

OHIO STATE UNIVERSITY EXTENSION

Management of Ohio Winter Malting Barley

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THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

Management of Ohio Malting Barley

Winter malting barley is a new crop to Ohio. Malting barley requires careful management to maximize grain yield and to maintain high quality grain for malting purposes. Here, we offer practical management recommendations. Malting barley management trials are currently being conducted to further fine-tune management guidelines. We will continue to update this guide as we develop new research findings.

In 2009, Dr. Eric Stockinger (Department of Horticulture and Crop Science) initiated a winter malting barley breeding program by testing different varieties obtained from outside sources for their suitability in Ohio. As winter-hardiness is the most critical parameter for successful barley cultivation in the Midwest, emphasis on winter-hardiness and developing winter-hardy barley varieties is a key breeding program goal.

Ohio farmers need to carefully consider growing winter malting barley as it may not be suitable for all operations. Malt quality barley must meet several criteria to avoid being rejected by the malt facility- this risk may be too high for certain farmers since today there are no markets in Ohio for barley that does not meet the requirements for malt. Malting barley is not sold through traditional grain elevators like corn, soybean, and wheat, so contracts or agreements should be in place before planting. Special considerations for post-harvest handling include drying capability, grain cleaning, and delivering in totes (versus hopper trucks). Each farmer must understand the unique challenges of growing malt quality barley before contracting and purchasing seed.

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Cultural Practices

FIELD SELECTION

Proper field selection is necessary for maximizing grain yield and quality. When selecting fields for winter malting barley production, consider the following:

- **Drainage-** Select a well-drained field with a low chance of ponding.
- **Crop rotation-** Do not plant malting barley after corn, wheat, or other small grain crop. Be mindful of herbicides used on previous crops and follow label instructions.
- **Soil fertility-** Select a field with adequate fertility (see soil fertility section for more details).
- **Tillage-** Barley may be produced with or without tillage. No-till can help prevent erosion, reduce spring heaving, and lower production costs. However, tillage may be useful to control weeds and reduce the risk of diseases.

SEED SOURCES

Each year, the Ohio Seed Improvement Association publishes a directory listing of Ohio seed dealers that supply Certified Seed. The 2017 directory can be found here: <https://ohseed1.org/publications/>.

PLANTING DATE

Do not plant barley prior to the county Hessian fly-safe date (Figure 1). The fly-safe date coincides with reduced numbers of adult aphids, which transmit Barley Yellow Dwarf Virus to seedlings in the fall. The best time for seeding is the 10-date period starting the day after the fly-safe date. If freezing weather is delayed until late November or early December, planting three to four weeks after the fly-free date has been successful.



Figure 1. Hessian fly-safe dates for planting barley or wheat in Ohio counties.

Cultural Practices

SEEDING RATE

We recommend planting barley based on seeds/acre. Planting by pounds/acre or bushels/acre is inaccurate due to variability in seed size from one year to another and from one variety to another. Low seeding rates result in inadequate stands and winter injury, while excessively high rates increase lodging and the risk for powdery mildew. Calibrate the drill each year for each variety and seed lot planted. Use Table 1 to calibrate grain drills. **Keep in mind, barley seed is often larger (fewer seeds per pound) than winter wheat seed.**

The optimum seeding rate for barley is 1.2 to 1.6 million seeds/acre (18 to 24 seeds per foot of row in 7.5-inch row width) when planting during the two weeks following the fly-safe date (Figure 1). During the third and fourth week after the fly-safe date, plant 1.7 to 2.0 million seeds/acre (24 to 30 seeds/foot of row).

Table 1. Pounds of seed needed to plant from 1.2 to 2.0 million seeds/acre with seed of varying size.

