

**NEBRASKA AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF NEBRASKA-LINCOLN
DEPARTMENT OF AGRONOMY AND HORTICULTURE**

and

**UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
WASHINGTON, D. C.**

RELEASE OF NE15420 HARD RED WINTER WHEAT

NE15420 is a hard red winter wheat (*Triticum aestivum* L.) cultivar developed cooperatively by the Nebraska Agricultural Experiment Station and the USDA-ARS and released in 2020 by the developing institutions. It was released primarily for its superior adaptation to irrigated wheat production systems throughout Nebraska. Irrigated wheat cultivars require strong straw, short stature, and high yield potential.

NE15420 is a hard red winter wheat selected from the cross 'Hitch'/NW03666'. The pedigree of Hitch (HV9W02-942R) is Bezostaya 1/ Plainsman V sib, (G53)/4/Abilene//(G1113, Sturdy sel./Plainsman V)/3/Karl 92/5/ Jagger/6/(KS89180B, KS8010-73/ KS8010-1-4-2//107349/KS811252/ Karl)' and the pedigree of NW03666 is 'N94S097KS'/'NE93459'. The cross was made in 2009. The F₁ generation was grown at Yuma AZ (row 254) in 2010 and the F₂ to F₃ generations were advanced using the bulk breeding method in the field at Mead, NE in 2011 to 2012. In 2013, single F₃-derived F₄ rows were planted for selection at Lincoln, NE. The F_{3.5} was evaluated as a single four row plot at Lincoln, NE and a single row at Mead, NE in 2014. NE15420 was identified in 2015 as the experimental line, NE15420, and selected for further testing. The only selection thereafter was to remove off types, usually taller plants. This line seems to be narrowly adapted to irrigated production fields in Nebraska. It was selected specifically for irrigated production using both phenotypic and genomic selection.

NE15420 was evaluated in Nebraska replicated yield nurseries starting in 2015 as part of our preliminary yield trial (DUP15) which is grown in an augmented incomplete block design in eight locations in Nebraska and one cooperative location in Kansas. Based on its short plant stature, it was also grown in the Irrigated-Dry Nursery beginning in 2015 (IRDR15) which was grown at three rainfed locations and one irrigated location in an alpha lattice with three replications. In 2015 the line was also genotyped using genotyping by sequencing. Though NE15420 was ranked 59 out of 270 experimental lines in the 2015 preliminary observation nursery, its estimated breeding value was very low, so it was not among the 57 lines that were selected for the advanced yield trial. However, in the IRDR15, the irrigated nursery trial was lost to bad weather, and for the three dryland sites, NE15420 was ranked 14 out of 40 entries so it was advanced to the IRDR16 nursery. In 2016, NE15420 ranked 23 in the average of the three rainfed trials, but third in the irrigated trial (111.4 bu/a) similar to the highest yield line (114.6 bu/a). Thereafter NE15420 was grown in the IRDR nurseries, but the irrigated trial was lost in 2017 and resources prevented an irrigated trial in 2018 and 2019. However, NE15420 was tested in the University of Nebraska Fall Sown Wheat Performance Trials in 2018 to 2020. In the

Nebraska IRDR Nursery (2015 to 2020, Table 1), NE15420 performed as expected with most sites being rainfed. NE15420 was significantly higher yielding than Goodstreak, a tall wheat, not significantly different from Freeman, and significantly lower yielding than LCS Valiant, Ruth, Siege, and Robidoux. As such it was not submitted for testing the USDA-ARS regional nursery program where most trials are rainfed. The grain volume weight was similar to widely grown cultivars, but lower than Siege which is known for its high grain volume weight. For plant height, it was the shortest line in the nursery and it flowers at a time similar to most Nebraska bred cultivars. NE15420 genetically is a semi-dwarf wheat, containing the *RhtB1b* allele (formerly known as Rht1). NE15420 has good straw strength for a semi-dwarf wheat cultivar with little lodging reported in the years it has been tested. The winter hardiness of NE15420 is comparable to cultivars commonly grown in Nebraska. In the last three years, it has been tested in the irrigated trials (but again not the rainfed trials) in the Nebraska State Variety Trials across 4 environments (Table 2, full data available at <http://cropwatch.unl.edu/web/varietytest/wheat>). NE15420 was the second highest yielding line and not significantly different from WBB418 and WB-Grainfield, Long Branch, AM Eastwood, and CP7869, but was significantly higher yielding than Wesley (a very popular irrigated wheat cultivar known for its strong straw). Its grain volume weight was also good under irrigation, as was its grain protein content. As previously described, it is a short statured wheat under irrigation. The Foundation seed production field performed similarly well under irrigation (data not shown). Based upon these data, NE15420 is adapted to irrigated production, but other cultivars would be recommended for rainfed production.

