Draft Only for Internal Discussion – prepared by T. Dickson, BMBRI/ABC
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Malting Barley Grower Best Management Practices:

Acknowledgements: Information in this Technical Advisory Leaflet is produced with input from BMBRI members, provincial department of agriculture agronomists, Elite malting barley growers, CWB and grain selecting company specialists. This information is generic for western Canada. Growers are also advised to seek additional information from their local agronomist and customers in making malting barley management decisions.

Introduction

Malting barley is now very much a specialty crop across western Canada in terms of production and preparation for market delivery practices. Across western Canada there are many variables which growers need to be aware of and which will influence their management practices. These variables include:

- Local climate
- Local soil type
- Market demand and relative returns for malting barley and other crops in the region
- Malting barley variety and quality needs of the customer
- Best crop rotation in which factors local climate, soil, customer quality and market returns for each crop in the rotation

Speciality malting barley growers should make their decision on producing malting barley having got best information and advice from their local, provincial, or private agronomists and customer representatives. Having made the decision to produce malting barley the following are some important considerations that growers need to know and implement.

1. What are the **Malting Barley Selection Quality Factors** required for market selection and acceptability at delivery?
2. What **Grower Best Management Practices** should be implemented to increase the chances of market selection and acceptability at delivery?

1. Malting Barley Selection Quality Factors

For a number of years BMBRI has provided the following list (updated and revised periodically) on the important quality factors in malting barley.

High quality malting barley should have the following characteristics:

- Pure lot of an acceptable variety
- Protein content of 10.0% to 12.5% (dry basis)
- Plump kernels of uniform size
- Fully mature
- Moisture content of 13.5% maximum
- Germination of 95% or higher (3 day test)
- Less than 5% peeled and broken kernels
- Free from heat damage
- No signs of pre-harvest sprouting

- Not weathered or deeply stained
- Free from frost damage
- Free of DON from *Fusarium* head blight
- Free of insects, admixtures, ergot, treated seeds, smut and odour
- Free of chemical residues
- General Best Management Practices

A detailed explanation of why each of these factors is important in malting and brewing is provided in a separate brochure from BMBRI - (http://www.bmbri.ca/PDF/Quality%20Factors%20in%20Malting%20Barley%20-%20May%202010.pdf)

2. **Grower Best Management Practices (BMP)**

For each of the above malting barley selection quality factors growers should carefully consider the following advice for each factor:

Pure lot of an acceptable variety

*Check your local malting company and elevator, provincial guide, variety test results and industry recommended varieties in order to choose a variety that is preferred and best suited to the expected customer demand and the environmental conditions in your area. (1, 2)

*Use of certified seed ensures varietal purity, plumpness, high percentage of germination, and minimal risk of importing weed seeds and diseases. (2, 3)

*Use of several small bins may be necessary to keep each variety in a separate bin. Label each bin clearly and take accurate samples which are a true representation of the crop you are storing. (1)

Protein content of 10% to 12.5% (dry basis)

*Be aware of the protein specification for the target buyer, as some buyers prefer higher protein content than others.

*Nitrogen/protein management is one of the key practices which growers can control. Information from agronomy specialists should be consulted in this management decision.

*Although some producers are reluctant to fertilizer for fear of producing a high protein barley crop, most prairie soils are deficient in nitrogen. This inverse relationship between protein and yield is commonly observed and certain varieties are generally higher in one parameter or the other, and should be chosen based on the soil conditions. Soil testing can be useful to determine the nutrient status of your soil and help avoid over fertilization, which could result in high protein levels and increased lodging. Crop inspections, tissue testing, fertilizer rate test strips, and variable rate fertility programs may be advantageous to producers. (3&24)

*Planting malt barley into pea stubble has been found to increase yields, while keeping the protein level low enough for malt specifications. In addition, these crops required less fertilization. (24)

*Recognize that the nutrient removal of a crop is lower than the crop requirement (which does not account for the fertilizer use efficiency of the crop). An 80 bu/ac malt barley crop will remove approximately 106 pounds per acre of nitrogen, according to Alberta Agriculture, but would require more than this amount of nitrogen fertilizer. Calculate how much nitrogen you need for your malt barley crop at: http://www.gov.mb.ca/agriculture/financial/farm/nitrogencalc.html or http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3904 (3, 6 & 7)

