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Preliminary Report 24

2024 Wheat, Barley, and Oats Variety Performance in Minnesota Preliminary Report

Preface

Jochum Wiersma

What a difference a year can make; a three-year dry spell broke and the 2024 growing season was a wild, wet ride that was one to simultaneously remember and forget. The 2024 state average grain yield for HRSW was a record-breaking 68.5 bu/acre. Simultaneously, Fusarium Head Blight caused widespread problems in wheat, barley, and even oats across the state. It was, however, a single rain event followed by three hot and humid days in mid-August that really left a sour taste in northwest Minnesota as the resulting sprout damage relegated an otherwise stellar crop to mere feed.

After three dry years and an unusually mild and drier-than-normal winter, rains returned to Minnesota in April. By the end of June many parts of the State had an unsurpassed surplus resulting in widespread flooding in the southern fifth of the state and drowned out crops and/or prevented planting of acreage across the rest. The mild winter meant that some field work was completed in March. By April 1st 6% of the oat acreage had been seeded and the first fields had already emerged. Rain delays, ultimately resulted in three distinct planting windows for small grains; the first being the first half of April, the second being the last week of April, and the third being the final two weeks of May. Half of the wheat, barley and oat acreage was seeded before May 1st with the other half getting seeded in the last two weeks of May.

By mid-June I started to get seriously worried about the risk of Fusarium head blight (FHB) causing problems as higher temperatures and dew points combined with the already wet conditions. By the 4th of July it was clear that FHB would be a serious issue for many across the state and I started to have flashbacks to the 1993 and 1994 growing seasons. The risk maps ultimately indicated moderate to high risk for FHB for nearly a month straight. Fortunately, the nearly ubiquitous use of fungicides to suppress FHB at anthesis and improved genetics avoided a repeat of 1994.

Harvest of winter wheat started in late July in southern Minnesota and the first spring wheat came off in northwest Minnesota by the end of the first week of August. Initial harvest reports from the southern and western parts of the state and southern Red River Valley pointed to problems as elevators and mills started to reject grain with DON levels exceeding 4 ppm. However, initial reports from the heart of the Red River Valley indicated better than expected grain yield with good quality and lower than expected DON levels.

A statewide soaker on August 13th followed by three very hot and humid days changed everything in northwest Minnesota. The weather caused post-harvest dormancy to dissipate unusually quickly, resulting in sprouting of the standing crop. As a result the Hagberg Falling Numbers plummeted and a record breaking spring wheat crop's value was decimated.

In the September Small Grains Summary USDA-NASS reported Minnesota's average spring wheat yield to be 68.5 bu/acre or 6.5 bushels year-over-year increase. It is not only a new record state average but it beat the June 1st and August 1st yield estimates by 5.5 and 1.5 bushels per acre, respectively. The state's average barley yield decreased 4 bushels year-over-year to 70.0 bu/acre, while the state average for oat increased 11 bu/acre year-over-year to 88 bu/acre. Acreage of spring wheat bounced back up to just over 1.5 million acres while oat acreage increased nearly a third to 210,000 acres. Barley acreage dropped to just 40,000 acres of which only an estimated 25,000 was harvested.

The US Wheat Associate Regional HRSW Quality Report has not been released as I write this. Based on comments I have received I have to conclude that DON is present in most of the spring wheat. Most of this grain has concentrations low enough that the trade can manage it. There is, however, a substantial amount of grain with DON levels between 5 to 10 ppm and in some cases DON concentrations have exceeded 30 ppm. An equally big issue is the sprout damage. Most of the wheat seeded in April and harvested after the middle of August has HFN below 150, regardless of variety.

Introduction

Successful small grain production begins with selection of the best varieties for a particular farm or field. For that reason, varieties are compared in trial plots on the Minnesota Agricultural Experiment Station (MAES) sites at St. Paul, Becker, Waseca, Lamberton, Morris, Grand Rapids, and Crookston. In addition to these seven MAES locations, trials are also planted at the Magnusson Research Farm near Roseau and with nine farmer cooperators. The trials are handled so factors affecting yield and performance are as close to uniform for all entries at each location as possible.

The MAES 2024 Wheat, Barley, and Oat Variety Performance in Minnesota Preliminary Report 24 is presented under authority granted by the Hatch Act of 1887 to the Minnesota Agricultural Experiment Station to conduct performance trials on farm crops and interpret data for the public.

Variety Classifications

Varieties are listed in the tables alphabetically. Seed of tested varieties can be eligible for certification, and use of certified seed is encouraged. However, certification does not imply a recommendation. The intellectual property rights of the breeders or owners of the variety are listed as either PVP, PVP(pending), PVP(94), patent, or none. PVP protection means that the a variety is protected under the Plant Variety Protection Act for a period of 20 years, while PVP(94) means that a variety is protected for 20 years with the additional stipulation that seed of the variety can only be sold as registered and certified classes of seed. PVP(pending) indicates that the PVP application has been made and that you should consider the variety to have the same intellectual property rights as those provided by PVP(94). The designation of 'Patent' means that the variety is protected by a utility patent and that farm-saved seed may be prohibited by the patent holder. The designation 'None' means that the breeder or owner never requested any intellectual property protection or that legal protection has expired. Registered and certified seed is available from seed dealers or from growers listed in the 'Minnesota Crop Improvement Association 2024 Directory', available through the Minnesota Crop Improvement Association office in St. Paul or online at http://www.mncia.org

Interpretation of the Data

The presented data are the preliminary variety trial information for single (2024) and multiple year (2022-2024) comparisons in Minnesota. The yields are reported as a percentage of the location mean, with the overall mean (bu/acre) listed below. Two-year and especially one-year data are less reliable and should be interpreted with caution. In contrast, averages across multiple environments, whether they are different years and/or locations, provide a more reliable estimate of mean performance and are more predictive of what you may expect from the variety the next growing season. The least significant difference or LSD is a statistical method to determine whether the observed yield difference between any two varieties is due to true, genetic differences between the varieties or due to experimental error. If the difference in yield between two varieties equals or exceeds the LSD value, the higher yielding one was indeed superior in yield. If the difference is less, the yield difference may have been due to chance rather than genetic differences, and we are unable

to differentiate the two varieties. The 5% or 10% unit indicates that, with either 95% or 90% confidence, the observed difference is indeed a true difference in performance. Lowering this confidence level will allow more varieties to appear different from each other, but also increases the chances that false conclusions are drawn.

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SPRING WHEAT

James Anderson, Jochum Wiersma, Susan Reynolds, Nathan Stuart, Danielle Fiebelkorn-Wrucke, Rafael Moreira, Ruth Dill-Macky, and Yue Jin.

WB9590 was the most widely grown variety in Minnesota for a second year in the row with 23% acres across the state and 27% of the acreage in northwest Minnesota. MN-Rothsay jumped to second place with 22% of the acreage statewide and 21% of the acreage in northwest Minnesota. MN-Torgy and MN- Rothsay combined for over half the acreage in west central Minnesota and the southern half of the Red River Valley. MN-Torgy's share of the acreage in northwest Minnesota, however dropped out of the top five with 8% of the acreage. SY Valda's drop to 4th place overall in acreage with 10% but remains the second most popular variety in the southern part of the state. WB9479 reached a fifth place with 7% of the acreage, most of which is grown in the northwest Minnesota.

A dozen HRSW varieties were tested for the first time in the 2024 trials. This included AP Elevate, CAG Ceres, CP 3055, Dyna-Gro 8582, Dyna-Gro Rocker, LCS Hammer AX, ND Thresher, PFS Rolls, TCG-Badlands, TCG-Zelda, TW Olympic, TW Starlite, and TW Trailfire. ND Stampede was entered in the trials under number in 2023 and results are reported for the first time this year. WestBred did not enter any HRSW varieties in the University of Minnesota variety trial system. WB9479, WB9590, however, were included in the testing in 2024 as they each occupied more than 5% of the acreage in 2023.

The results of the variety performance evaluations for spring wheat are summarized in Tables 1 through 6. The varietal characteristics are presented in Tables 1 through 3. Tables 4, 5, and 6 present the relative grain yield of tested varieties in 1, 2, and 3-year comparisons. The trials in Waseca and Fergus Falls were abandoned as a result of flooding and hail, respectively. The average yield across the five southern testing locations was 66 bu/acre in 2024. This average compares to a southern average of 78 bu/acre in 2023 and a three-year average of 68 bu/acre. The seven northern locations averaged again 95 bu/acre in 2024 with the three-year average jumping 6 bushels to 92 bu/acre. A closer look at the yield and test weight data of individual varieties shows some stark differences in the year-over-year performance and between the southern and northern locations. Very late maturing varieties, like CP 3099A, did not fare well this past growing season compared to the last two growing seasons. Likewise, stripe rust, stem rust, and FHB caused substantive yield and test weight losses in a number of locations.