NE15420 is resistant to *Soilborne wheat mosaic virus* in field nurseries in Nebraska. It is resistant to stem rust (caused by *Puccinia graminis Pers.: Pers. f. sp. tritici* Eriks & E. Henn.) in field nursery tests at St. Paul, MN and moderately resistant to stripe rust (caused by *P. striiformis* Westendorp f. sp. *tritici*), in field nurseries in Nebraska. In greenhouse seedling tests, it is resistant or segregating for resistance to stem rust races QFCSC, QTHJC, RKQQC, TMPKC, and TTTTF (Table 3). It is moderately susceptible to leaf rust (caused by *P. triticina* Eriks., data obtained from field observations in the Great Plains). By molecular markers, it is believed to carry the following genes or translocations: *Sbm1*, *Lr24/Sr24*, and *Lr37/Sr38/Yr17*. NE15420 is moderately susceptible to Fusarium head blight (caused by *Fusarium graminearum*, data from greenhouse and field observations in Nebraska and Kansas) and moderately susceptible to DON accumulation. NE15420 is susceptible to Hessian fly (*Mayetiola destructor* Say.). Based on genomic data, it is expected to be susceptible to *Wheat streak mosaic virus*.

The milling and baking properties of NE15420 were determined for five years by the Nebraska Wheat Quality Laboratory (Table 4). In these tests, the comparative cultivars changed and were either Wesley or LCS Valiant (both lines considered to have good milling and baking quality). For most traits, NE15420 was very similar to Wesley and LCS Valiant. NE15420 may be slightly lower in flour yield and slightly higher in four protein and ash content, water absorption and Mixtime. NE15420 had a lower Mixing Tolerance score which is most likely due to its having molecular markers indicative of the 1B.1R translocation which is known to reduce Mixing tolerance. NE15420 has a slightly smaller loaf volume, but it was very similar to LCS Valiant for other baking scores. Wesley, an excellent baking wheat cultivar, was superior to NE15420 and LCS Valiant. NE15420 should be acceptable to the milling and baking industries.

In positioning NE15420, based on performance data to date, it should be well adapted to irrigated wheat production systems in Nebraska. NE15420 is not recommended for rainfed wheat production, except where the grain yields are high enough to mimic irrigated production

systems due to other cultivars having superior yield potential in rainfed systems. Where adapted, NE15420 should be a new red wheat with excellent yield potential. NE15420 is genetically complementary to virtually all wheat cultivars grown in Nebraska.

NE15420 is an awned, white-glumed cultivar. Its field appearance is most similar to Wesley, but it can be easily separated from Wesley because Wesley has bronze chaff. After heading, the canopy is moderately closed and erect. The flag leaf is erect and twisted at the boot stage. The foliage is green with a waxy bloom on the leaf sheath, but little wax on the spike at anthesis, or on the leaves. The leaves are glabrous. The spike is strap, midwide, and middense. The glume is narrow, and the glume shoulder is medium and rounded. The beak is acuminate. The spike is predominantly erect at maturity. Kernels are red colored, hard textured, and mainly oval in shape. The kernel has no collar, a brush of medium length, rounded cheeks, large germ, and a narrow and middeep crease.

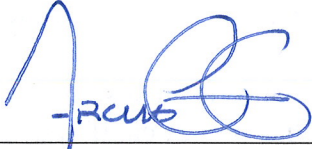
NE15420 has been uniform and stable since 2017. Less than 0.5 % of the plants were rogued from the Breeder's seed increase in 2017-20. The rogued variant plants were taller in height (5 - 15 cm) or were awnless and/or had red chaff. Up to 1% (10:1000) variant plants may be encountered in subsequent generations. The Nebraska Foundation Seed Division, Department of Agronomy and Horticulture, University of Nebraska-Lincoln, Lincoln, NE 68583 will have foundation seed available to qualified certified seed enterprises in 2021 with the first sale of certified seed in 2021 or 2022. The U.S. Department of Agriculture will not have commercial seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. NE15420 will be submitted for plant variety protection under P.L. 10577 with the certification option. Small quantities of seed for research purposes may be obtained from Dr. P. S. Baenziger and the Department of Agronomy and Horticulture, University of Nebraska-Lincoln for at least 5 years from the date of this release. In addition, a seed sample will be deposited in the USDA-ARS National Small Grains Collection, Aberdeen, ID, and this seed is freely available to interested researchers.