*If a nitrogen application is going to be applied after emergence, it should be done before the five-leaf stage, in order to reduce the chance of increasing the protein levels in the plant. (3)

*A lack of precipitation will often result in higher protein and moist conditions will usually yield barley with lower protein content. Therefore, producers may want to consider available soil water along with soil test information when deciding on fertilizer application rates. For more information on this check out: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex98 (3)

Plump kernels of uniform size

*Early sown barley matures while soil moisture is adequate to allow sufficient grain filling. In additional, early seeding results in early maturity and reduced risk of fall frost and cool, wet harvest conditions. Later seeding has been proved to be beneficial in northern areas, likely due to the soil moisture conditions at that time. (3&24)

*Current malt barley varieties have a high percentage of plump kernels, so barley must be grown at optimum plant density to realize this characteristic. Seeders should be calibrated (accounting for both the rate of germination and seedling mortality), for emergence of 20 to 25 plants per square foot (approximately 220 plants/metre). Seeding up to 300 plants/m^2 can achieve this density along with increased germination indices. Higher rates will result in decreased kernel weight and plumpness, and lower rates increase tillering. Certain instances, such as late seeding, abundant moisture, high weed pressure, deep seeding and a rough seed bed may require a higher seeding rate. To try out a seeding rate calculator at: http://www.agric.gov.ab.ca/app19/loadSeedRateCalc or do your own calculations at: http://www.gov.mb.ca/agriculture/crops/cropproduction/faa03s00.html (3, 8, 9, 10 & 24)

*Be aware of precipitation levels when adding nitrogen fertilizer, as moisture stress during grain filling results in higher protein levels and reduced plumpness. (3)

*Recent research indicates that uniformity of size can produce optimal malting and brewing results. Growers should look at related best management practices (including seeding date, rate, etc.) to optimize grain size uniformity. (23)

Fully mature

*Planting barley early in the season helps to ensure the crop will accumulate sufficient growing degree days to reach maturity. (1&2)

*Select relatively uniform fields in sandy loam soils (if possible) for malt barley production to obtain even maturity and reduce the occurrence of green patches at harvest. (3, 10 & 11)

*The crop should not be swathed when it is green, but if necessary, swath around green patches to avoid collecting above threshold green or immature kernels for malt barley. (3, 5 & 10)

Moisture content of 13.5% maximum

*When feasible, it is optimal to begin combining when malt barley is 13.5 per cent kernel moisture, since harvesting at higher moisture requires more careful storage management. When harvested at 13.5 per cent moisture, aeration can be used to prevent storage problems. (3)

*Harvesting at higher moisture content can be successfully done if the grower implements proper aeration and drying practices. (See *Germination of 95% or higher* and *Free from heat damage*)

*Take accurate samples of barley when it's entering the bin to produce a representative sample which can be used to decide on aeration requirements. (1)

Germination of 95% or higher (3 day test)

*Where practical, aim to harvest barley around 13.5 per cent moisture. (3)

*Grain harvested at a high moisture (≥16%) content requires careful artificial drying, and ventilation. (See *Free from heat damage*) (3)

*If grain is dried after harvest, always dry the grain slowly using large volumes of air. It is important to leave the fans running after turning the heat off to equalize grain temperatures and prevent moisture movement. Also, aerate whenever the outside temperature drops over 10^{o}C. (4)

*Direct combining is preferred to swathing, as this lessens the risk of weathering and germination losses in difficult weather. (5)

*Maintain proper storage techniques, such as using aerated steel bins, monitoring your bins regularly with temperature and moisture probes, cautiously turn grain only when needed (to eliminate all moisture pockets), and keeping the air temperature above 10^{o}C and relative humidity below 60%. (4&5)

Less than 5% peeled and broken kernels

*Two-row barley varieties may be chosen over six-row barley varieties, which are more prone to shattering. (3, 5)

