ARS GAPM 19:2018
Good Agricultural Practices Outreach Information for African Standards on Barley

Based on ARS 878:2018, Barley - Specifications
African Organisation for Standardisation

BARLEY

ARS GAPM 19:2018
Good Agricultural Practices Outreach Information for African Standards on Barley
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INTRODUCTION

Barley (Hordeum vulgare L.) is one of the most important cereal crops in the world. It is widely grown as the fourth cereal and among top ten crop plants in the world. Barley was mainly cultivated and used for human food supply in the last century but nowadays it is significantly grown as animal feed, malt products and human food respectively. In addition, barley is very well known as a model crop for plant breeding methodology, genetics, cytogenetics, pathology, virology and biotechnology studies (Hockett and Nilan 1985; Hogberg, 1987).


The African Standard ARS 878:2018, Barley — Specification’s Scope specifies the requirements and methods of test for barley grains of varieties (cultivars) grown from Hordeum vulgare Lin and Hordeum bulbosum intended for human consumption, malting and animal feed. It does not apply to other products derived from barley grains.
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DEFINITION OF PRODUCE
DEFINITION OF PRODUCE

This outreach material specifies the requirements and methods of sampling and test for barley grains of varieties (cultivars) grown from common barley (Hordeum vulgare Lin and Hordeum bulbosum), intended for human consumption, malting and animal feed.
CROP PROTECTION

IMPACT OF PESTS ON BARLEY PRODUCTION

Insect, disease and weed pressures are one of the greatest threats to our food supply as they compete with crops for essential nutrients and rob them of their yield and quality. Farmers rely on crop protection products to prevent these pests from damaging their crops and limiting their harvest. However, as the impacts of climate change grow, these pest pressures will become more extreme – making effective use of crop protection products more important than ever before.

PEST TRENDS:

Currently, 30-40% of barley yields are lost annually to pests. Insects, weeds and disease thrive in warm climates. As temperatures rise due to climate change, these pests will also increase in number and resiliency.
30-40% of barley yields are lost annually to pests
MAIN PESTS AFFECTING BARLEY

Barley Thrips

Cereal leaf beetle (parasitic wasps)
Grasshoppers

Wheat Stem Sawfly
Wireworm
MAIN CONTROL METHODS

All insects have natural enemies which, in addition to weather and food supply, limit their populations. This process, unaided and often unrecognized by man, is termed natural control. It is important to recognize the impact of natural control factors and, where possible, encourage their action. Biological control does not present the human health and environmental concerns associated with chemical pesticide use. Nor is there much chance pests will develop resistance to natural enemies, as commonly occurs with insecticides.

GENERAL POINTS ON COMBATING PLANT PESTS AND DISEASES:

Successful production requires an integrated approach to managing pests and diseases. An important part of this approach involves a number of preventative strategies that minimise the likelihood of occurrence and when infection occurs, its severity. When these measures are implemented adequately, pest and disease problems will not reach economic thresholds.

A range of preventative measures are important to minimize susceptibility to pest and disease pressures. Some key preventative measures are as follows:

- **Location/regional occurrence** - Understanding the prevalence, timing and severity of specific pests or diseases for a given location is very important and can have a significant impact on production costs and reliability of production. One has to consider location, its microclimate and soils.

- **Surrounding land use** - Neglected farms or poorly managed surrounding properties can be a constant source for new outbreaks of pests or diseases, and infestation of properly managed fields.

- **Variety** - Selection of plant material with resistance characteristics shall be used wherever possible. Selecting varieties that are well suited to the local growing conditions will ensure healthy growth and resilience to problems.

- **Healthy crop** - Emphasis on maintaining healthy crop that is naturally able to cope with minor pest or disease problems is important. The foundation for healthy crop is healthy seeds and a healthy soil. Ensure certified disease-free seeds are used. If the seeds are pink, red, green or blue, they have been treated with fungicides and cannot be used for organic production. Healthy soil is achieved by creating a biologically active soil with adequate organic matter and nutrient cycling (mulch) to balance the chemical, biological and physical condition of the soil.

- **Biodiversity** - Farm floor management that involves a mix of plant species and moving at the right time to encourage beneficial insects such as predators, parasitoids and pollinators (which like flowers). Windbreaks and shelterbelts can also be designed to encourage biodiversity.

- **Hygiene** - Vigilant and thorough farm hygiene is very important. Removal of infected fruit and other plant tissues can reduce the severity of subsequent problems.