Varieties with a lodging score of 2 or 3 are considered exceptionally good and will only lodge in extreme cases, while varieties with a rating of 4 or 5 have adequate straw strength most years. Increasing seeding rates generally increases the risk of lodging for all but the strongest and shortest semi-dwarf HRSW varieties. Conversely, lower seeding rates will lower the risk of lodging, but commonly results in lower grain yield potential. Linkert continue to be rated superior for straw strength with a rating of 2 while MN-Rothsay is the only other public release with a lodging rating of 3. Private releases that have a rating of 3 for lodging include AP Smith, TCG-Teddy, TCG-Wildcat, WB9479, and WB 9590.

The University of Minnesota spring wheat breeding program has had a controlled environment screening method in place for pre-harvest sprouting for more than two decades. A rating of 1 or 2 was considered sufficient to avoid pre-harvest sprouting (PHS) in most conditions, even if the crop endured wet weather between reaching physiological maturity and harvest. This years' experiences, at first glance, suggest that this may not be good enough and that even varieties with the best PHS rating were not able to resist sprouting and associated low falling numbers under the challenging conditions experienced this year. One way to reduce the risk of sprouting in the field is to start harvest at a higher moisture content than the ideal 13.5% grain moisture. Spring wheat can be harvested at 18% grain moisture and stored safely for about a month when the grain's temperature in the bin is brought down to 70^{o}F with aeration. That time nearly doubles and triples when the temperature of the grain is brought down to 60^{o}F and 50^{o}F, respectively.

Varieties with disease ratings of 4 or lower are considered the best defense against a particular disease. Varieties that are rated 7 or higher are likely to suffer significant economic losses under even moderate disease pressure. The differences in yield between the trials managed with and without fungicide that are reported in Table 7 are illustrative for this reason and informative in next year's variety selection. The foliar disease rating represents the total complex of leaf diseases other than the rusts, and includes the Septoria complex and tan spot. Although varieties may differ from their response to each of those diseases, the rating does not differentiate among them. Therefore, the rating should be used as a general

indication and only for varietal selection in areas where these diseases historically have been a problem or if the previous crop is wheat or barley. Control of leaf diseases with fungicides may be warranted, even for those varieties with an above average rating.

Bacterial leaf streak (BLS) cannot be controlled with fungicides. Selection of more resistant varieties is the only recommended practice at this time if you have a history of problems with this disease. CAG Reckless, CP3915, Driver, LCS-Buster, LCS Trigger, MN-Torgy, and SY611 CL2 combine the best resistance against BLS with acceptable levels of resistance to the fungal diseases, including FHB. Ascend-SD, LCS Boom, ND Heron have the best available resistance against FHB, but are susceptible to BLS or other fungal diseases.

BARLEY

Kevin Smith, Ruth Dill-Macky, Jochum Wiersma, Brian Steffenson,
Karen Beaubien, and Ed Schiefelbein

The results of the variety performance evaluations for spring barley are summarized in Tables 8 through 12. The varietal characteristics and disease reactions are presented in Tables 8 and 9. Tables 10 through 12 present the relative grain yield of the tested varieties in single and multiple year comparisons. The varieties were tested in 13 locations, however, Fergus Falls was lost to hail. The average yield across the 12 testing locations was 102 bu/acre in 2024 (Table 12). This is down from a state average of 105 bu/acre in 2023. The highest yields this year were recorded in Hallock with 152 bu/acre (Table 10) while the lowest grain yields were recorded in Lamberton with 58 bu/acre (Table 11).

ND Treasure was the highest yielding six-row variety and AAC Connect was the highest yielding two-row varieties based on the 2024 state average (Table 12). AAC Synergy and Tradition had lower stem breakage (Table 8). On average, two-rows head about four days later than six-rows. ND Treasure is a new six-row entry from NDSU that is intended for the pet food market.

Table 9 describes the reaction of this year's entries to five major diseases in the region. Disease reaction is based on data from at least two experiments and scored from 0–9; where 0 is most resistant and 9 is most susceptible. Net blotch can be an important disease and most varieties tested have good resistance. The six rows, with the exception of Quest, are generally more susceptible to Fusarium head blight expressed as lower concentrations of vomitoxin or DON. All the varieties tested are generally susceptible (ratings from 3-8) to the QCCJ race of stem rust which has not been identified as a threat in the Midwest yet. All listed varieties carry stem rust resistance to the predominant Puccinia graminis f. sp. tritici race (MCCF). Most varieties possess pre-heading resistance to stem rust; thus, they will not likely incur much damage unless the disease epidemic is severe. Bacterial Leaf Streak (BLS) cannot be controlled by fungicides and there are some modest differences (ratings from 3-5) in resistance among the tested two row varieties.

OATS

Kevin Smith, Ruth Dill-Macky, Nicholas Metz, Karen Beaubien, Jochum Wiersma

Entries in the state oat variety trial were evaluated in nine locations, however Fergus Falls was lost to hail and Waseca to excess rain. In addition, entries were evaluated for disease resistance to crown rust, barley yellow dwarf virus (BYDV), and smut in dedicated, inoculated nurseries. The results of the variety evaluations are summarized in Tables 13 to 17. The origin and agronomic characteristics of the tested oat varieties are listed in Table 13. Maturity, height, and test weight data are presented as statewide averages from 2022-2024 except where noted. Straw strength data is also a statewide average from the same period, but only from locations where lodging was present. Maturity, height, and lodging are important considerations for variety selection based on the intended location and expected end use of the crop.

Crown rust continues to be a major limiting factor to oat production in Minnesota that must be managed to achieve optimal yield. Buckthorn (*Rhamnus cathartica* L.), the alternate host of crown rust is widespread in Minnesota, allowing for a persistent and particularly aggressive pathogen population. Rust in all yield trials was managed through treatment with a propiconazole-based fungicide when the flag leaf was fully extended (Feekes 9) to evaluate the yield potential with

little to no disease. Crown rust and other disease resistance ratings are listed in Table 14. All disease scores were converted to a 1- 9 scale. A score of 1 is very resistant and a score of 9 is very susceptible. The most economical way of controlling crown rust is through resistant varieties; however, application of fungicide to a variety with rating of 4 or greater is prudent if crown rust is present in the lower canopy at Feekes 9. Mink, Esker2020 and SD Momentum appear to be the best varieties for crown rust resistance.

Other important diseases include BYDV and smut which were evaluated in inoculated nurseries at the University of Illinois and the University of Minnesota, respectively. We observed little difference among the tested varieties for resistance to BYDV (ratings from 3-4). Most varieties tested had good resistance to smut with the exception of ND Heart. A seed treatment and certified seed should be used to manage smut. Choose the varieties with the lowest disease ratings in an organic production system and plant as early as possible to reduce the risk of yield losses caused by these diseases.

For grain production, lodging and grain quality traits should be considered when choosing a variety (Table 13). Oat varieties with high protein and low oil are preferred in the food market. High test weight, as a proxy for milling yield, is very important in both the food and feed markets. Contact your local elevator or buyer and ask whether they prefer particular varieties.

Tables 15 through 17 present the relative grain yield of the tested varieties in single and multiple year comparisons. For 2024, the highest yields were in Stephen and the lowest yields in Becker. Mink followed by Esker2020 and Saddle were the top yielding varieties in statewide averages for 2024. Mink performed well in both the northern and southern regions in 2024. Some varieties perform differently in the north and south. For example, in 2024 MN-Pearl and ND Carson both performed below average in the south and above average in the North. In general, earlier maturing varieties perform better in southern Minnesota because flowering can occur when it is cooler. Similarly, later performing varieties tend to perform better in northern Minnesota.

Table 1. Origin and agronomic characteristics of hard red spring wheat varieties in Minnesota in single-year (2024) and multiple-year comparisons.

