

**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 SEVEN WINTER TRITICALE LINES

Seven winter triticale (x *Triticosecale* Wittmack) lines: NT05421, NT07403, NT09423, NT11406, NT11428, NT12414, and NT12434, developed cooperatively by the Nebraska Agricultural Experiment Station and the USDA-ARS were released in 2017 by the developing institutions. The lines were developed for grain or forage production primarily in the Great Plains and to provide triticale growers with greater diversity to select winter triticale lines for grain, forage, or cover crop. Moreover, the University of Nebraska has commercial triticale partners who have tested these lines in regions beyond Nebraska thus our testing network extends to locations beyond Nebraska. In this way, the USDA-University of Nebraska collaborative project is using a “participatory plant breeding” procedure where the USDA-University of Nebraska works with commercial partners who decide which of the advanced lines do best for them using their selection and commercialization criteria. Proprietary data from our cooperators are not shown and only data developed from Nebraska are presented. The agronomic data on the lines is presented in Table 1. The previously released winter triticale (‘NE426GT’) that is good for both grain and forage production (Baenziger et al., 2005) was used for head-to-head comparisons. ‘NE422T’ (Baenziger and Vogel, 2002), also previously released was included in the comparisons as it is an excellent forage triticale (4% better forage yielding than NE426GT). However, NE422T is a lower grain yielding line (16%) than NE426GT which increases the cost of seed production. Hence the two previously released cultivars represent the current grain and forage yield of commercially available winter triticale lines in our trials. In reviewing the forage data, no lines were significantly better than NE426GT, but two lines (NE11406 and NT12434) were significantly lower forage yielding than NE426GT. For grain yield, two lines (NT07403 and NT09423) were significantly better than NE426GT. No new line was significantly lower grain yielding than NE426GT. Hence most of the modern triticale lines were similar in forage yield and equal or better for grain yield to the currently available commercial lines. Considering other attributes, for flowering date, NE422T was significantly later than NE426GT which was expected. Only NT07403 was significantly earlier than NE426GT. The remaining lines were not significantly different from NE426GT. For plant height, NE422T, NT05421, and NT11428 were significantly taller than NE426GT, while NT07403 and NT12414 were significantly shorter than NE426GT. Triticale has few diseases in Nebraska and there are no regional nurseries, hence there is little disease or insect data to report. Historically, triticale is very resistant to most diseases commonly found in Nebraska, such as the rusts (incited by *Puccinia spp.*) and many of the virus diseases such as wheat streak mosaic virus which is prevalent in western Nebraska. For example in 2012, NT05421, NT07403, and NT09423 were evaluated in Kenya using field races (TTKSK and its derivatives; David Marshall, personal communication) and had stem rust (incited by *P. graminis Pers.: Pers. f. sp. tritici* Eriks & E. Henn.) infections of 10%,

1%, and 1% with infection types of S, S, and S, respectively, whereas in the same nursery 'Jagger' wheat (*Triticum aestivum* L.) ranged from 50% - 70% infection and infection type of S. For stripe rust (incited by *P. striiformis* Westendorp f. sp. *tritricina*), NT05421, NT07403, NT09423, and Jagger were all rated as having an infection type of moderately susceptible. In 2013, NT11406 and NT11428 were evaluated for stem rust resistance in Kenya using field races and both lines were rated as being resistant whereas Jagger ranged from 15% - 60% infected with a susceptible infection type of dead (killed by the disease). Stripe rust was not present in 2013. In Nebraska, when leaf rust (caused by *P. tritricina* Eriks.), stripe rust, or stem rust were present on wheat, NT05421, NT07403, NT09423, NT11406, NT11428, NT12414, and NT12434, would be considered as resistant. In years of high infection of ergot (caused by *Claviceps purpurea* (Fr.) Tul.), NT05421, NT07403, NT09423, NT11406, NT11428, NT12414, and NT12434, had very low infections. During its selection, experimental lines with ergot are routinely discarded. Triticale is susceptible to bacterial streak disease (incited by *Xanthomonas campestris* pv. *translucens* (Jones et al.) Dye). There were no significant differences among the lines tested. Note bacterial streak disease was absent the year that NT12414 and NT12434 were evaluated, so no data are presented for those lines.