- **Rapid decomposition** - Infected plant material – as a source of future inoculum – can be reduced by rapid decomposition assisted with mulch from the farm floor.
SURROUNDING LAND USE Neglected farms or poorly managed surrounding properties can be a constant source for new outbreaks of pests or diseases.

VARIETY Selection of plant material with resistance characteristics shall be used wherever possible.
PLANTING

Barley can be grown on a wide range of soil types; ranging from heavy clays to light or sandy loam soils. It grows well on fertile, deep loam soils with a pH of 6 to 7.5. Soils with a pH lower than 6 may induce aluminium toxicity, leading to poor growth. Barley is more sensitive to very wet conditions but more tolerant to alkaline soil than the other small grains.

CLIMATIC REQUIREMENTS

TEMPERATURE

It requires a shorter growing period and needs an average temperature of 15 to 17 °C during flowering. The annual temperatures required range from 5 to 27 °C (low temperatures and high temperatures during ripening). It tolerates high temperatures.

WATER REQUIREMENTS

The seasonal water requirement for barley depends on the variety, targeted yield and crop management. Barley is a drought resistant crop and requires 390 to 430 mm of rainfall for optimum yield. The moisture application under irrigation shall be lowered during flowering, increased during pod filling and ceased during ripening. Irrigation scheduling must be done according to evaporation and as per growth stage, because barley is more sensitive to stress during jointing, booting and heading. To optimise yield, soil moisture levels shall remain above 50% of available moisture in the active root zone from seeding to the soft dough stage.
**WATER REQUIREMENTS** The seasonal water requirement for barley depends on the variety, targeted yield and crop management. Barley is a drought resistant crop during ripening.

**IRRIGATION** Never irrigate barley fields with untrusted water sources.
GENERAL REQUIREMENTS

Barley grains shall meet the following general requirements:

a) shall be the dried mature grains of Hordeum vulgare Linn;
b) be sweet, hard, clean, wholesome, uniform in size, shape, colour and in sound merchantable condition;
c) shall be free from a substance which renders it unfit for human or animal consumption or processing into or utilisation thereof as food or feed;
d) shall be free of pests, live animals, animal carcasses, animal droppings, fungus infestation, added colouring matter, moulds, weevils, obnoxious substances, discoloration and all other impurities except to the extent indicated in this standard and must meet any other phytosanitary requirements specified by the importing country authority;
e) shall be free from filth (impurities of plant and animal origin including insects, rodent hair and excreta) in amounts that represent a hazard to human health;
f) shall be free from toxic or noxious seeds that are commonly recognized as harmful to health;
g) shall be free from abnormal flavours, musty, sour or other undesirable odour, obnoxious smell and discoloration;
h) shall be free from micro-organisms and substances originating from microorganisms, fungi or other poisonous or deleterious substances in amounts that may constitute a hazard to human health;
i) shall be free from glass, metal, coal or dung;
j) shall contain no chemical residues which exceed the prescribed maximum residue limit: Provided that:
   (i) if the prescribed maximum residue limit of an importing country is lower than is permissible, the prescribed maximum residue limit of the importing country shall be complied with; and
   (ii) the Food Safety Authority may grant permission for barley with a higher maximum residue limit, to be exported to countries where this higher residue limit is permissible: Provided that the export documents are accordingly endorsed with the name of the importing country;
k) shall contain not more than 10 microgram per kilogram aflatoxin of which not more than 5 microgram per kilogram may be aflatoxin B1: Provided that:
   (i) if the prescribed maximum aflatoxin limit of an importing country is lower than is permissible, the prescribed maximum aflatoxin limit of the importing country shall be complied with.
(ii) the Food Safety Authority may grant permission for barley with a higher maximum aflatoxin content to be exported to countries where this higher aflatoxin limit is permissible: Provided that the export documents are accordingly endorsed with the name of the importing country; and

(iii) an inspector shall verify compliance to the levels of aflatoxin by sampling and submitting samples for analysis of only certain consignments according to a risk-based plan.

(l) shall comply with the requirements for declared plant injurious organisms of phytosanitary importance as determined by the plant health protection agency.
SPECIFIC REQUIREMENTS

GRADING
Barley grains shall be graded into four grades on the basis of the tolerable limits established in See Table on Page 17 which shall be additional to the general requirements set out in the standard.