	Millions of Seeds/Acre				
Seeds/lb	1.2	1.4	1.6	1.8	2.0
10,000	120	140	160	180	200
11,000	109	127	145	164	182
12,000	100	116	133	150	167
13,000	92	108	123	138	154
14,000	85	100	114	129	143
15,000	80	93	107	120	133
16,000	75	88	100	113	125
17,000	71	82	94	106	118
18,000	66	77	89	100	111

ROW WIDTH

Planting barley in 7.5-inch row width is ideal. However, wide-row barley production may also be feasible. Winter wheat grown in 15-inch row width yields 1-11% lower than wheat grown in 7.5-inch rows. We recommend planting 25-29 seeds/foot of row (0.85 to 1.0 million seeds/acre) if growing barley in 15-inch row width. When planting barley in wide-rows consider the following:

- Plant barley as soon as possible after the Hessian fly-safe date.
- Spring herbicide application is very important to maximize yield in wide-rows.
- Changing row spacing will change the microclimate within the barley canopy, and this could affect disease development. Scout fields for foliar diseases to determine whether disease risk is high enough to warrant a fungicide application.

Soil Fertility

SOIL SAMPLING

Recent soil test results should be used to guide lime and fertilizer applications. See the Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat, and Alfalfa (Extension Bulletin E-2567) available at: <https://stepupsoy.osu.edu/soybean-production/soybean-fertility/tri-state-soil-fertility-guidelines>

pH

Soil pH should be between 6.3 and 6.8. When proper soil pH is maintained, micronutrients should be available at adequate levels. The lime test index or buffer pH on the soil test report should be used for lime recommendations. These recommendations are for mineral soils with adequate drainage containing 1 to 5 percent organic matter.

NITROGEN (N)

20 to 30 lb N/acre of fall-applied N is recommended for early fall and spring growth.

In the spring, great care should be taken to avoid over-fertilizing. High N application may result in grain protein levels too high for quality malting. Excess N may also lead to lodging and increase the risk for powdery mildew. Spring N application rate typically should be between 75-90 lb N/acre.

Ideally, plants should be under non-limiting N conditions until flowering, and complete grain fill under N limiting conditions. In some instances it may be desirable to increase grain protein content, but caution is warranted. During grain-fill N is mobilized to the grain from other plant parts. Once heads are completely out of the boot (Feekes 10.5), externally-applied N is directly mobilized to the grain. Split N applications can be done if desired. Initial spring N application should be applied between green-up and Feekes growth stage 6.0.

Nitrogen source is not a concern unless conditions are conducive for nitrogen loss. In general, urea-ammonium nitrate solutions have the greatest potential for loss, then urea, and ammonium sulfate the least.

Soil Fertility

PHOSPHORUS (P)

Phosphorus is important for early tiller development and should be applied prior to planting when the soil test level is below 50 ppm (100 lb/acre) Bray P. At soil test levels of 50 ppm (100 lb/acre) or greater, additional P fertilizer is not recommended. Table 2 shows P recommendations for barley.

Table 2. Phosphorus (expressed as lb P₂O₅/acre) recommended for barley. Soil test values reported as Bray P.

Soil test value		Annual recommendation
lb/acre	ppm	(lb P ₂ O ₅ /acre)
30	15	115
40	20	90
50-80	25-40	65
90	45	35
100	50	0

POTASSIUM (K)

Potassium recommendations vary by soil cation exchange capacity (CEC). Soils with larger CEC values are more likely to inhibit K availability than soils having lower CEC values. See Table 3 for K guidelines.

Table 3. Potassium (expressed as lb K₂O/acre) recommended for barley by soil cation exchange capacity (CEC).

Soil test value		CEC (meq/100 g soil)		
lb/acre	ppm	10	20	30
50	25	165	255	300
150	75	90	155	240
250	125	50	55	115
350	175	0	0	0

SULFUR

Barley grown in sandy soils and/or soils low in organic matter (<2%) is most likely to respond to S fertilizer. If applied in the fall, elemental S is recommended to minimize loss. In the spring, suitable S fertilizers include ammonium sulfate, ammonium thiosulfate, and gypsum.