*Kernels are more susceptible to peeling or breaking during combining in dry conditions, when barley is below 13.5 per cent moisture. (3)

*Decrease the amount of grain handling and therefore the amount of damage to the seed by straight cutting. If swathing is necessary, swaths should not be allowed to dry excessively. (3)

*Harvesting malt barley in the early morning or late evening when kernels are dry but chaff is mildly damp from the dew is preferential. (5)

*Run combines at capacity loads and make adjustments to harvest machinery according to the weather and varying crop/swath conditions to reduce handling and causing peeled and broken kernels. This may include using a lower cylinder seed, (especially for two-row barley, as the day warms up, and the crop dries out) replacing old cylinder rasp bars, (to avoid skinning) and decreasing the concave clearance (but avoid over-threshing) to help separate grain from straw. Adjust the sieves to allow the return of the smallest quantity of tailings, remain fairly open and slightly elevated at the rear, and use lots of wind to prevent barley losses. For more information, see: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop1256

*Periodically sampling the grain to ensure a bit of awn is left on the kernel will let the operator know if the machine is adjusted to the proper settings. (3)

*Before harvest, plan where grain will be stored to limit handling (moving from one bin to another). When loading and unloading grain, augers should be run full. When this is no longer possible, run the augers at a lower speed. (3, 4)

*Prevent peeled and broken kernels by only turning stored grain cautiously if necessary. (4)

Free from heat damage

*Dry stored grain slowly and continuously, using large volumes of air, but never let the grain temperature rise above 43^{o}C and avoid batch drying if possible. (4)

*Watch for the development of "hot spots" and moisture migration during ventilation due to outdoor temperatures affecting the spatial variation in grain temperature. (5)

*Check the temperature of stored grain regularly with temperature monitors or hand-probed samples. (1&2)

*Use aeration in bins to lower the temperature of the grain and prevent moisture migration, after drying is completed. Aerate every time the air temperature drops 10 degrees Celsius. Other grain storage tips can be found at: http://www.grainscanada.gc.ca/technology-technologie/germination/pgemb-pegob-4-eng.htm (4, 12 & 13)

*For more information on proper grain storage, please visit: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex4509 or http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop1204

No signs of pre-harvest sprouting

*Choose straight cutting rather than swathing, if possible, to eliminate the risk of swaths getting rained on. The crop can handle precipitation better if it is still standing, since there is increased risk of sprouting in a swath. (2&3)

*Consider varieties that have less susceptibility to pre-harvest sprouting.

Not weathered or deeply stained

*Straight cutting will eliminate the risk of swaths sitting out too long before being harvested. If this isn't possible, wait until the crop is below 30% moisture and head have lost their green colour before swathing, and then combine as soon as possible after. This will reduce the risk of staining, weathering, peeling and breaking of kernels, and germination opportunities. (1, 3, 5)

*Some producers find it useful to harvest the crop slightly earlier, while it is at a higher moisture content (16%) and then use natural air drying systems to further reduce the moisture content. This limits the amount of time the grain is vulnerable to weathering and staining, but can be risky. (See *Germination of 95% or higher*) (3, 5)

Free from frost damage

*Seeding early ensures barley has the maximum number of growing days needed to achieve maturity, and increases the chance of harvesting when weather is favourable with minimal risks of fall frost. (1, 3)

*Select a variety with fewer days to maturity if barley is grown in an area with a short growing season. (3, 11)

Free of DON from Fusarium head blight and other diseases

*Plan your crop rotation to facilitate disease management. Planting malt barley after canola or peas is recommended, but avoid planting malt barley directly after another cereal crop (especially malt barley) to avoid volunteer cereals, harbouring diseases (including Fusarium head blight), yield loss and reduced kernel plumpness. (1&3)

* Choose registered seed treatment for control of seed-borne Fusarium. (1, 3, 14, 15, 16)

*Use only clean, weed-free machinery and hauling facilities and restrict animal movement from infected fields to clean fields. (17)

*If possible, choose land that has no risk of infecting the crop with Fusarium head blight to grow barley on, since there is zero tolerance for infected malt barley. (3, 16, 18)