UNGRADED BARLEY GRAINS
Shall be barley grains which do not fall within the requirements of Grades 1, 2, 3 and 4 of this standard but are not rejected barley grains.

REJECT GRADE BARLEY
1. Does not meet the requirements for the Grades 1, 2, 3, or 4.
2. Has a musty, sour, or commercially objectionable foreign odour except smut or garlic odour; or
3. Is heating or otherwise of distinctly low quality.

Ref: ARS 87B:2018, Barley - Specification
(2) See Clause 4.2 General purpose barley grades
<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>SPECIFICATION</th>
<th>METHOD OF TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varietal restriction</td>
<td>Approved varieties only</td>
<td></td>
</tr>
<tr>
<td>Moisture, max (%)</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td>Standard of quality</td>
<td>Minimum test weight kg/hl (g/0.5 L)</td>
<td>79(395)</td>
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<tr>
<td>Protein, min % m/m Nt1@5.7 % moisture basis</td>
<td>Hard/strong white</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>Soft white</td>
<td>10.0</td>
</tr>
<tr>
<td>Foreign matter, Max (% m/m)</td>
<td>TOTAL</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>Unmillable material above the screen, (% by wt)</td>
<td>0.60</td>
</tr>
<tr>
<td>Screenings, Max (% by wt)</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Falling Number, Min (sec)</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>Edible grains other than wheat (whole or identifyably broken), (% by wt)</td>
<td>0.50</td>
<td>1.50</td>
</tr>
<tr>
<td>Wheat of other classes or varieties (% by wt)</td>
<td>Contrasting classes</td>
<td>1.0</td>
</tr>
<tr>
<td>Defective grains, max (% by count, 300 grain sample, unless otherwise stated)</td>
<td>TOTAL</td>
<td>3.0</td>
</tr>
<tr>
<td>Other contaminants, Max</td>
<td>Total Aflatoxin (AFB1+AFB2+AFG1 +AFG2), ppb</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Aflatoxin B1 only, ppb</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Fumonisin – Total ppm(FB1 + FB2 + FB3)</td>
<td>2</td>
</tr>
</tbody>
</table>

NOTE Grade 4 will not be considered suitable for export.
GENERAL REQUIREMENTS

GRADE 1 - Foreign matter 0.40% - Edible grains other than barley (whole or identifiably broken) 0.50%

GRADE 2 - Foreign matter 0.70% - Edible grains other than barley (whole or identifiably broken) 1.50%
GENERAL REQUIREMENTS

GRADE 3 - Foreign matter 1.30% - Edible grains other than barley (whole or identifiably broken 2.0 %

GRADE 4 - Defective grains Maximum 15 %

Grade 4 will not be considered suitable for export.
GENERAL REQUIREMENTS

UNGRADABLE - Edible grains other than barley (whole or identifiably broken exceeding 3%)

UNGRADABLE - Moisture Content Exceeding 14%
TEMPERATURE
Moisture content of 14% maximum shall be maintained.

TRANSPORTING BARLEY TO WAREHOUSE
Barley shall be packed in a suitable container (suitable packages which shall be clean, sound, free from insect, fungal infestation and the packing material shall be of food grade quality.) to protect them from normal hazards of transportation and handling.
For traceability, Marking and labelling, each container shall be legibly labeled with the following information;

- product name as “Barley Grains”;
- variety and grade;
- name, address and physical location of the manufacturer/packer/importer;
- lot/batch/code number;
- net weight, in g/kg;
- the declaration “Food for Human Consumption”;
- storage instruction as “Store in a cool dry place away from any contaminants”;
- crop year; packing date; expiry date or best before ____________ month ______ year;
- a declaration of the product lifespan;
- instructions on disposal of used package;
- country of origin;
- a declaration on whether the barley was genetically modified or not.

Transporting barley to Warehouse Barley shall be packed in a suitable sacks 50kg maximum where human loading and offloading is involved

Ref: ARS 878:2018, Barley - Specification
(3) See Clause 7 Packaging, 8 Marking or labelling
# RECORD KEEPING

Packaging and storage practice

<table>
<thead>
<tr>
<th>PLOT NUMBER</th>
<th>WEIGHT (KG)</th>
<th>Type of Containers</th>
<th>Cleaning container and storage practice</th>
<th>Location of storage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

Source of produce

<table>
<thead>
<tr>
<th>PLOT NUMBER</th>
<th>GRADE OF BARLEY</th>
<th>WEIGHT (KG)</th>
<th>HARVESTING DATE</th>
<th>FARM OWNER</th>
<th>ADDRESS</th>
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</thead>
<tbody>
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</table>

Worker Profile

<table>
<thead>
<tr>
<th>PLOT NUMBER</th>
<th>WORKERS NAME</th>
<th>AGE</th>
<th>AREAS OF WORK</th>
<th>HEALTH REPORT</th>
<th>FARM OWNER</th>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Name……………………………… Recorder……………………Date ………………….. 