Considering each line separately, NT05421 is a winter triticale with prostrate growth habit in the winter. It was derived from a complex cross mainly involving NE422T which the final cross was made in 1999. The F₁ was grown in the greenhouse in 2000 and the F₂ seed was planted as a bulk at Lincoln, NE and harvested with a combine in 2001 and replanted that fall at Lincoln, NE as an F₃ bulk. In 2002, F_{3:4} heads were snapped from the F₃ bulk and planted in Lincoln, NE that fall as individual short rows (approximately 75 cm long with 25 cm between rows). In 2003, based upon visual selection for the absence of disease, good straw strength, and agronomic appearance, the better rows were selected. The harvested seed was visually inspected for seed quality and ergot and those samples with poor seed quality (shriveled grain) and ergot were discarded. The remaining lines (F_{3:5}) were planted at Lincoln, NE in four row plots that were 3 m long with 25 cm between rows in the fall of 2003 and combine harvested in 2004. The center two rows were cut and threshed using a plot thresher. There was no further selection thereafter. Based upon grain yield, seed quality, and agronomic and resistance to disease, F_{3:6} lines were advanced for planting in fall of 2004 and harvesting in 2005 in a multilocation trial at Lincoln (single replication), Mead (two replications), and Sidney, NE (single replication). The name NT05421 is derived from the line being selected in Nebraska (N) being a triticale (T) in 2005 (hence 05) and being derived from plot 421. Thereafter it was tested in multilocation trials with three replications at the same three NE locations. The plant color at boot stage is blue-green and the stem is without anthocyanin. The neck is moderately hairy and straight. The flag leaf is upright, not twisted, and with a waxy bloom. The auricle is colorless. The head is awned and the color is yellow. The seed is amber in color, oval, wrinkled, and with a large and long brush.

NT07403 is a winter triticale with prostrate growth habit in the winter. It was derived from the cross NE98T424/FLOOD//NT00418 which was made in 2001. The pedigree of NE98T424 is PRESTO/NE91T409 and the pedigree of NT00418 is RAH-123/NE94T409. The same breeding procedure as described for NT05421 was used beginning with the cross being made two years later. The plant color at boot stage is green and the stem is without anthocyanin. The neck is hairy and straight. The flag leaf is drooping, twisted and with a waxy bloom. The auricle is colorless. The head is mid-dense, clavate, awned, and the color is tan. The glumes at maturity are pubescent, mid-long, narrow, with a wanting shoulder. The beak is acute. The seed is amber in color, oval, slightly wrinkled, and with a large and long brush.

NT09423 is a winter triticale with prostrate growth habit in the winter. It was derived from the cross NE426GT/NT01417, which was made in 2003. The pedigree of NT01417 is NE85T121/NE87T148//RAH-123. The same breeding procedure as described for NT05421 was

used beginning with the cross being made four years later. The plant color at boot stage is green and the stem is without anthocyanin. The neck is hairy and straight. The flag leaf is upright, not twisted and with a waxy bloom. The auricle is colorless. The head is mid-dense, fusiform, awned, and the color is tan. The glumes at maturity are glabrous, mid-long, narrow, with a wanting shoulder. The beak is acuminate. The seed is amber in color, ovate, wrinkled, and with a large and long brush.