*If planting on land with a risk of Fusarium head blight, favour varieties that are least susceptible to the disease. (3, 16, 18)

*During the growing season, growers should check fields for the presence of FHB, especially three weeks after anthesis and at harvest (so it can be stored separately). A timely foliar fungicide application may also be useful if label directions are carefully followed. (3, 16, 18)

*For more info on Fusarium head blight, see
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex5210

http://www.agriculture.gov.sk.ca/Default.aspx?DN=24a3bb18-a096-4bcd-889c-b1e2c94a03e9
http://www.gov.mb.ca/agriculture/crops/diseases/fac68s00.html

Free of insects, admixtures, ergot, treated seeds, smut and odour

*Use clean, pedigreed seed to reduce risk of insects, admixtures, ergot, treated seeds, smut and odour in grain. (3 & 20)

*Harvesting hot grain (above 20^{o}C) will attract grain insects, so cooling grain through aeration may be needed to reduce the risk of insect infestation. (5)

*Avoid planting malt barley in fields that have volunteer barley, other cereals, or large oilseeds (such as sunflowers). (3 & 10)

*Keep records of pests in each field. If you've had problems with ergot in your field, practice crop rotation with a non-susceptible crop, to reduce disease incidence. If you notice ergot in your field, mow the grass headlands and roadsides before the crop reaches heading to try to reduce the spread of the fungus. After harvest, cultivate the field to at least two inches to try to bury the ergot bodies. (3 & 10)

*Use scald resistant varieties and proper crop rotation to help control scald, which overwinters on infected leaves. (3, 10 & 19)

*If smut presence is unknown, variety ratings can be useful. Varieties rated susceptible to smuts should be treated every year, while varieties rated intermediate or resistant should be treated every second and third year, respectively. (3)

*Treated seed can protect against smut, but if it does occur, proper use of chemicals may be needed. (3 &19)

*Increased seeding rates can increase plant competitions to help control weeds and reduce the number of weed seeds harvested. (17 & 10)

*Regular field monitoring can help identify leaf diseases early, so if it becomes economical to spray, a registered fungicide can be applied (according to instructions) at the appropriate timing. (3&20)

*For more information on the control of weeds, insects, and various systemic fungicides, please check out the Alberta Agriculture and Rural Development's Crop Protection publication, available from: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex32 (17&21)

Free of chemical residues

*Do not apply pre-harvest pesticides or desiccants that are not recommended by Canada's Malting and Brewing industry, irrespective of Canadian regulatory agency approval (for pre-harvest use on barley).

*Only apply pesticides if the pest has surpassed the economic threshold and if the plant is at the appropriate stage in development. (3, 17, 22)

*Apply pesticides according to the product label instructions and avoid irrigation soon after. (3, 22)

*The use of persistent herbicides directly before rain, on flood-prone soil, or on sandy soil is not recommended. (22)

*To determine loss potentials of some common agricultural chemicals, see: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9350#Pesticide

General Best Management Practices

*Signing a production/pre-plant contract with a company ensures the producer knows exactly which specifications they must aim to meet and guarantees a market for their product when those specifications are met. This may allow producers to try growing new varieties with less risk. (2)

*Seed malt barley 1.5 to 2 inches in to the soil (depending on the conditions and the soil type) so that it is in contact with moist soil. Seeding deeper than this may result in reduced emergence, weak plants, increased susceptibility to root rot, and decreased yield. Determine your optimal seeding rate at: http://www.gov.mb.ca/agriculture/crops/cropproduction/faa03s00.html (3&9)

*Choose herbicides for malting barley that are more gentle, to reduce injury and secondary tillering and rotate the chemical groups used, to prevent resistant pest populations. (3& 22)

*Reduce the drift of your spray by reducing sprayer speed, lowering the boom, reducing the sprayer pressure, using low drift nozzles, a drift-reducing adjuvant, or an air assist. It is also effective to increase droplet size, avoid spraying at when there are high temperatures, temperature inversions, low humidity, or wind speeds above 16 to 20 km/h. (22)

*Reduce the movement of pesticides via wind and water by growing shelterbelts around crops and allowing buffer zones to grow around waterways. (22)

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