Weed Management

Effective weed control is important to maintain barley yield and quality, and to ensure control in any following crop of double crop soybean. A healthy barley crop completes well with weeds, especially when production techniques result in an initial uniform stand and when loss of stand due to winter injury is minimal. Effective weed control and prevention of weed seed production in prior crops will reduce the severity of weed problems in barley. Barley should be planted into a weed-free seedbed through the use of tillage or burndown herbicides. Some barley fields can benefit greatly from herbicide application in late fall or spring, and failure to scout and take the appropriate measures can result in loss of yield or quality, and harvesting problems. The weeds that appear above the barley canopy late in the season, such as giant ragweed and Canada thistle, can often be easily controlled or suppressed with a spring herbicide treatment.

WINTER ANNUAL WEEDS

Winter annual weeds, such as common chickweed, marestail, purple deadnettle, shepherd's purse, and field pennycress, become established in late summer and fall along with the barley, and can interfere with early development of barley in spring. Gramoxone, glyphosate, and Sharpen are labeled for burndown application any time prior to barley emergence. Low rates of dicamba can be applied at least 15 days before planting, but 2,4-D is not labeled for preplant burndown in small grains. Sharpen can control emerged marestail and provide residual control following planting, but should be mixed with glyphosate or Gramoxone for control of most other emerged weeds. Sharpen rates of 1.5 to 2 oz/acre also provide residual control of broadleaf weeds for several weeks following application. No-till fields not treated with burndown herbicides at time of planting can be treated with postemergence herbicides later in the fall to control winter annual weeds, marestail, and dandelion as necessary. Options include Huskie, and mixtures of dicamba (2 to 4 oz of 4L) with products that contain tribenuron or tribenuron + thifensulfuron. Late fall-applied herbicides can be more effective for control of these weeds and safer to the crop than spring-applied herbicides. Where spring applications are necessary to control winter annual weeds, Huskie or mixtures of 2,4-D or MCPA with products that contain tribenuron + thifensulfuron are among the effective treatments.

WILD GARLIC

Wild garlic bulbets can contaminate harvested grain making it unsuitable for malting. Herbicides containing thifensulfuron are effective when applied in the spring after garlic has several inches of new growth.

Weed Management

CANADA THISTLE

Canada thistle can greatly suppress barley growth due to its tendency to occur in dense patches. Many spring-applied barley herbicides have at least some activity on thistle, and can suppress it adequately through harvest if not applied too early in spring.

DANDELION

Dandelion can interfere with barley establishment in the fall and barley growth in the spring. Emerged dandelion should be controlled prior to barley planting with tillage or glyphosate, or at least by late fall with postemergence herbicides. The combination of dicamba (4 oz of 4L) and tribenuron (Express, etc) applied in early November has been effective in OSU research.

SUMMER ANNUAL BROADLEAF WEEDS

Summer annual broadleaf weeds, such as common and giant ragweed, can begin to emerge in late March. A healthy barley crop can adequately suppress these weeds, but a spring application is occasionally warranted.

Herbicides must be registered for use on barley, and label guidelines followed to minimize the risk of crop injury, including application at the appropriate stages of barley growth. When barley has not yet reach the jointing stage, any approved herbicide can be safely applied. As barley growth stage advances past jointing and approaches the boot stage, herbicide choices become much more limited. Most herbicides can be applied in UAN when barley is top-dressed. This may increase crop injury somewhat, and some labels recommend adjusting surfactant rates to minimize injury. Information on herbicides and specific weed problems can be found in the current edition of the *Weed Control Guide for Ohio, Indiana, and Illinois*, Extension Bulletin 789, available at all County Extension offices and online at CFAES publications: <http://estore.osu-extension.org/> and also as a pdf for download at <http://u.osu.edu/osuweeds>.

Disease Management

GENERAL MANAGEMENT GUIDELINES

Barley is affected by several leaf, spike, and root diseases that have the potential to negatively impact grain yield and quality by reducing stand and grain-fill, and contaminating grain with mycotoxins. Disease management is critical for the production of high malting quality barley, and this should begin in the fall in order to prevent early disease establishment and reduce risk.