Variety	Origin[1]	Year of Release	Legal Status	Desired Stand[2]	Days to Heading[3]	Plant Height[3]	Straw Strength[4]
				(Mln/ac)	(days)	(inches)	(1-9)
AP Elevate	AgriPro/Syngenta	2024	PVP (94) pending	1.3	60.0	31.9	4–5
AP Gunsmoke CL2[5]	AgriPro/Syngenta	2021	PVP (94)	1.3	56.5	33.5	5
AP Murdock	AgriPro/Syngenta	2020	PVP (94)	1.3	57.1	32.6	5
AP Smith	AgriPro/Syngenta	2021	PVP (94)	1.3	60.8	32.2	3
Ascend-SD	SDSU	2021	PVP (94)	1.3	59.9	37.0	5
Brawn-SD	SDSU	2022	PVP (94) pending	1.3	57.9	35.4	5
CAG Ceres	Champions Alliance Group	2024	PVP (94) pending	1.3	56.8	33.4	3–4
CAG Justify	Champions Alliance Group	2021	PVP (94)	1.2	59.9	35.4	5
CAG Reckless	Champions Alliance Group	2021	PVP (94)	1.3	57.6	35.5	5
CAG Recoil	Champions Alliance Group	2022	PVP (94) pending	1.4	64.5	32.2	4
CP3055	Winfield United	2020	PVP (94) pending	1.3	64.7	35.8	4
CP3099A	CROPLAN	2020	PVP (94) pending	1.3	63.7	36.4	4
CP3188	CROPLAN	2021	PVP (94) pending	1.3	58.7	35.5	6
CP3322	CROPLAN	2022	PVP (94) pending	1.3	63.5	34.1	4
CP3360AX[6]	Winfield United	2023	PVP (94) pending	1.3	56.3	33.7	3–4
CP3915	CROPLAN	2019	PVP (94) pending	1.3	58.5	33.1	4
Driver	SDSU	2019	PVP (94)	1.3	60.1	34.9	4
Dyna-Gro 8582	Nutrien Ag Solutions	2024	PVP (94) pending	1.5	55.8	33.1	2–3
Dyna-Gro Ambush	Dyna-Gro	2017	PVP (94) pending	1.5	55.7	33.4	5
Dyna-Gro Ballistic	Dyna-Gro	2018	PVP (94) pending	1.5	58.3	35.1	5
Dyna-Gro Commander	Dyna-Gro	2019	PVP (94) pending	1.5	56.1	34.7	4
Dyna-Gro Rocker	Nutrien Ag Solutions	2023	PVP (94) pending	1.5	61.0	35.1	6
LCS Ascent	Limagrain Cereal Seeds	2022	PVP (94)	1.3	55.5	33.3	5
LCS Boom	Limagrain Cereal Seeds	2023	PVP (94)	1.3	54.5	32.3	4
LCS Buster	Limagrain Cereal Seeds	2020	PVP (94)	1.3	63.2	36.4	5
LCS Cannon	Limagrain Cereal Seeds	2018	PVP (94)	1.3	54.5	32.1	4
LCS Dual	Limagrain Cereal Seeds	2021	PVP (94)	1.3	57.3	33.7	4
LCS Hammer AX[6]	Limagrain Cereal Seeds	2022	PVP (94)	1.3	57.2	31.8	2–3
LCS Trigger	Limagrain Cereal Seeds	2016	PVP (94)	1.3	63.8	36.1	5
Linkert	MN	2013	PVP (94)	1.3	58.1	31.7	2
MN-Rothsay	MN	2022	PVP (94)	1.3	61.1	31.0	3
MN-Torgy	MN	2020	PVP (94)	1.3	57.2	33.4	4
MS Charger	Meridian Seeds	2023	PVP (94)	1.2	56.8	33.1	5
MS Cobra	Meridian Seeds	2022	PVP (94)	1.4	57.7	32.7	4
ND Heron	NDSU	2021	PVP (94)	1.3	55.5	34.2	6
ND Stampede	NDSU	2024	PVP (94) pending	1.3	56.3	34.9	4
ND Thresher	NDSU	2023	PVP (94) pending	1.3	60.0	32.7	5
PFS Buns	Peterson Farm Seeds	2021	PVP (94) pending	1.3	64.6	33.0	4
PFS Rolls	Peterson Farms Seed	2025	PVP (94) pending	1.3	59.9	35.4	4–5
Shelly	MN	2016	PVP (94)	1.3	61.0	32.0	5
SY 611 CL2[5]	AgriPro/Syngenta	2019	PVP (94)	1.3	56.8	31.5	4
SY Valda	AgriPro/Syngenta	2015	PVP (94)	1.3	58.4	33.3	5
TCG-Badlands	21st Century Genetics	2023	Patent pending	1.3	57.4	34.0	3–4
TCG-Teddy	21st Century Genetics	2022	Patented	1.3	59.3	30.2	3
TCG-Wildcat	21st Century Genetics	2020	PVP (94), Patent pending	1.3	59.4	34.1	3
TCG-Zelda	21st Century Genetics	2023	Patent pending	1.3	57.3	31.3	3–4
TW Olympic	Thunder Seed	2022	PVP (94)	1.3	58.4	34.3	5
TW Starlite	Thunder Seed	2022	PVP (94)	1.3	61.4	41.5	5–6
TW Trailfire	Thunder Seed	2024	PVP (94)	1.3	55.0	34.2	6
WB9479	WestBred	2017	Patented, PVP (94)	1.3	56.8	30.5	3
WB9590	WestBred	2017	Patented, PVP (94)	1.3	56.2	30.2	3
Mean					**58.9**	**33.5**	

[1] Abbreviations: MN = Minnesota Agricultural Experiment Station; NDSU = North Dakota State University Research Foundation; SDSU = South Dakota Agricultural Experiment Station

[2] Our standard seeding rate is designed to achieve a desired stand of 1.3 million plants/acre, assuming a 10% stand loss and adjusting for the germination percentage and seed weight of each variety.

[3] Heading is days after planting. 2024 data from Crookston, Lamberton, Roseau, and St. Paul.

[4] 1-9 scale in which 1 is the strongest straw and 9 is the weakest. Based on 2014-2024 data. The rating of newer entries may change by as much as one rating point as more data are collected.

[5] AP Gunsmoke CL2 and SY 611 CL2 have tolerance to Beyond® herbicide.

[6] CP3360AX and LCS Hammer AX have tolerance to Agressor AX® herbicide.

Table 2. Grain quality of hard red spring wheat varieties in Minnesota in single-year (2024) and multiple-year comparisons.

Variety	Test Weight		Grain Protein[1]		Baking	Pre-harvest
	2024	2 yr	2024	2 yr	Quality[2]	Sprouting[3]
	---(lbs/bu) ---		-------(%) -------		(1-9)	(1-9)
AP Elevate	58.5	-	14.2	-	–	2
AP Gunsmoke CL2	57.8	59.4	14.9	14.8	5	2
AP Murdock	57.9	58.9	13.8	13.9	5	1
AP Smith	58.2	59.7	14.4	14.4	3	3
Ascend-SD	58.8	60.2	14.3	14.2	5	5
Brawn-SD	59.5	61.0	13.3	13.1	–	1
CAG Ceres	58.5	-	13.4	-	–	2
CAG Justify	56.0	57.4	13.3	13.2	7	3
CAG Reckless	58.8	60.3	13.9	14.0	3	4
CAG Recoil	56.8	58.3	14.3	14.1	–	1
CP3055	54.0	-	12.5	-	–	1
CP3099A	51.2	55.2	10.6	11.1	6	1
CP3188	55.2	57.4	12.9	12.7	6	2
CP3322	54.4	57.0	13.2	13.0	–	2
CP3360AX	58.7	-	13.0	-	–	1
CP3915	57.8	59.6	14.1	14.1	4	1
Driver	58.6	60.1	13.9	13.9	6	2
Dyna-Gro 8582	58.6	-	13.9	-	–	2
Dyna-Gro Ambush	59.2	60.6	14.4	14.4	2	3
Dyna-Gro Ballistic	57.3	58.8	13.5	13.4	5	3
Dyna-Gro Commander	58.4	59.9	13.9	14.1	6	1
Dyna-Gro Rocker	55.4	-	14.1	-	–	2
LCS Ascent	58.4	60.0	13.0	13.4	–	3
LCS Boom	59.5	61.1	14.2	14.2	–	3
LCS Buster	56.1	57.7	12.3	12.1	7	5
LCS Cannon	59.2	60.9	14.1	14.1	4	3
LCS Dual	58.4	59.9	13.6	13.6	–	2
LCS Hammer AX	56.1	-	13.6	-	–	1
LCS Trigger	58.6	59.7	12.0	12.1	7	1
Linkert	58.3	60.1	14.8	15.0	1	1
MN-Rothsay	58.1	59.8	13.9	14.0	5	2
MN-Torgy	59.1	60.4	14.2	14.3	4	1
MS Charger	57.6	59.3	12.7	12.8	–	1
MS Cobra	58.1	59.9	14.0	14.1	3	4
ND Heron	59.2	60.8	14.6	14.7	–	2
ND Stampede	57.6	59.2	13.8	13.9	–	6
ND Thresher	56.2	-	14.6	-	–	2
PFS Buns	54.5	56.6	13.1	13.0	–	4
PFS Rolls	56.7	-	13.9	-	–	2
Shelly	58.0	59.7	13.3	13.4	5	1
SY 611 CL2	59.3	60.5	14.1	14.2	6	2
SY Valda	58.4	59.8	13.6	13.7	6	2
TCG-Badlands	57.7		13.6		–	5
TCG-Teddy	56.2	58.5	14.6	14.4	–	2
TCG-Wildcat	58.0	59.8	14.2	14.3	4	1
TCG-Zelda	57.9	-	14.1	-	–	2
TW Olympic	58.8	-	14.1	-	–	3
TW Starlite	58.7	-	14.5	-	–	1
TW Trailfire	57.6	-	14.3	-	–	2
WB9479	57.7	59.6	14.9	15.1	1	1
WB9590	57.5	59.3	14.2	14.5	4	2
Mean	**57.8**	**59.5**	**13.9**	**13.9**		
No. of Trials	**10**	**20**	**11**	**22**		

[1] 12% moisture basis.

[2] 2014-2022 crop years, where applicable.

[3] 1-9 scale in which 1 is best and 9 is worst. Values of 1-2 should be considered as resistant.

Table 3. Disease reactions[1] of hard red spring wheat varieties in Minnesota in multiple-year comparisons.