*Keep records at least for five years*
FOOD SAFETY CONCERNS
FOOD SAFETY

Food hygiene is regularly cited as a cause of food poisoning. Those who produce and distribute papays must respect rules of hygiene, but individuals shall also be concerned about the food they eat.

Food poisoning is not caused solely by insufficient hygiene but also by various types of contaminants which, at certain concentrations, can be toxic for the consumer. Despite the recognized health benefits of regular fruit and vegetable consumption, recent studies on consumer exposure to pesticide residues point to an identifiable risk of poisoning for some groups such as children. (Claeys., 2010).

Risks for the average consumer, however, remain low, but they can be reduced further when simple and efficient hygiene rules are applied and all operators implement food safety management systems based on an analysis of the hazards linked to their professional practices and the type of product they handle.

In order to meet food quality and safety requirements, agricultural businesses must identify all aspects of their activities that are decisive factors for the safety of their products. They must be able to control all hazards at all stages of product life cycle (development, production, storage, transport, marketing) in order to meet specifications (regulatory and market) and assure consumers that their food is safe.

The farmers and the producers must be able to identify all hazards (physical, biological or chemical) that can potentially contaminate their products at different stages of production. They must also be able to assess the level of each risk (probability) according to their working conditions, procedures and practices. On the basis of these analyses, the appropriate control measures, adapted to the type and level of risk, can be adopted. The company must then make sure that these measures are effectively implemented, complied with and regularly reviewed.

Ref: ARS 878:2018, Barley - Specification
(4) See Clause 6 Hygiene
REDUCING RISKS FROM ANIMALS AND MANURE

Animal manure is a significant source of human pathogens. Dangerous pathogens such as E. coli 157:H7, Listeria, and Cryptosporidium are found in cattle, sheep, and deer feces. These pathogenic bacteria can be transferred from barley to barley by human hands or contaminated processing equipment. Droppings from poultry, wild birds, and even pets are a potential source of Salmonella bacteria. When raw manure is not handled and applied correctly or if wild or domestic animals have access to growing areas, barley could be contaminated.

WILD AND DOMESTIC ANIMALS

It is not possible to exclude all animal life from barley growing areas. But it is important that you consider the risks and set up procedures to limit potential contamination.

- Take measures to limit wild/domestic animal access to growing areas.
- Do not locate growing areas adjacent to dairy, livestock, or fowl production facilities unless adequate barriers exist.
- Fence in livestock to exclude them from barley growing areas.
- If using working animals, confine them to lanes outside growing areas close to harvest.
- Have procedures in place to remove and dispose of droppings.
- Make sure workers in animal holding areas check their shoes for contamination before entering barley growing areas.
- Monitor for signs of animal entry such as the presence of feces, damage to the crop, or evidence of animal trails in or barley growing areas.
Pets are a potential source of Salmonella bacteria

Take measures to limit wild/domestic animal access to barley growing areas
FOOD SAFETY CONCERNS

Take measures to limit wild/domestic animal access to barley growing areas

Do not locate barley growing areas adjacent to dairy, livestock, or fowl production facilities
Droppings from poultry, birds, and even pets are a potential source of Salmonella bacteria.
SHOE DISINFECTION MAT Visitors shall disinfect their shoes before entering the production area.

DISINFECTANT BASIN Farm workers in animal holding areas must check their boots for contamination before entering barley growing areas.
FOOD SAFETY CONCERNS

BOOT WASH AND DISINFECT MACHINE Farm workers must wash their boots to avoid contamination before entering barley growing areas.

Farm workers in animal holding areas must not enter barley growing areas with muddy boots.
ANIMAL MANURE AS A SOIL SUPPLEMENT

The best fertilizer are the foot prints in the field. Plant nutrition shall constantly be monitored and needed fertilizer is applied on time. The best fertilizer is the organic compost mixed with the soil during land preparation.