- Avoid planting highly susceptible varieties.
- Avoid planting barley after corn or wheat, as both crops are hosts for *Fusarium graminearum*, the fungus that causes head scab and contaminates grain with vomitoxin.
- Avoid planting barley without tillage after barley or other related grass species. Till and/or rotate with soybean. Several of the leaf and root diseases of barley are caused by pathogens that overwinter in stubble left in the field after harvest.
- Avoid planting barley too early. Rusts, viruses, and leaf blotching disease may become established in early-planted barley, getting a head-start in the spring.
- Plant treated seeds. This will reduce stand loss due to seed and seedling diseases; help to control smuts; and prevent early establishment of leaf diseases.
- Control weeds in and around barley fields, as some weed species are hosts for viruses that affect barley and the insect vectors that transmit them.
- Avoid excessive N fertilization and high planting density.

SPECKLED/SEPTORIA LEAF BLOTCH

Speckled/Septoria leaf blotch (*Septoria passerinii*) is **not** the same Septoria that affects winter wheat. It is a different species. Speckled/Septoria leaf blotch:

- Characterized by light brown, rectangular lesions with small black dots (pycnidia) primarily on leaves and leaf sheaths.
- Thrives under cool conditions (50-68°F) with extended wet periods.
- Survives in crop stubble and remains viable in straw for at least two seasons, buried or on the surface.
- Disseminated by splash within the canopy, and by wind-blown rain at longer distances.

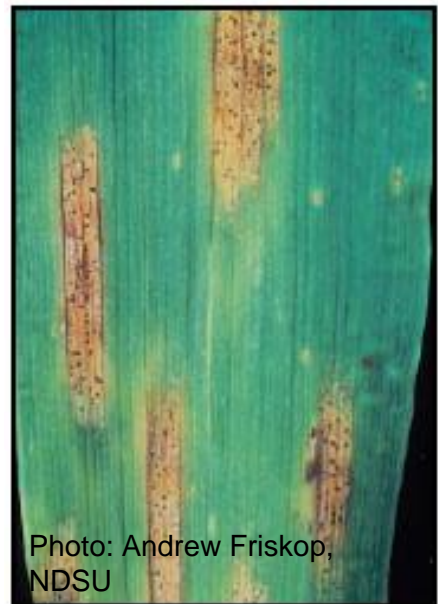


Photo: Andrew Friskop, NDSU

Figure 2. Speckled/Septoria leaf blotch (*Septoria passerinii*)

Disease Management

STAGONOSPORA BLOTCH

Stagonospora leaf blotch (*Parastagonospora nodorum*) is **not** the same Stagonospora found on wheat **but** barley may also be infected by some isolates of the wheat biotype. Stagonospora leaf and glume blotch:

- Characterized by brown to grayish irregular spots on leaf blades and sheaths. Spots may also develop on glumes and awns of the spike.
- Thrives under warm conditions (59-77°F) with extended wet periods.
- Disseminated by splashing rain.
- Survives in crop straw for up to three years if not buried or disturbed.
- Also survives in seeds for several years.



Photo: Andrew Friskop, NDSU

Figure 3. Stagonospora leaf blotch (*Parastagonospora nodorum*)

NET BLOTCH

Net blotch (*Pyrenophora teres*) is **not** the same as tan spot on wheat; it is a different species of the same genus.

- Characterized by brown spots that develop in a net-like pattern on leaf blades and sheaths and glumes.
- Thrives under warm conditions (59-77°F) with extended wet periods.
- Seedborne and survives in crop stubble.
- Excessive N fertilizer increases disease severity.
- Disseminated by wind.