Variety	Leaf Rust	Stripe Rust[2]	Stem Rust[3]	Bacterial Leaf Streak[4]	Other Leaf Diseases[5]	Fusarium Head Blight
	(1-9)					
AP Elevate	3	1	–	3–4	4	4
AP Gunsmoke CL2	3	4	1	8	7	5
AP Murdock	3	1	1	4	6	7
AP Smith	6	2	2	4	4	6
Ascend-SD	3	2	1	3	6	3
Brawn-SD	1	2	2	3	6	4
CAG Ceres	4	1	–	3	5	7–8
CAG Justify	3	2	2	4	4	4
CAG Reckless	1	1	1	2	4	4
CAG Recoil	2	1	1	2	5	7
CP3055	3	2	–	3–4	4	4–5
CP3099A	6	2	8	5	5	7
CP3188	1	3	6	5	6	5
CP3322	7	3	2	5	4	7
CP3360AX	2	1	–	6	6	5
CP3915	1	2	1	2	4	4
Driver	2	1	1	3	4	4
Dyna-Gro 8582	8	2	–	5	5	3–4
Dyna-Gro Ambush	4	2	1	4	4	4
Dyna-Gro Ballistic	4	2	3	4	5	5
Dyna-Gro Commander	4	1	1	4	6	5
Dyna-Gro Rocker	6	2	–	5	6	5
LCS Ascent	4	1	1	6	6	4
LCS Boom	3	1	1	5–6	6	3
LCS Buster	3	2	2	3	3	3
LCS Cannon	4	1	1	5	7	4
LCS Dual	3	2	2	4	5	5
LCS Hammer AX	7	3	–	6	7	7–8
LCS Trigger	1	3	1	2	3	3
Linkert	3	1	1	4	5	5
MN-Rothsay	4	2	1	4	3	4
MN-Torgy	3	1	1	3	4	3
MS Charger	2	4	2	5	6	5
MS Cobra	2	1	1	5	4	5
ND Heron	5	2	1	6	5	3
ND Stampede	3	7	2	5	6	4
ND Thresher	2	2	–	4	5	4
PFS Buns	4	5	1	2	3	6
PFS Rolls	3	3	–	5	4	3–4
Shelly	5	1	1	5	4	4
SY 611 CL2	4	1	5	3	4	3
SY Valda	4	3	1	4	5	4
TCG-Badlands	3	1	–	5	5	4–5
TCG-Teddy	2	1	1	5	6	5
TCG-Wildcat	3	2	3	5	6	7
TCG-Zelda	3	2	–	3–4	5	5
TW Olympic	4	2	–	3	3	3–4
TW Starlite	6	1	–	4	4	3
TW Trailfire	6	1	–	5	6	4
WB9479	6	3	1	5	5	7
WB9590	7	2	2	6	6	7

[1] 1-9 scale where 1=most resistant, 9=most susceptible.

[2] Based on natural infections in 2024 at Becker.

[3] CP3099A is the only variety that had significant damage due to stem rust in 2024. Ratings of other varieties is based on inoculated trials.

[4] Bacterial leaf streak symptoms are highly variable from one environment to the next. The rating of entries may change as more data is collected.

[5] Combined rating of tan spot and Septoria spp.

Table 4. Relative grain yield of hard red spring wheat varieties in northern Minnesota locations in single-year (2024) and multiple-year comparisons (2022-2024).

Variety	Crookston			Fergus Falls[1]	Hallock			Oklee			Perley			Roseau[2]		Stephen			Strathcona		
	2024	2 yr	3 yr	2 yr	2024	2 yr	3 yr	2024	2 yr	3 yr	2024	2 yr	3 yr	2024	2 yr	2024	2 yr	3 yr	2024	2 yr	3 yr
	(% of mean)																				
AP Elevate	95				101			103			104			105		101			112		
AP Gunsmoke CL2	104	94	94	101	93	98	98	97	95	96	96	96	91	89	93	88	98	96	89	98	98
AP Murdock	105	97	100	92	98	96	94	102	97	98	98	99	105	98	99	104	96	99	106	98	102
AP Smith	97	101	100	97	104	98	96	105	99	104	98	96	98	100	94	103	99	98	102	97	95
Ascend-SD	110	101	100	107	100	101	100	101	102	99	98	101	101	104	106	94	96	102	88	94	102
Brawn-SD	97	96	99	109	102	99	100	96	96	100	108	108	109	104	102	94	96	99	98	99	97
CAG Ceres	93				105			94			88			97		103			108		
CAG Justify	112	104	100	102	104	108	110	103	110	106	107	106	105	112	114	97	106	105	97	109	110
CAG Reckless	96	95	93	100	102	105	103	99	101	99	102	97	97	104	103	94	93	96	97	102	102
CAG Recoil	103	100	102	101	96	95	95	105	99	98	99	97	102	106	95	94	95	95	96	89	90
CP3055	100				95			107			104			104		95			94		
CP3099A	66	92	101	117	111	104	107	65	90	98	101	113	110	106	111	98	111	108	97	107	109
CP3188	87	95	98	98	101	103	100	107	105	103	102	105	101	97	99	102	104	101	108	112	109
CP3322	77	90			92	102		95	99		99	107		102		99	102		65	82	
CP3360AX	114				102			112			103			98		104			101		
CP3915	96	101	99	98	101	100	99	102	96	97	96	91	96	89	92	98	98	99	98	96	102
Driver	102	98	100	105	97	102	102	105	99	101	100	95	99	103	107	95	95	95	93	99	99
Dyna-Gro 8582	110				95			109			104			97		101			99		
Dyna-Gro Ambush	104	102	97	103	95	96	99	97	96	100	103	100	98	94	97	97	101	104	106	105	104
Dyna-Gro Ballistic	111	115	108	110	106	109	106	111	106	103	106	104	98	102	97	99	107	106	96	102	102
Dyna-Gro Commander	108	111	107	92	104	100	99	111	104	103	104	98	101	100	98	106	101	100	99	107	104
Dyna-Gro Rocker	69				104			79			95			92		102			99		
LCS Ascent	112	108	103	101	108	103	103	106	100	101	109	105	100	102	104	109	105	104	102	100	101
LCS Boom	110	94			96	97		104	103		91	94		97		102	96		108	107	
LCS Buster	117	117	114	110	106	110	110	108	109	108	109	112	110	117	107	98	106	105	100	104	102
LCS Cannon	101	99	97	97	93	96	93	105	103	102	89	92	96	97	101	98	98	99	111	107	105
LCS Dual	95	96	98	102	99	94	96	91	95	92	104	105	104	101	97	96	98	98	83	96	96
LCS Hammer AX	76				104			86			81			91		104			91		
LCS Trigger	120	113	112	109	101	105	108	118	119	118	102	106	112	116	114	95	99	102	99	104	106
Linkert	94	89	92	86	90	91	90	87	90	89	93	91	91	82	84	90	90	91	91	92	91
MN-Rothsay	102	107	106	101	101	103	105	107	97	99	109	104	104	111	108	99	105	105	107	102	101
MN-Torgy	107	102	102	103	102	101	102	102	101	96	108	104	103	100	99	94	95	101	107	103	99
MS Charger	106	109	111	107	102	103	104	118	110	109	115	107	105	109	108	102	106	102	101	105	105
MS Cobra	92	94	96	92	100	98	98	98	99	99	99	97	96	105	100	103	103	100	109	108	102
ND Heron	97	90	91	94	94	93	93	93	95	96	99	96	93	98	102	96	97	95	110	110	103
ND Stampede	112	108			107	107		101	103		105	107		106		111	114		123	113	
ND Thresher	93				93			97			100			96		95			86		
PFS Buns	96	107			102	106		108	104		110	111		116		98	98		78	85	
PFS Rolls	100				105			102			98			100		101			93		
Shelly	106	103	102	108	105	107	108	105	100	100	103	101	101	99	105	106	107	106	103	100	101
SY 611 CL2	118	110	105	102	101	102	99	107	104	104	105	103	106	103	103	108	102	102	106	100	98
SY Valda	116	107	100	104	97	102	103	111	110	109	110	107	109	105	102	106	105	105	92	94	94
TCG-Badlands	87				97			95			96			95		104			99		
TCG-Teddy	79	92			91	95		100	98		89	97		92		93	94		96	96	
TCG-Wildcat	92	97	100	92	105	100	100	94	98	98	94	98	98	99	102	114	104	103	110	107	105
TCG-Zelda	100				106			100			107			104		114			110		
TW Olympic	95				107			102			98			107		103			86		
TW Starlite	111				102			93			97			98		99			93		
TW Trailfire	99				98			100			97			96		98			112		
WB9479	96	100	99	88	103	99	98	98	100	98	96	93	94	94	91	102	96	95	106	98	99
WB9590	110	108	105	98	102	103	102	96	98	100	93	95	95	97	97	102	103	100	101	101	101
Mean (bu/acre)	**83.7**	**87.6**	**91.3**	**79.0**	**116.7**	**115.5**	**104.6**	**107.3**	**106.3**	**94.9**	**85.6**	**95.0**	**95.7**	**95.0**	**89.5**	**100.7**	**99.1**	**96.7**	**77.0**	**78.2**	**80.9**
LSD (0.1)	**9.5**	**13.0**	**9.3**	**5.7**	**6.3**	**8.3**	**6.2**	**5.6**	**11.5**	**9.3**	**7.8**	**7.2**	**7.1**	**5.6**	**7.5**	**7.5**	**9.3**	**7.5**	**6.8**	**9.1**	**7.1**

[1] 2024 Fergus Falls was abandoned due to hail. 2 yr data is 2022 & 2023, [2] 2023 Roseau was abandoned due to hail. 2 yr data is 2022 & 2024

Table 5. Relative grain yield of hard red spring wheat varieties in southern Minnesota locations in single-year (2024) and multiple-year comparisons (2022-2024).

