London  
W1Y 8EE  
Tel: 020 7499 8144  
Fax: 020 7499 1156  
E-mail: enquiries@igb.org.uk

## **MAGB – Maltsters Association of Great Britain**

31b Castle Gate  
Newark on Trent  
Nottinghamshire  
NG24 1AZ  
Tel: 01636 700781  
Fax: 01636 701836  
E-mail: info@magb.org.uk

## **NFU**

Agriculture House  
164 Shaftesbury Avenue  
London  
WC2H 8HL  
Tel: 020 7331 7200  
Fax: 020 7331 7313  
E-mail: nfu@nfu.org.uk

## **NFUS – NFU of Scotland**

The Rural Centre  
West Mains  
Ingliston  
Newbridge  
Midlothian  
EH28 8LT  
Tel: 0131 335 3533  
Fax: 0131 335 3633  
E-mail: webmaster@nfus.org.uk

## **SWA – Scotch Whisky Association**

20-21 Atholl Crescent  
Edinburgh  
Midlothian  
EH3 8HF  
Tel: 0131 222 9200  
Fax: 0131 222 9203  
E-mail: info@swa.org.uk

## **SWRI – Scotch Whisky Research Institute**

Robertson Trust Building  
Heriot Watt Research Park  
Riccarton  
Edinburgh  
EH14 4AP  
Tel: 0131 449 8900  
Fax: 0131 449 8901  
E-mail: general.swri@swri.co.uk

## **UFU – Ulster Farmers Union**

475 Antrim Road  
Belfast  
BT15 3DA  
Tel: 028 9037 0222  
Fax: 028 9037 0739  
E-mail: info@ufuhq.com

## **UKASTA – United Kingdom Agricultural Supply Trade Association**

3 Whitehall Court  
London  
SW1A 2EQ  
Tel: 020 7930 3611  
Fax: 020 7930 3952  
E-mail: enquiries@ukasta.org.uk

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For information on HGCA services, please contact the appropriate department.

### Research and Development

Tel: 020 7520 3945

E-mail: [research@hgca.com](mailto:research@hgca.com)

### Crop Marketing

#### Market Information (MI)

Tel: 020 7520 3972

E-mail: [mi@hgca.com](mailto:mi@hgca.com)

#### British Cereal Exports (BCE)

Tel: 020 7520 3925

E-mail: [bce@hgca.com](mailto:bce@hgca.com)

#### British Cereal Products (BCP)

Tel: 020 7520 3927

E-mail: [bcp@hgca.com](mailto:bcp@hgca.com)

Website: [www.hgca.com](http://www.hgca.com)

HGCA, Caledonia House,  
223 Pentonville Road, London N1 9HJ

£25 (free to HGCA levy payers)

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