Photo: Andrew Friskop, NDSU

Figure 4. Net blotch (*Pyrenophora teres*)

Disease Management

SPOT BLOTCH

Spot blotch (*Bipolaris sorokiniana*):

- Characterized by chocolate-brown round to elongated spots on leaf blades and sheaths.
- May also affect spikes and kernels under favorable weather conditions.
- Thrives under warm conditions (60-82°F) with extended wet periods.
- Seedborne and survives in crop stubble, soil, and on grasses.
- Disseminated by wind.



Figure 5. Spot blotch
(*Bipolaris sorokiniana*)

SCALD

Scald (*Rhynchosporium secalis*):

- Characterized by oval spots with a water-soaked appearance, later becoming bleached or straw-colored, on the leaf and spike.
- Thrives under cool temperatures (59-68°F) with extended wet periods.
- Seedborne and survives in crop stubble.
- Disseminated predominately by splashing rain.



Figure 6. Scald
(*Rhynchosporium secalis*)

Disease Management

RUSTS- STRIPE, LEAF, AND STEM

Rusts (*Puccinia spp.*):

- Differentiated based on types, color, arrangement, and location of pustules on the plant.
- Stripe rust develops best under cool conditions (50-59 F), whereas leaf and stem rusts thrive under warmer conditions (68 F). They are all favored by wet, rainy conditions.
- They all need a live host to survive, so will not overwinter in crop residue.
- Disseminated over long distance by wind and spread rapidly within and between fields.



Photos: Andrew Friskop, NDSU

Figure 7. Stripe (left) and leaf (right) rust (*Puccinia spp.*)

MANAGING FOLIAR DISEASES

A variety of strategies should be used to manage foliar disease beginning with selecting resistant varieties and cultural practices that take into account disease survival and dissemination. Then, consider the application of foliar fungicides.

Net blotch, spot blotch, scale, Septoria, and Stagonospora are residue-borne. This means residue management is a critical component to managing these diseases including crop rotation and/or tillage. Leaf rust and stripe rust are not residue born and travel long distances by wind.

When timed correctly (between flag leaf emergence and heading, depending on the disease), foliar diseases have been adequately controlled by fungicides including

- tebuconazole
- propiconazole
- propiconazole + trifloxystrobin
- azoxystrobin
- prothioconazole + tebuconazole
- prothioconazole
- metconazole
- fluoxastrobin
- fluoxastrobin + flutriafol

Read labels carefully and follow guidelines when making a fungicide application.

Disease Management

FUSARIUM HEAD BLIGHT (SCAB)

Fusarium head blight (FHB) or scab (*Fusarium graminearum*) is probably the biggest disease concern in winter malting barley. FHB reduces grain yield and malting quality by contaminating the grain with mycotoxins (vomitoxin). **Vomitoxin levels in malting barley must be ≤ 1 ppm.**

At best, winter malting barley varieties are moderately resistant to FHB. Two-row barley tends to be more resistant than six-row barley. Fungicide efficacy is good (not great) with application timing being extremely important.



Figure 8. Fusarium head blight (*Fusarium graminearum*) on malting barley.

MANAGEMENT OF FUSARIUM HEAD BLIGHT

Conditions: FHB prefers temperatures of 65-80°F and wet conditions.

Crop rotation: Planting barley after soybean will reduce the risk of FHB. Do not plant barley after barley, wheat, corn, or any other grasses.

Timing of fungicide application: Fungicides have the greatest efficacy against FHB when applied at or within the first 5 days after heading. This is different from what is recommended for wheat as anthesis generally occurs *before* anthers are extruded. Once anthers are extruded, fungicide efficacy greatly decreases.

Integrated management: The highest levels of scab and vomitoxin reduction are achieved when the most resistant varieties are combined with the best fungicides (metconazole or prothioconazole + tebuconazole).

Fungicide selection: Strobiliurin fungicides have been found to increase vomitoxin contamination of grain. Check fungicide labels and avoid applying those containing a strobiliurin such as pyraclostrobin, trifloxystrobin, or azoxystrobin.