Variety	Becker			Benson[1]		LeCenter			Lamberton			Morris[2]	St. Paul			Waseca[3]
	2024	2 yr	3 yr	2024	2 yr	2024	2 yr	3 yr	2024	2 yr	3 yr	2022	2024	2 yr	3 yr	2 yr
	(% of mean)															
AP Elevate	101			106		116			103				95			
AP Gunsmoke CL2	106	107	105	91	92	98	99	99	98	88	96	114	78	92	96	98
AP Murdock	108	94	93	105	98	115	105	104	119	108	105	111	105	97	91	92
AP Smith	106	104	101	101	98	113	104	102	87	94	95	91	103	100	98	101
Ascend-SD	105	105	108	110	104	110	114	111	124	115	114	128	116	111	106	109
Brawn-SD	112	111	111	109	105	115	113	112	105	104	106	117	91	109	110	114
CAG Ceres	113			95		114			116				103			
CAG Justify	109	106	103	109	108	95	102	103	107	96	101	128	107	104	105	109
CAG Reckless	98	98	101	105	103	113	107	103	113	116	113	114	98	109	109	97
CAG Recoil	105	101	91	95	96	102	101	103	99	102	99	102	100	95	92	101
CP3055	102			106		104			102				95			
CP3099A	101	104	99	96	102	70	96	101	70	99	104	92	42	74	79	125
CP3188	99	104	100	105	107	103	111	108	90	85	86	110	99	93	94	99
CP3322	70	90		87	95	64	88		68	91			78	88		
CP3360AX	119			107		117			123				123			
CP3915	109	101	99	109	102	95	93	94	90	99	101	86	99	108	110	90
Driver	102	98	99	90	95	91	98	99	87	81	89	107	104	105	109	100
Dyna-Gro 8582	103			102		112			132				121			
Dyna-Gro Ambush	101	103	103	98	96	110	101	103	117	109	109	106	100	103	103	97
Dyna-Gro Ballistic	122	118	107	111	110	118	109	105	106	103	103	101	101	111	111	110
Dyna-Gro Commander	111	107	102	105	101	126	109	105	119	107	101	104	107	105	105	105
Dyna-Gro Rocker	107			78		63			50				68			
LCS Ascent	109	106	107	112	105	112	103	102	127	106	104	108	94	106	109	99
LCS Boom	112	105		100	96	102	99		123	108			111	113		
LCS Buster	97	102	102	115	109	88	95	100	110	109	107	96	93	103	101	117
LCS Cannon	113	105	109	100	97	105	97	98	119	94	98	112	108	101	111	98
LCS Dual	94	95	101	97	97	100	103	101	99	99	101	104	76	90	92	103
LCS Hammer AX	101			79		92			83				84			
LCS Trigger	108	98	96	119	111	110	105	106	134	126	120	108	119	118	111	118
Linkert	89	91	94	88	91	94	90	90	94	91	93	92	92	92	96	87
MN-Rothsay	92	93	94	103	102	92	98	96	93	92	90	90	105	103	98	102
MN-Torgy	107	104	104	105	102	107	106	104	107	100	101	88	102	105	92	101
MS Charger	103	104	109	113	110	115	109	108	132	112	112	109	102	100	105	106
MS Cobra	102	100	102	96	100	99	98	98	96	95	97	84	100	105	108	98
ND Heron	105	104	104	96	93	98	94	93	112	93	93	92	93	98	104	90
ND Stampede	101	107		109	105	118	113		115	116			122	119		
ND Thresher	97			110		100			100				101			
PFS Buns	86	84		116	113	100	108		95	104			95	88		
PFS Rolls	106			99		99			93				105			
Shelly	93	97	93	100	100	101	101	99	93	94	99	93	100	104	104	105
SY 611 CL2	111	101	105	100	101	110	100	98	105	107	103	96	90	91	94	99
SY Valda	100	97	97	111	107	120	107	108	116	109	106	98	116	104	107	100
TCG-Badlands	109			100		101			87				102			
TCG-Teddy	100	102		86	96	95	98		86	95			93	94		
TCG-Wildcat	96	101	104	94	96	87	93	96	74	101	102	118	111	109	103	98
TCG-Zelda	124			98		109			88				104			
TW Olympic	105			104		108			110				107			
TW Starlite	94			104		88			109				105			
TW Trailfire	104			92		116			128				105			
WB9479	99	92	93	89	88	102	95	95	103	100	99	89	85	90	94	88
WB9590	106	102	102	101	97	116	100	99	110	102	97	94	90	97	101	92
Mean (bu/acre)	**55.8**	**63.2**	**60.0**	**87.7**	**92.8**	**63.8**	**77.0**	**78.8**	**53.7**	**64.3**	**63.2**	**59.0**	**66.9**	**61.3**	**58.7**	**60.1**
LSD (0.1)	**7.3**	**7.5**	**5.3**	**7.0**	**7.2**	**6.3**	**10.1**	**7.1**	**5.9**	**11.6**	**8.4**	**18.4**	**7.0**	**10.7**	**9.1**	**17.0**

[1] 2022 Benson was abandoned due to early season flooding., [2] The Morris location has not been seeded since 2022, [3] 2024 Waseca was discarded due to excessive rainfall. 2 yr data is 2022-2023.

Table 6. Relative grain yield of hard red spring wheat varieties in Minnesota in single-year (2024) and multiple-year comparisons (2022-2024).

Variety	State			North			South		
	2024	2 yr	3 yr	2024	2 yr	3 yr	2024	2 yr	3 yr
	(% of mean)								
AP Elevate	103	-	-	103	-	-	104	-	-
AP Gunsmoke CL2	94	96	97	94	96	96	93	96	98
AP Murdock	104	98	99	101	97	99	110	99	98
AP Smith	102	99	98	102	99	98	102	100	99
Ascend-SD	104	103	105	99	100	102	113	109	110
Brawn-SD	102	103	104	100	100	101	106	109	110
CAG Ceres	101	-	-	98	-	-	107	-	-
CAG Justify	105	106	106	105	107	106	105	104	106
CAG Reckless	101	102	101	99	100	99	105	105	105
CAG Recoil	100	98	97	100	97	97	100	99	97
CP3055	101	-	-	100	-	-	102	-	-
CP3099A	87	102	104	92	104	107	76	100	100
CP3188	100	102	101	101	103	101	100	101	100
CP3322	86	97	-	91	99	-	75	92	-
CP3360AX	109	-	-	105	-	-	117	-	-
CP3915	99	98	98	97	96	98	101	100	99
Driver	98	98	100	99	99	101	95	96	99
Dyna-Gro 8582	106	-	-	102	-	-	113	-	-
Dyna-Gro Ambush	101	100	101	99	99	100	104	101	102
Dyna-Gro Ballistic	107	108	105	105	107	104	111	110	107
Dyna-Gro Commander	107	104	102	105	103	101	113	105	103
Dyna-Gro Rocker	86	-	-	92	-	-	73	-	-
LCS Ascent	108	104	103	107	104	102	110	105	105
LCS Boom	103	99	-	101	98	-	109	101	-
LCS Buster	106	109	107	108	110	109	101	106	105
LCS Cannon	102	98	100	99	99	99	108	98	102
LCS Dual	95	97	98	96	98	98	93	97	99
LCS Hammer AX	90	-	-	91	-	-	87	-	-
LCS Trigger	111	110	110	107	109	110	118	112	110
Linkert	90	90	90	89	90	90	91	90	92
MN-Rothsay	102	102	101	105	103	104	98	98	97
MN-Torgy	104	102	101	103	101	101	105	103	100
MS Charger	109	107	107	108	107	106	113	107	109
MS Cobra	100	99	99	101	100	98	98	99	100
ND Heron	98	96	96	98	96	96	100	95	96
ND Stampede	110	109	-	109	108	-	113	111	-
ND Thresher	97	-	-	94	-	-	102	-	-
PFS Buns	101	104	-	102	104	-	100	104	-
PFS Rolls	100	-	-	100	-	-	100	-	-
Shelly	102	102	102	104	103	103	98	100	99
SY 611 CL2	105	102	101	106	103	102	102	100	100
SY Valda	108	104	104	105	104	103	112	104	104
TCG-Badlands	97	-	-	96	-	-	100	-	-
TCG-Teddy	92	96	-	92	95	-	92	97	-
TCG-Wildcat	98	100	100	101	100	100	93	99	101
TCG-Zelda	105	-	-	106	-	-	104	-	-
TW Olympic	102	-	-	100	-	-	106	-	-
TW Starlite	99	-	-	99	-	-	100	-	-
TW Trailfire	102	-	-	100	-	-	107	-	-
WB9479	98	95	95	100	97	96	95	92	93
WB9590	101	100	99	100	100	100	104	98	98
Mean (bu/acre)	**82.8**	**85.0**	**81.5**	**95.1**	**95.3**	**92.2**	**65.6**	**71.8**	**67.5**
LSD (0.1)	**3**	**3**	**1**	**4**	**4**	**2**	**5**	**5**	**3**
No. of Trials	**12**	**25**	**39**	**7**	**14**	**22**	**5**	**11**	**17**

Table 7. Grain yield of hard red spring wheat varieties grown under conventional and intensive management in single-year (2024) and multiple-year comparisons (2022-2024).

