Evaluation of Barley Varieties for Agronomic Characters and Panicle Diseases in Northeast Iowa

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Barley *(Hordeum vulgare)*, a member of the grass family Poaceae, is a major cereal grain grown in temperate climates globally. Two-row Barley has two rows of seeds on each spike, whereas six-row Barley has six rows of seeds on each spike. Two-row barley varieties tend to be spring grown, whereas six-row barley varieties include spring and winter grown types. Barley has been used as animal fodder, as a fermentable material for beer and certain distilled beverages, and as a component of various health foods. It is used in soups, stews, and barley bread in various cultures. Barley grains are commonly made into malt in a traditional and ancient preparation method. The United States produced 165.3 million bushels of barley in 2020, down 7.2 million bushels from the prior year. Idaho produced the most barley in the United States in 2020, followed by Montana and North Dakota. Idaho and Montana accounted for nearly 61% of the U.S. production of barley in 2020. However, there are not many fields of barley in Illinois, Missouri, and Iowa.

There was an outbreak of barley ergot (*Claviceps purpurea*) in northeastern Iowa and southwestern Wisconsin in 1996. There have been reported ergotism symptoms in dairy cows fed ergot-infested grain. The loose smut of barley is caused by Ustilago nuda, and occurs everywhere barley is grown. It is a seed-borne disease. Objectives of the study were to: collect and evaluate barley germplasm for adaptability in Midwestern states, evaluate potential germplasm in multiple states for biotic and abiotic stresses, study the potential germplasms for post-harvest qualities, including malting and brewing characteristics, and evaluate the economic and environmental impacts of barley.

Materials and Methods

Seven barley varieties were tested in 2020. Seed of the seven varieties was provided by Kent Newman, President, Iowa Small Grains, LLC (Table 1). The soils at the site consist of 84 Clyde silty clay loam. The site was in soybean the previous year and has been in a soybean-corn crop rotation. The site was soil tested just prior to plot establishment, and the soil test showed 41 ppm P_20_5 (very high), 322 ppm K_20 (very high), 6.1 pH, 6.7 BpH, and 4.0% organic matter. On April 19, the site was field cultivated according to the plot plan to compare tillage vs. no-tillage systems. Barley was planted April 20 with a John Deere 1108BD seeder set at 2.5 bushels per acre in 7.5-in. row spacing and followed with a cultipacker pass. Each plot of a variety occupied 375 sq. ft., and there were four replications. On May 9, a low temperature of 26°F caused some injury to emerged barley plants. The trial did not require herbicides, but was hand weeded.

Data recorded included stand counts (May 7 and June 5), plant vigor on a 1-9 scale (June 19), plant height (July 19), as well as loose smut (June 19), and ergot (July 13) incidences in each plot. Also, sclerotia count was recorded from 200g out of 10 lbs. grain collected at harvest from only two replications (Table 1). The trial was harvested July 24 with a JD4420 combine with Avery Weigh-Tronix load cells on a weighing bin with grain moisture documented by a Shivvers 5010 moisture meter.

Table 1. Evaluation of Barley varieties for agronomic characters and panicle diseases, Nashua, IA.[1]

Trial number	Barley variety	Variety type (rows)[2]	Tillage	Stand count 1	Stand count 2	Vigor on 1-9 scale	Plant Ht (inch)	Loose smut inc %	Ergot inc %	Number of ergot sclerotia per 200g grain	Grain yield bu./ac.
1	ND Genesis	2	CT	169.75ba	255.00bac	8.5ba	23.75bc	3.92ba	1.64a	4.5	51.27a
2	ND Genesis	2	NT	194.00a	264.50ba	8.25bac	23.50bcd	5.39a	1.03bac	2.5	46.36ebdcf
3	Traditional	6	CT	166.25ba	255.50bac	8.5ba	23.13bcde	0.0c	1.33ba	2.0	48.51ebdac
4	Traditional	6	NT	178.00ba	254.50bac	8.5ba	23.25bcde	1.93bc	0.79bac	3.5	45.31ebdcf
5	Robust	6	CT	187.00a	263.25bac	8.5ba	24.81ba	0.0c	1.01bac	6.0	51.50a
6	Robust	6	NT	170.00ba	215.75c	8.8a	25.63a	0.0c	0.70bac	3.0	49.28bdac
7	Conlon	2	CT	189.50a	241.00bac	8.0bac	19.25i	0.0c	1.32ba	5.5	44.53egf
8	Conlon	2	NT	180.25ba	280.50a	7.7bc	21.69cdefgh	0.0c	0.89bac	1.5	43.66gf
9	Lacy	6	CT	187.50a	260.25bac	8.0bac	22.13cdefgh	0.23c	1.35ba	5.0	49.46bdac
10	Lacy	6	NT	197.8a	257.50bac	8.5ba	22.56cdef	0.94c	0.71bac	3.0	50.45bc
11	Rasmusson	6	CT	178.00ba	250.25bac	8.0bac	20.94gfih	0.0c	0.49bc	1.5	50.66bc
12	Rasmusson	6	NT	212.00a	240.00bac	8.5ba	21.50efgh	0.0c	0.42bc	1.5	49.93bcd
13	Oddessey	2	CT	158.50ba	223.75bc	7.5c	20.69gih	0.0c	0.1c	3.5	40.27g
14	Oddessey	2	NT	130.25b	219.75bc	6.3d	20.50ih	0.0c	0.23c	2.5	29.84h
15	MIXED	Both	CT	182.00ba	267.25ba	8.5ba	22.31cdefg	0.87c	1.39ba	7.0	49.24bdac
16	MIXED	Both	NT	167.25ba	249.50bac	8.0bac	22.38cdefg	1.79bc	1.62a	5.0	45.10edf

[1]Means within column followed by the same letter(s) are not significantly different from each other at 5% level of significance ($P < 0.05$). 22-rows= Two-row barley has two rows of seeds on each spike, and 6-rows= six-row barley has six rows of seeds on each spike, CT= Conventional tillage, NT= No till.

Results

Data recorded on stand counts, plant vigor, plant height, and incidences of loose smut and ergot and sclerotia count are provided in Table 1. Loose smut (*Ustilago nuda*) symptoms were observed when barley was at the milk stage of the early emergence of heads, with dark green or black masses observed in place of kernels (Figure 1A). Spores rupture from the protective membrane on heads, and the fungus can survive in infected seeds. Management options for loose smut are to use only certified smut-free seed, treat seeds with hot water prior to planting to kill fungi, treat seeds with systemic fungicide (fungi inside seed) fungicide, and grow resistant varieties. Sclerotial stage symptoms of Ergot (*Claviceps purprea*) were observed at the hard dough stage; unfortunately, recording honeydew stage symptoms was missed. However, sclerotial stage symptoms were very prominent (Figure 1B). Management options for ergot are to till crop residue deep into the soil to prevent spores from being released into the air, control weeds, especially grasses, in the field, which act as a secondary host for ergot. Plots were harvested with JD4420 w per weigh bin (concave set at <1, cylinder speed-1100 RPM). Grain yields per plot converted bushels per acre (Table 1).

Figure 1. Loose smut (A) and ergot (B) of barley, observed during 2020 growing season.