Raw and composted animal manure is a valuable soil conditioner and source of nutrients. However, the shorter the time between raw manure application and harvest, the greater the risk of pathogens being present in the soil at the time of harvest.

- Do not apply raw manure on barley field during or immediately prior the harvesting.
- Never apply raw or farm-composted human feces to barley in harvesting areas.
- Maximize the time between application of manure to production areas and harvest.
- Incorporate manure into the soil as soon as possible. Soil microorganisms can reduce pathogens.
- Consider treatment of manure by composting in order to reduce potential pathogens. To reduce pathogen loads, maintain compost at high temperatures with good aeration, moisture, and mixing.
- Properly store compost to minimize recontamination from fresh manure and bird droppings by tapping, using buffer zones.
The best fertilizer is the organic compost mixed with the soil during land preparation.
Do not apply raw manure on barley during or immediately prior to harvesting.

**REDUCING FOOD SAFETY RISKS DURING HARVEST**

During harvest look for ways to reduce contaminating barley as much as possible. Harvest tools, bins, harvesters, and the environment are all potential sources of contamination.

**HARVEST**

Before and during harvest take time to look for conditions that might affect barley’s safety. Be aware that harvesting involves a lot of hand contact and take measures to prevent contamination of produce by workers.

- Make sure harvesters have washed their hands before starting to harvest barley.
- Conduct an inspection of the barley growing area before harvest to determine if animals or animal droppings are present.
- Harvesters must reject barley that shows decay, is damaged, or has visible signs of bird droppings.
- No barley that comes in contact with animal or bird feces shall be harvested.
- Farm workers shall watch for signs of animal waste in nearby areas.
During harvest look for ways to reduce contaminating barley as much as possible.

Conduct an inspection of the barley growing area before harvest.
Harvesters must wash their hands with clean running water before starting to harvest.

Harvesters must reject barley grains which shows signs of decay.
FOOD SAFETY CONCERNS

barley grains shall be free from any living insects

Post-Harvest, inculcate the stems into the soil to improve organic carbon content.
Post-Harvest, inculcate the stems into the soil to improve organic carbon content.

Never use sacks for chemicals to store barley during harvesting.
Use clean sacks for harvesting barley
REDUCING FOOD SAFETY RISKS IN THE WAREHOUSE

Basic sanitation recommendations for keeping packing areas clean and appropriately sanitary.

WAREHOUSE

- An enclosed packing area is preferred.
- Keep packing area clean, orderly, and well lit.
- Have a regular cleaning schedule for all areas, including equipment, walls, floors, and overhead structures.
- Inspect interior walls and floors for signs of water entry or holes. Fill cracks with grout or other appropriate filler materials.
- Water should drain away.
- Look for overhead places where birds can perch. Prevent perching with methods such as covering rafters, installing bird spikes, or installing steep-sided pyramids on beams.
- Areas outside of the packing buildings shall be cleared of tall grass, weeds, and idle equipment that can provide hiding places for rodents.
- Allow sufficient space between equipment and interior walls to make inspecting for pests easier.
- Walk the perimeter of your packing building. Check for damage to the roof and cracks or holes in exterior walls that could allow pests to enter.
- Trees provide cool shade, but they are perching sites for birds. Consider ways to reduce the risk from these birds.
- Keep pests out.
Enclosed packing area. Keep packing area clean, orderly, and well lit. Have a regular cleaning schedule for all areas, including equipment, walls, floors, and overhead structures.
Keep pests out.

Look for overhead places where birds can perch and prevent perching.
TRANSPORTATION
TRANSPORTATION

The last stage in the warehouse process is loading barley sacks into trucks.

• Make sure you continue to consider food safety risks and take measures to prevent contamination and microbial growth.
• Before loading trucks, inspect them for cleanliness.
• There shall be no signs of the previous load left in the truck.
• Never use trucks that were previously used to transport animals or other contaminated materials.
• Avoid damaging the product during loading. Not only does this lower its value, it also creates opportunities for pathogenic and spoilage microorganisms to grow.
• Properly label your boxes and keep good shipping records for traceability purposes.
2. Evans, K.A. 2012. Do we need to be worried about the potential threat of invasive species to crops as the climate changes? Proceedings Crop Protection in Northern Britain. 55-60.
9. ARC-Small Grain Institute and the National Chamber of Milling (South Africa)
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