	North						South[1]				State					
	2024		2-year		3-year		2024		2-year		2024		2-year		3-year	
Variety	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int
	(bu/acre)															
AP Elevate	89.9	105.5	–	–	–	–	55.0	60.1	–	–	78.3	90.3	–	–	–	–
AP Gunsmoke CL2	85.9	97.9	84.9	92.7	85.6	96.9	52.8	53.4	62.9	65.7	74.9	83.1	76.9	82.9	77.1	85.2
AP Murdock	90.7	102.6	89.4	97.5	91.0	101.9	63.9	67.3	63.2	65.9	81.7	90.8	83.1	90.0	80.6	88.4
AP Smith	88.2	103.0	92.6	98.9	89.6	98.4	46.7	56.3	53.2	62.1	74.4	87.4	81.1	88.2	76.0	84.8
Ascend-SD	95.5	108.5	93.7	99.5	94.0	101.4	66.5	65.1	69.8	71.9	85.9	94.0	86.9	90.9	84.9	90.3
Brawn-SD	90.0	108.3	90.6	104.3	91.4	102.3	56.2	61.0	64.2	70.4	78.7	92.6	82.0	93.5	81.2	90.4
CAG Ceres	84.8	107.8	–	–	–	–	62.1	63.4	–	–	77.3	93.0	–	–	–	–
CAG Justify	100.3	112.3	98.2	105.3	96.8	106.5	57.5	58.0	67.3	65.0	86.0	94.2	88.0	93.5	85.8	91.0
CAG Reckless	89.4	99.9	90.4	98.0	88.8	96.5	60.9	63.7	64.6	66.6	79.9	87.8	83.0	89.4	79.7	85.3
CAG Recoil	93.4	102.1	93.9	99.8	90.7	98.0	53.2	56.3	56.6	59.6	80.0	86.8	83.7	89.0	77.9	83.6
CP3055	91.4	113.7	–	–	–	–	54.9	54.8	–	–	79.2	94.1	–	–	–	–
CP3099A	78.2	117.4	89.4	111.2	96.1	113.2	37.5	54.2	54.0	63.8	64.7	96.3	76.4	96.9	80.3	94.7
CP3188	82.2	105.0	88.0	99.4	90.3	102.3	48.4	54.1	55.9	62.2	71.0	88.0	78.1	88.1	77.4	87.3
CP3322	80.6	96.6	86.8	101.6	–	–	36.4	36.0	–	–	65.8	76.4	74.2	85.2	–	–
CP3360AX	94.6	113.3	–	–	–	–	66.1	67.2	–	–	85.1	98.0	–	–	–	–
CP3915	82.3	106.2	89.0	98.0	88.0	100.0	48.4	49.3	54.3	59.7	71.0	87.3	78.9	85.8	75.4	84.9
Driver	91.7	101.4	91.9	95.1	94.0	98.3	46.8	50.6	58.1	62.2	76.8	84.5	80.7	84.0	80.6	84.8
Dyna-Gro 8582	92.2	108.0	–	–	–	–	70.6	65.8	–	–	85.0	93.9	–	–	–	–
Dyna-Gro Ambush	88.6	104.9	91.2	103.6	89.0	102.5	63.0	62.2	64.1	69.3	80.1	90.7	84.1	93.2	79.6	90.1
Dyna-Gro Ballistic	94.9	108.2	101.5	106.4	95.3	103.6	56.7	56.9	59.8	64.0	82.1	91.1	90.3	94.0	82.0	88.8
Dyna-Gro Commander	92.6	112.3	98.7	105.5	94.8	103.7	63.6	62.6	59.8	63.1	83.0	95.8	90.0	94.8	81.6	88.5
Dyna-Gro Rocker	72.9	96.3	–	–	–	–	26.6	35.9	–	–	57.5	76.1	–	–	–	–
LCS Ascent	95.4	106.1	97.3	101.7	94.9	103.0	68.2	70.8	63.9	71.5	86.4	94.3	90.0	94.0	83.2	91.2
LCS Boom	92.0	103.8	87.0	93.8	–	–	65.8	63.9	–	–	83.3	90.5	81.7	86.3	–	–
LCS Buster	104.5	115.0	107.4	110.2	102.1	109.2	59.0	59.8	59.4	65.9	89.3	96.6	95.3	97.6	86.1	92.9
LCS Cannon	88.4	105.2	90.4	97.0	90.5	99.4	63.8	64.9	64.7	68.3	80.2	91.8	83.8	89.0	80.8	87.7
LCS Dual	87.8	100.9	90.0	97.1	89.4	97.7	53.2	53.8	59.5	63.1	76.2	85.2	80.8	86.3	78.2	84.8
LCS Hammer AX	75.3	98.2	–	–	–	–	44.5	50.2	–	–	65.0	82.2	–	–	–	–
LCS Trigger	105.5	115.2	105.0	110.8	103.2	111.0	72.1	71.9	67.5	74.4	94.3	100.8	96.8	101.1	89.8	97.2
Linkert	78.1	90.7	79.4	86.4	81.6	89.2	50.3	46.9	54.4	58.4	68.9	76.1	72.1	76.5	71.4	77.6
MN-Rothsay	95.4	108.9	99.8	104.6	97.7	105.5	50.0	51.4	51.9	57.7	80.3	89.7	87.3	91.3	80.5	87.6
MN-Torgy	92.2	99.0	93.1	94.7	92.8	97.5	57.5	64.6	57.9	65.6	80.6	87.5	84.2	87.2	79.7	85.5
MS Charger	96.5	113.9	100.4	107.3	100.4	107.9	70.9	68.9	67.8	71.7	88.0	98.9	93.0	97.7	88.2	94.3
MS Cobra	88.3	104.2	89.8	99.0	89.2	98.6	51.5	53.1	54.4	59.4	76.1	87.2	80.2	87.5	76.1	83.9
ND Heron	87.3	95.9	85.5	92.6	87.3	93.4	60.3	58.1	56.8	63.0	78.3	83.3	79.2	84.0	75.9	82.0
ND Stampede	97.0	117.8	98.8	111.2	–	–	61.9	72.6	–	–	85.3	102.8	89.6	101.5	–	–
ND Thresher	84.5	97.8	–	–	–	–	53.6	51.7	–	–	74.2	82.5	–	–	–	–
PFS Buns	95.3	103.6	101.3	104.5	–	–	50.8	57.8	–	–	80.5	88.4	88.7	92.8	–	–
PFS Rolls	89.0	104.6	–	–	–	–	50.0	47.7	–	–	76.0	85.6	–	–	–	–
Shelly	91.6	107.2	93.3	102.7	94.2	104.3	49.9	52.0	57.2	60.4	77.7	88.8	82.5	90.0	80.3	87.8
SY 611 CL2	98.5	107.0	98.6	101.6	95.4	101.8	56.5	60.2	57.1	62.9	84.5	91.4	88.0	91.3	81.0	87.2
SY Valda	98.7	109.9	97.6	104.6	92.6	103.6	62.2	62.1	60.2	68.9	86.5	94.0	88.8	94.0	80.5	90.6
TCG-Badlands	81.9	99.2	–	–	–	–	46.5	51.2	–	–	70.1	83.2	–	–	–	–
TCG-Teddy	76.6	99.0	85.0	98.7	–	–	46.1	52.2	–	–	66.4	83.4	75.3	87.1	–	–
TCG-Wildcat	85.1	103.1	90.0	100.2	92.4	103.1	39.5	43.6	57.4	64.8	69.9	83.3	77.4	86.0	79.3	88.8
TCG-Zelda	91.4	109.1	–	–	–	–	47.1	54.4	–	–	76.6	90.9	–	–	–	–
TW Olympic	90.5	107.2	–	–	–	–	59.0	59.6	–	–	80.0	91.3	–	–	–	–
TW Starlite	92.8	103.4	–	–	–	–	58.5	64.4	–	–	81.4	90.4	–	–	–	–
TW Trailfire	87.0	100.7	–	–	–	–	68.8	68.0	–	–	80.9	89.8	–	–	–	–
WB9479	85.1	99.7	90.4	97.1	88.2	97.1	55.6	57.5	56.0	62.1	75.3	85.6	81.7	87.2	76.1	84.0
WB9590	92.2	98.4	96.1	97.4	93.3	100.6	58.9	60.5	56.0	64.5	81.1	85.8	86.8	88.1	79.3	87.0
Mean (bu/acre)	**89.4**	**103.3**	**92.1**	**99.2**	**91.7**	**100.4**	**53.7**	**56.3**	**58.6**	**64.0**	**77.5**	**87.6**	**82.8**	**88.7**	**79.3**	**86.7**
LSD (0.1)	**9**	**9**	**9**	**8**	**7**	**5**	**6**	**7**	**7**	**6**	**7**	**7**	**8**	**7**	**5**	**4**
No. of Trials	**2**	**2**	**3**	**3**	**5**	**5**	**1**	**1**	**3**	**3**	**3**	**3**	**4**	**4**	**8**	**8**

[1] There were no intensive trials in southern locations in 2023. 2-year is 2022 and 2024.