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Approval



A handwritten signature in blue ink, appearing to be 'R. C. ...', written over a horizontal line.

Director, Nebraska Agricultural
Experiment Station

1/15/2021
date

For
Administrator, Agricultural Research Service
United States Department of Agriculture
Washington, D. C.

date

Table 1. Head to head comparisons of NE15420 to popularly grown or new cultivars from trials in Nebraska beginning in 2015 until 2020. Data on grain yield, grain volume weight, plant height, and anthesis date were from trials at up to eight locations (Mead, Lincoln, Clay Center, North Platte, McCook, Grant, Sidney, and Alliance) in Nebraska in each year (total environments in the comparison is N) and not every cultivar was grown in the same trial across the state.

	Grain Yield		Grain Volume Weight		Height		Anthesis Date	
	N	Line NE15420 bu/a	N	Line NE15420 lbs/bu	N	Line NE15420 in	N	D after Jan. 1 Line NE15420
Goodstreak	17	58.32	12	56.43	18	38.66	6	142.5
		62.47	**	56.05	n.s.	31.03	**	142.19
Freeman	17	66.26	13	56.4	18	33.79	6	141.92
		62.47	n.s.	56.03	n.s.	31.03	**	142.19
LCS Valiant	33	69.51	21	57.66	31	32.55	11	141.45
		62.48	**	55.65	n.s.	30.96	**	141.86
Ruth	21	71.01	16	59.05	22	35.45	7	142.5
		64.61	**	55.37	n.s.	31.23	**	142.36
Siege	20	67.31	15	58.05	20	33.81	7	142.5
		63.04	*	56.23	**	31.31	**	142.36
Robidoux	23	70.19	23	58.2	30	35.33	10	142.81
		63.04	**	55.91	n.s.	31.83	**	142.36

*, **, n.s. Significantly different at the P=0.05, P=0.01 probability level or not significantly different.

Table 2. Grain yield, grain volume weight, plant height, and grain protein content for Nebraska from 2018 to 2020 representing 4 location-years of data from irrigated environments.

Cultivar	Grain Yield (bu/a)	Grain Vol. Wt (lbs/bu)	Height (in)	Grain Protein (%)
WBB418	103.4	56.7	30.5	13.2
NE15420	101.5	57.0	29.5	13.4
WB4303	101.3	55.6	30.3	13.8
NHH144913-3	99.3	55.7	32.5	13.1
WB-Grainfield	98.0	56.8	29.4	13.1
Long Branch	97.8	57.2	30.4	12.5
AMEastwood	97.8	57.2	29.3	13.7
CP7869	97.5	56.9	27.4	13.1
Wesley	94.2	56.4	30.1	13.8
SY Sunrise	93.5	57.9	29.4	13.2
Siege	89.1	57.1	29.8	13.9
Robidoux	86.3	53.6	27.4	14.4
Mean	96.9	56.5	29.6	13.4
LSD 0.05*	4.67	0.99	1.26	0.45

* Least significant difference (P=0.05)

Table 3. Seedling stem rust reaction scores of NE15420 hard red winter wheat and other check cultivars evaluated in the 2017 and Regional Germplasm Observation Nursery (RGON)[†] at the USDA-ARS Cereal Disease Laboratory, St. Paul, MN.

Line/selection	St. Paul, MN					Adult plant field response**
	QFCSC*	QTHJC	RKQQC	TPMKC	TTTTF	
	Hill Plots					Rows
	06ND76C 75ND717C 99KS76A-1 74MN1409 01MN84A-1-2					7/3/2017 6/27/2017
NE15420	;	;	;	;	;2-	0
TAM-107	2-	2/3	2-/2;/13/4	2/4	2-/4	20MR/40MSS
Mattern	;1-	13;/;	13;/4	;	33-	0
Overland	2C	2/3	23-	4/;	4/3	70MSS
McNair 701	4	4	4	4	4	90S 70S
Red Chief	2+	2+3	2+3	4	4	40MS
Prairie Red	2-	2	;2-	2-	2-	10MR

*Complete data set can be found at <http://www.ars.usda.gov/Research/docs.htm?docid=11932> (accessed November 23, 2020). Seedling infection type: 0 = immune response, no sign of infection, 1 = small uredinia surrounded by necrosis; 2 = small uredinia surrounded by chlorosis; 3 = moderate size uredinia without necrosis or chlorosis; 4 = large uredinia without necrosis or chlorosis; + = uredinia larger than normal; - = uredinia smaller than normal; semicolon (;) = hypersensitive chlorotic or necrotic flecks; S = seedlings with scores of 3 or higher.