Harvest and Storage

HARVEST DATE

Clean all equipment and bins prior to harvest to avoid contamination. Barley is harvested between mid-June and early July approximately two weeks before wheat. It is important to realize that the quality of the grain is of utmost importance to meet malting standards- damaged grain or grain that has poor germinability is not suitable for malting because **malting is the germination process.** Kernels should not be broken or damaged and the husk should remain tightly-adhered to the grain.

Barley is physiologically mature at approximately 35% grain moisture content. However, harvesting at moisture levels of 20% or greater makes the kernel highly prone to damage during combining, which can make it unusable for malting.

Weather-related factors will usually dictate when the actual harvest can take place. Mature grain that remains in the field for an extended period of time, especially if grain is re-wetted, is prone to shattering, pre-harvest sprouting, lodging, and increased vomitoxin levels. These factors will reduce grain yield and grain may be unsuitable for malting.

GRAIN DRYING

Following harvest, the grain should be dried to 13.5% moisture content at 70°F and 60% relative humidity. Using natural air or low temperature drying gives the highest quality grain. If heat is used, it should be less than 90°F. Desiccants should never be used for drying malting barley. Barley dried with the use of desiccants will be rejected by the malting and brewing industry

Harvest and Storage

GRAIN STORAGE

Grain to be held in long-term storage should be clean, intact, and dry. Grain that is contaminated with foreign material or with broken kernels is susceptible to attack by fungi, insects, and mites. Ideal grain moisture content is 12%. Higher grain moisture content is acceptable if low temperatures are used to dry.

Grain bins and all equipment that comes in contact with newly-harvested material should be clean and free of residual material. Grain may be stored in bins that have been treated with Chlorpyrifos-methyl and Cyfluthrin (Storcide), but the grain itself cannot be directly treated.

Grain should be stored in a well ventilated area, under a water-tight roof, and be proofed against birds and rodents. Shatter proof light covers and shatter-resistant bulbs should be used.

Grain also needs to be protected against growth of insect, mite, and fungal populations. The most effective means, is through temperature and moisture level control.

Grain weevils and Indian meal moths are the greatest insect threats to stored grain. Grain weevils will bore into barley and render it unable to germinate; therefore, it cannot be malted. These insects reproduce much more rapidly at warmer temperatures than at cooler temperatures. Temperatures below 60°F slow their growth. Nonetheless grain weevils are still capable of completing their life cycle down to about 54°F. Two months at $\leq 30^{\circ}\text{F}$ will kill grain weevils and meal moths, as will four days at -4°F . Any insecticides applied to malting barley before or during storage must be food-grade. Fungi are still capable of growth at or near freezing temperatures and are best controlled by keeping the grain moisture content at $\leq 14.5\%$.

Temperature and humidity should be regularly monitored at locations in the bin that are distal from the source of where control is applied. Insects and are best monitored through the use of traps.

Grain Quality

QUALITY MEASUREMENTS

After drying the barley, a composite sample should be created by taking an equal volume of material from multiple locations in the bin, and combining these. The composite sample should be sent to a barley quality lab for testing. Several quality labs exist to test barley- University of Vermont, Michigan State University Extension, Hartwick College, and others. Samples should be taken from each variety grown and from each field. Malting facilities require a test report for each crop to determine if it meets malting quality standards. Additionally, the grain should be clean and free of insects, admixtures, ergot, or foreign material.

A typical barley test profile will include:

- **Test weight-** Should be 48 lb/bu or higher
- **Moisture-** Should be less than 13.5%
- **Percent plump (vs. thin kernels)-** Plump kernels on a 6/64 screen should be greater than 90%; Thin kernels through a 5/64 screen should be less than 3%
- **Germination tests-** Germination should be 95% or higher
- **Pre-harvest sprout-** Should have no evidence of
- **Deoxynivalenol (DON)/Vomitoxin-** ≤ 1 ppm
- **Protein-** 9.5 to 12.5% on a dry basis



For more information on crop production:
<http://stepupsoy.osu.edu>
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