Table 8. Agronomic characteristics of malting barley varieties (2022-2024).

Variety	Origin[1]	Year of Release	PVP status	Heading (DAP)	Height (inches)	Lodging (0-9)	Protein (%)
2-row							
AAC Connect	AAFC	2017	PVP	58	30	3	12.7
AAC Synergy	AAFC	2012	PVP(94)	57	31	3	12.7
ABI Cardinal	ABI	2021	PVP(94)	58	29	3	13.0
Excelsior Gold	NY			55	33	2	12.8
Explorer	SR	2020		57	27	2	12.5
ND Genesis	ND	2015	PVP(94)	56	32	2	11.8
6-row							
Lacey	MN	2000	Expired	53	32	2	13.2
ND Treasure[2]	ND			55	30	2	12.4
Quest	MN	2010	PVP(94)	53	33	4	13.3
Rasmusson	MN	2008	PVP(94)	53	30	2	12.8
Robust	MN	1984	Expired	53	33	2	13.3
Tradition	ABI	2003	PVP(94)	53	31	2	12.9
No. of Trials				**10**	**9**	**11**	**21**

[1] Agriculture and Agri-Food Canada (AAFC), Anheuser-Busch InBev (ABI), Cornell University (NY), Secobra Recherches (SR), North Dakota State University (ND), University of Minnesota (MN).

[2] ND Treasure evaluated in 2023 and 2024.

Table 9. Disease reactions of barley varieties in multiple year comparisons.

Variety	DON[1, 2,3]	Net Blotch[1]	Stem Rust[1,4]	Bacterial Leaf Streak [1]	Powdery Mildew[1,5]
2-row					
AAC Connect	3	0	3	4	4
AAC Synergy	4	0	4	3	4
ABI Cardinal	4	1	6	5	2
Excelsior Gold	2	1	6	4	4
Explorer	4	2	5	4	0
ND Genesis	4	1	6	5	5
6-row					
Lacey	5	1	4	6	6
ND Treasure[6]	5	1	0	5	6
Quest	3	1	2	5	6
Rasmusson	4	1	4	5	6
Robust	6	0	5	6	6
Tradition	5	1	4	6	5
No. of Trials	**4**	**3**	**3**	**3**	**2**

[1] Trait measured on a scale from 0-9 where 0=resistant and 9=susceptible.

[2] Deoxynivalenol (DON) is the mycotoxin produced by the Fusarium head blight pathogen

[3] Data is for 2022 and 2023.

[4] Data is for stem rust pathogen QCCJ. All lines were resistant to stem rust pathogen MCCF in years tested.

[5] Data from two trials with natural Powdery Mildew infection in 2024 only.

[6] ND Treasure evaluated in 2023 and 2024.

Table 10. Relative grain yield of barley varieties in northern Minnesota locations in single-year (2024) and multiple year comparisons (2022-2024).

	Crookston		Hallock		Oklee		Perley		Roseau		Stephen		Strathcona	
Variety	**2024**	**3 yr**	**2024**	**3 yr**	**2024**	**3 yr**	**2024**	**3 yr**	**2024**	**3 yr[1]**	**2024**	**3 yr**	**2024**	**2 yr[2]**
2-row	----------(% of mean)----------													
AAC Connect	106	104	97	102	104	99	116	107	98	99	104	105	101	94
AAC Synergy	108	105	102	104	99	99	103	107	96	97	97	107	82	93
ABI Cardinal	106	100	98	99	114	105	109	106	90	94	101	105	77	88
Excelsior Gold	89	94	108	105	106	104	117	110	100	105	100	100	90	89
Explorer	105	102	94	96	108	100	98	90	99	102	98	98	87	91
ND Genesis	101	102	109	106	95	98	104	103	102	105	100	106	122	109
6-row														
Lacey	98	102	108	99	109	104	97	97	101	100	96	91	119	108
ND Treasure[3]	119	.	112	.	106	.	105	.	115	.	117	.	111	104
Quest	86	95	73	89	75	93	66	85	98	95	101	96	.	118
Rasmusson	102	107	99	101	102	104	93	101	105	105	100	101	107	106
Robust	89	92	98	96	91	94	94	93	96	97	88	95	97	98
Tradition	91	96	102	103	91	99	99	100	100	99	99	95	109	104
Mean (bu/acre)	**131**	**117**	**152**	**144**	**135**	**116**	**106**	**114**	**143**	**136**	**135**	**121**	**90**	**111**
LSD(0.1)	**7**	**5**	**7**	**4**	**8**	**5**	**10**	**5**	**5**	**4**	**6**	**4**	**12**	**6**

[1] Trial data is from 2022 and 2024 only.

[2] Trial data is from 2023 and 2024 only.

[3] ND Treasure evaluated in 2023 and 2024.

Table 11. Relative grain yield of barley varieties in southern Minnesota locations in single-year (2024) and multiple year comparisons (2022-2024).

	Becker		Fergus Falls	Lamberton		Le Center		Rochester		St. Paul	
Variety	**2024**	**3 yr**	**2 yr[1]**	**2024**	**3 yr**	**2024**	**3 yr**	**2024**	**3 yr[2]**	**2024**	**3 yr**
2-row	----------(% of mean)----------										
AAC Connect	104	102	102	110	98	111	103	101	100	80	96
AAC Synergy	94	99	102	98	97	100	97	99	106	92	102
ABI Cardinal	98	104	97	95	91	108	106	105	89	89	102
Excelsior Gold	100	96	104	92	95	99	95	103	97	79	84
Explorer	103	99	96	95	100	95	95	83	87	101	117
ND Genesis	86	92	110	93	100	104	104	91	101	82	95
6-row											
Lacey	96	101	95	109	106	118	106	96	104	128	111
ND Treasure[3]	129	.	.	112	.	110	.	120	.	121	.
Quest	106	103	96	108	115	72	94	73	94	99	87
Rasmusson	110	118	107	100	103	111	108	121	118	128	114
Robust	84	87	88	98	96	95	96	114	106	108	91
Tradition	90	100	102	88	97	75	97	93	98	93	101
Mean (bu/acre)	**65**	**77**	**118**	**58**	**62**	**85**	**98**	**60**	**70**	**64**	**64**
LSD(0.1)	**12**	**7**	**5**	**8**	**6**	**11**	**5**	**11**	**8**	**12**	**8**

[1] Trial data is from 2022 and 2023 only; 2024 trial lost to hail.

[2] Trial data is from 2022 and 2024 only.

[3] ND Treasure evaluated in 2023 and 2024.

Table 12. Relative grain yield of barley varieties in a single-year (2024) and multiple year comparisons (2022-2024).

	State			North			South		
Variety	**2023**	**2 yr**	**3 yr**	**2023**	**2 yr**	**3 yr**	**2023**	**2 yr**	**3 yr**
2-row	----------(% of mean)----------								
AAC Connect	103	101	101	103	101	101	102	101	101
AAC Synergy	98	100	101	99	100	102	97	101	100
ABI Cardinal	100	101	99	100	99	99	100	104	99
Excelsior Gold	100	98	100	102	99	102	95	96	96
Explorer	98	98	98	99	98	97	96	98	98
ND Genesis	101	101	103	104	102	104	92	100	102
6-row									
Lacey	105	103	101	103	103	100	110	104	103
ND Treasure[1]	114	107	.	112	108	.	118	107	.
Quest	87	93	96	88	93	96	90	91	98
Rasmusson	105	105	106	101	103	104	114	109	111
Robust	95	95	95	93	94	95	99	95	93
Tradition	95	97	100	98	99	100	87	94	99
Mean (bu/acre)	**102**	**104**	**104**	**128**	**128**	**123**	**66**	**76**	**81**
LSD (0.1)	**2.5**	**0.9**	**1.0**	**2.9**	**1.0**	**1.3**	**4.9**	**1.9**	**1.7**
No. of Trials	**12**	**23**	**35**	**7**	**13**	**19**	**5**	**10**	**16**

[1] ND Treasure evaluated in 2023 and 2024

Table 13. Origin and agronomic characteristics of oat varieties in Minnesota in multiple-year comparisons (2022-2024).