** Adult plant infection response evaluation from a field stem rust nursery at St. Paul, MN inoculated with a composite of races QFCSC, QTHJC, RCRSC, RKQQC, and TPMKC;

Table 4. Comparison of NE154203 to LCS Valiant and Wesley from 2015 to 2019 for flour yield, bran score, mill type score, mill type scores, flour protein content, ash content, Mixograph water absorption (water abs.), Mixograph mixing time (MTime), Mixograph tolerance (MTol.), loaf volume, and external appearance (Ext. score), crumb grain score, crumb texture score, and overall baking score (Overall) as determined by the Wheat Quality Laboratory at the University of Nebraska (Baenziger et al., 2001). All reported values were measured at a 140 g H₂O 1000 g⁻¹ flour basis.

Sample ID	Year	Milling			Flour			Mixograph				Baking		
		Flour Yield, %	Bran Score†	Mill Type Score†	Protein (%)	Ash (%)	Water Abs (%)	MTime (min)	Mtol.‡	Loaf Vol (cc)	Ext. Score§	Crumb Grain Score§	Crumb Texture Score§	Overall§
NE15420														
	2015	70.9	3.5	4.5	11.7	0.44	63.3	4.0	3.0	932.5	4.8	3.8	3.8	4.1
	2016	69.2	3.5	4.5	11.3	0.40	61.3	4.3	1.8	896.3	4.4	3.3	3.3	3.6
	2017	69.8	3.5	2.5	12.3	0.44	63.8	5.6	2.3	937.5	5.3	5.0	5.0	5.1
	2018	70.3	3.5	3.5	11.2	0.39	61.0	6.2	3.3	867.5	4.3	3.9	4.0	4.0
	2019	72.0	3.5	3.5	11.7	0.56	62.5	5.9	4.0	905.0	4.5	4.3	4.3	4.3
Mean		70.4	3.5	3.7	11.6	0.45	62.4	5.2	2.9	907.8	4.6	4.0	4.1	4.2
Sterr		0.5	0.0	0.4	0.2	0.03	0.5	0.4	0.4	12.8	0.2	0.3	0.3	0.2
NE10478-1 LCS Valiant (CHECK)														
	2015													
	2016	72.1	3.5	4.5	11.3	0.38	61.8	3.9	4.2	912.5	4.6	3.6	3.1	3.8
	2017	71.8	3.5	3.5	10.8	0.39	62.0	4.2	4.4	962.5	5.0	4.8	5.3	5.0
	2018	73.0	3.5	3.5	11.1	0.43	61.0	4.2	4.3	906.3	4.0	3.5	3.8	3.8
	2019													
Mean		72.3	3.5	3.8	11.1	0.40	61.6	4.1	4.3	927.1	4.5	4.0	4.0	4.2
Sterr		0.4	0.0	0.3	0.1	0.02	0.3	0.1	0.1	17.8	0.3	0.4	0.6	0.4
WESLEY (CHECK)														
	2015	74.6	3.5	4.5	11.7	0.35	61.5	3.9	4.2	967.5	4.8	4.8	5.0	4.8
	2016	73.8	3.5	4.5	11.3	0.36	61.5	5.7	4.5	982.5	5.4	4.4	4.5	4.8
	2017													
	2018													
	2019													
Mean		74.2	3.5	4.5	11.5	0.35	61.5	4.8	4.3	975.0	5.1	4.6	4.8	4.8
Sterr		0.4	0.0	0.0	0.2	0.00	0.0	0.9	0.2	7.5	0.3	0.2	0.3	0.0

† Scores use a 1 to 5 scale with 5 being very good and 1 being very poor

‡ Scores use a 0 to 7 scale with 7 being very tolerant.

§ Scores use a 0 to 6 scale with 6 being excellent