Variety	**Origin[1]**	**Year of Release**	**Legal Status**	**Seed Color**	**Days to Heading**	**Plant Height**	**Straw Strength[5]**	**Test Weight**	**Grain Protein**
					(days)	(inches)	(1-9)	(lbs/bu)	(%)
Antigo	WI	2017	PVP(94)	Yellow	53.0	35.0	2.6	38.7	13.8
CS Camden	LS	2013	PVP(94)	White	58.9	37.2	2.4	34.3	12.7
Deon	MN	2014	PVP(94)	Yellow	59.6	41.0	3.5	37.3	12.7
Esker 2020	WI	2020	PVP(94)	Yellow	55.8	36.7	2.7	34.4	12.9
Hayden	SD	2015	PVP(94)	White	58.1	39.7	3.4	37.9	12.6
Mink	WI	2022	PVP(94)	Yellow	61.8	39.2	2.7	35.1	12.7
MN Pearl	MN	2018	PVP(94)	White	58.4	40.0	3.9	35.3	12.0
ND Carson[2]	ND	2023	Pending	White	61.2	39.5	2.1	36.2	12.1
ND Heart	ND	2020	PVP(94)	White	58.2	39.2	3.7	36.8	13.5
ND Spilde[2]	ND	2023	Pending	White	59.9	41.2	3.5	35.2	12.2
Reins	IL	2016	PVP(94)	White	52.8	30.8	1.5	37.3	13.4
Rushmore	SD	2020	PVP(94)	White	56.1	38.2	2.8	37.7	12.5
Saddle	SD	2018	PVP(94)	White	52.9	36.1	1.8	36.2	12.5
SD Buffalo	SD	2021	PVP(94)	White	57.3	39.7	3.5	36.9	12.5
SD Titan[3]	SD	2024		White	64.1	53.7	4.7	39.9	11.9
SD Momentum[3]	SD	2024		White	62.3	50.9	4.7	38.5	12.2
Streaker[4]	SD	2016	PVP(94)	Hulless	55.6	37.6	4.2	42.1	14.9
Sumo	SD	2017	PVP(94)	White	52.3	37.1	2.3	37.7	13.7
Warrior	SD	2019	PVP(94)	White	56.1	36.7	2.5	36.6	12.9
No. of Trials					**9**	**9**	**12**	**17**	**10**

[1] Lantmannen Seed (LS), North Dakota State University (ND), South Dakota State University (SD), University of Illinois Urbana-Champaign (IL), University of Minnesota (MN), University of Wisconsin-Madison (WI)

[2] Line tested in 2023 and 2024

[3] Line tested in 2024 only

[4] Hulless oat

[5] 1-9 scale where 1=most resistant, 9=most susceptible

Table 14. Disease characteristics of oat varieties.

Variety	Crown Rust[3]	Loose Smut[3]	BYDV[3,4]
	(1-9)	(1-9)	(1-9)
Antigo	3	4	4
CS Camden	5	3	4
Deon	5	1	4
Esker 2020	2	2	3
Hayden	5	1	3
Mink	2	2	.
MN Pearl	5	1	4
ND Carson[1]	5	1	.
ND Heart	4	6	4
ND Spilde[1]	3	1	.
Reins	6	1	4
Rushmore	5	3	4
Saddle	5	1	4
SD Buffalo	4	2	.
SD Titan[2]	3	1	.
SD Momentum[2]	2	1	.
Streaker	5	2	4
Sumo	3	1	4
Warrior	4	2	4

[1] Line tested in 2023 and 2024

[2] Line tested in 2024 only

[3] Disease scored on a 1-9 scale where 1 = most resistant, 9 = most susceptible.

[4] BYDV tested in 2021

Table 15. Relative grain yield of oat varieties in northern Minnesota locations in single-year (2024) and multiple-year comparisons (2022-2024).

Variety	Crookston		Fergus Falls	Roseau		Stephen	
	2024	3 yr	2 yr[4]	2024	2 yr[5]	2024	3 yr
	----------(% of mean)----------						
Antigo	89	88	76	95	88	95	93
CS Camden	100	105	112	103	108	92	105
Deon	108	109	105	106	108	108	109
Esker 2020	105	107	93	103	106	102	103
Hayden	99	105	109	102	106	102	104
Mink	106	110	108	133	121	113	115
MN Pearl	94	105	113	102	107	109	109
ND Carson[1]	111	.	.	99	.	104	.
ND Heart	100	100	100	92	89	100	91
ND Spilde[1]	100	.	.	100	.	103	.
Reins	95	95	85	98	96	95	95
Rushmore	104	101	101	97	103	100	104
Saddle	103	104	93	107	103	105	103
SD Buffalo	95	104	108	110	109	108	110
SD Titan[2]	106	.	.	100	.	99	.
SD Momentum[2]	106	.	.	94	.	101	.
Streaker[3]	78	76	84	66	71	70	71
Sumo	99	87	95	91	87	94	91
Warrior	104	105	118	101	98	99	96
Mean (bu/acre)	**197**	**184**	**143**	**211**	**202**	**219**	**204**
LSD(0.1)	**5.6**	**4.5**	**6.9**	**7.4**	**5.9**	**5.7**	**4.6**

[1] Line tested in 2023 and 2024

[2] Line tested in 2024 only

[3] Hulless oat

[4] Trial data is from 2022 and 2023; 2024 trial was lost to hail

[5] Trial data is from 2022 and 2024

Table 16. Relative grain yield of oat varieties in southern Minnesota locations in single-year (2024) and multiple-year comparisons (2022-2024).

Variety	Becker		Lamberton		Le Center		Rochester		St. Paul	Waseca
	2024	2 yr[4]	2024	3 yr	2024	3 yr	2024	3 yr[4]	2024[5]	2 yr[6]
	(% of mean)									
Antigo	106	109	131	99	94	97	90	89	110	87
CS Camden	109	117	123	119	100	106	102	94	102	120
Deon	106	96	125	128	107	109	108	114	106	101
Esker 2020	103	105	133	117	109	104	118	118	113	111
Hayden	86	96	116	114	96	109	99	105	103	96
Mink	109	112	115	121	120	110	136	132	107	131
MN Pearl	77	84	116	105	79	95	94	101	100	106
ND Carson[1]	97	.	98	.	97	.	97	.	98	.
ND Heart	100	94	101	101	90	93	101	93	82	88
ND Spilde[1]	113	.	115	.	117	.	118	.	94	.
Reins	83	92	126	106	96	98	81	76	103	94
Rushmore	88	89	133	106	97	103	93	102	118	108
Saddle	109	109	134	111	100	99	106	107	125	93
SD Buffalo	99	108	120	115	95	103	89	112	91	107
SD Titan[2]	112	.	128	.	121	.	118	.	96	.
SD Momentum[2]	108	.	138	.	116	.	102	.	104	.
Streaker[3]	80	73	106	83	78	82	69	70	65	72
Sumo	101	100	137	107	89	90	85	90	92	79
Warrior	114	116	127	112	98	102	94	99	91	105
Mean (bu/acre)	**95**	**97**	**122**	**110**	**139**	**138**	**123**	**134**	**171**	**86**
LSD(0.1)	**9.8**	**8.0**	**7.3**	**5.9**	**7.8**	**4.3**	**10.8**	**8.5**	**9.8**	**8.6**

[1] Line tested in 2023 and 2024

[2] Line tested in 2024 only

[3] Hulless oat

[4] Trial data is from 2022 and 2024

[5] Trial data is from 2024 only

[6] Trial data is from 2022 and 2023; 2024 trial was lost to excessive rain

Table 17. Relative grain yield of oat varieties in Minnesota in single-year (2024) and multiple-year comparisons (2022-2024).

Variety	North			South			State		
	2024	2 yr	3 yr	2024	2 yr	3 yr	2024	2 yr	3 yr
	(% of mean)								
Antigo	93	91	87	102	100	99	98	95	93
CS Camden	98	104	107	102	106	105	100	105	106
Deon	107	107	108	105	109	108	106	108	108
Esker 2020	103	103	103	113	111	111	108	107	107
Hayden	101	102	106	95	99	103	98	101	104
Mink	118	120	114	116	113	116	117	117	115
MN Pearl	102	104	108	89	94	97	95	99	102
ND Carson[1]	104	104	.	93	97	.	98	101	.
ND Heart	97	98	95	91	91	90	94	94	92
ND Spilde[1]	101	105	.	110	112	.	106	109	.
Reins	96	92	93	95	96	94	95	94	93
Rushmore	100	99	103	102	102	104	101	100	103
Saddle	105	101	101	109	109	107	107	105	104
SD Buffalo	105	106	108	93	98	102	99	102	105
SD Titan[2]	101	.	.	109	.	.	106	.	.
SD Momentum[2]	100	.	.	111	.	.	106	.	.
Streaker[3]	71	72	75	73	73	72	72	72	73
Sumo	95	90	89	94	92	92	94	91	91
Warrior	101	100	103	98	100	101	100	100	102
Mean (bu/acre)	**209**	**191**	**183**	**116**	**116**	**120**	**147**	**146**	**145**
LSD (0.1)	**3.7**	**2.1**	**1.8**	**4.1**	**2.5**	**2.3**	**2.8**	**1.6**	**1.5**
No. of Trials	**3**	**6**	**10**	**6**	**9**	**14**	**9**	**15**	**24**

[1] Line tested in 2023 and 2024

[2] Line tested in 2024 only

[3] Hulless oat