NT11406 is a winter triticale with prostrate growth habit in the winter. It was derived from the cross NT04427//NE92T422/NE426GT sib/3/NT02458//CTM86.101/GWT 88-12 which was made in 2005. The pedigree of NT04427 is NE422T/TX95V711, the pedigree of NE92T422 is 85LT401/NE83T24, and the pedigree of NT02458 is RAH-123/NE90T413. The same breeding procedure as described for NT05421 was used beginning with the cross being made six years later. The plant color at boot stage is yellow-green and the stem is without anthocyanin. The neck is hairy and straight. The flag leaf is upright, twisted and with a waxy bloom. The auricle is colorless. The head is mid-dense, oblong, awned, and the color is yellow. The glumes at maturity are slightly pubescent, mid-long, and mid-wide with a wanting shoulder. The beak is obtuse. The seed is amber in color, oval, slightly wrinkled, and with a mid-size and short brush.

NT11428 is a winter triticale with prostrate growth habit in the winter. It was derived from the cross NE03T413/3/NT02458//CTM86.101/GWT 88-12 which was made in 2005. The pedigree of NE03T413 is NE426GT sib//TRICAL 2700. The same breeding procedure as described for NT05421 was used beginning with the cross being made six years later. The plant color at boot stage is green and the stem is without anthocyanin. The neck is hairy and straight. The flag leaf is upright, twisted and with a waxy bloom. The auricle is colorless. The head is mid-dense, fusiform, awned, and the color is yellow. The glumes at maturity are slightly pubescent, mid-long, and mid-wide with a wanting shoulder. The beak is obtuse. The seed is amber in color, oval, slightly wrinkled, and with a large and long brush.

NT12414 is a winter triticale with prostrate growth habit in the winter. It was derived from the cross NT05433//NE426GT which was made in 2006. The pedigree of NT05433 is NE426GT/TX95VT7117. The same breeding procedure as described for NT05421 was used beginning with the cross being made six years later. The plant color at boot stage is blue green and the stem is without anthocyanin. The neck is moderately hairy and straight. The flag leaf is recurved, twisted and without to a very small waxy bloom. The auricle is colorless. The head is mid-dense, fusiform, awned, and the color is tan. The glumes at maturity are slightly pubescent, long, and mid-wide with a wanting shoulder. The beak is acuminate. The seed is amber in color, oval, slightly wrinkled, and with a mid-size and mid-long brush.

NT12434 is a winter triticale with prostrate growth habit in the winter. It was derived from the cross NT01451/NT05434 which was made in 2006. The pedigree of NT01451 is OMI-4MI-3MI/NE91T410//RAH-123 and the pedigree of NT05434 is NE98T424/PLAI. The same breeding procedure as described for NT05421 was used beginning with the cross being made six years later. The plant color at boot stage is blue green and the stem is without anthocyanin. The neck is hairy and wavy. The flag leaf is drooping, twisted and with a waxy bloom. The auricle is colorless. The head is mid-dense, oblong, awned, and the color is tan. The glumes at maturity are slightly pubescent, long, and wide with a wanting shoulder. The beak is acuminate. The seed is amber in color, ovate, wrinkled, and with a large and long brush.

The lines have been uniform and stable since 2014. Less than 2.0% of the plants were rogued from the Breeder's seed increase in 2014-15. The rogued plants were taller in height or were awnless. Up to 3% off types may be encountered in future generations. Husker Genetics (Nebraska Foundation Seed Division), Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, Lincoln, NE 68583 had Foundation seed available to qualified certified seed enterprises in

2015 with the first sale of certified seed in 2016. The U.S. Department of Agriculture will not have commercial seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. All lines will be submitted for plant variety protection under P.L. 10577 with the certification option. A fee will be assessed on all certified seed sales. 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 of each line has been 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



Director, Nebraska Agricultural
Experiment Station

3/9/17

Date



Deputy Administrator, Crop Production and Protection
Agricultural Research Service, United States Department of Agriculture

2/28/17

Date

Table 1. Head to head comparisons of NE422T, NT05421, NT07403, NT09423, NT11406, NT11428, NT12414, and NT12434 to NE426GT for forage and grain yield, flowering date, plant height and bacterial streak from trials in Nebraska beginning in 2007 until 2015. Data on grain yield was from trials at up to three rainfed locations (Mead, Lincoln, and Sidney) and for forage yield was from up to two locations (Mead and Sidney) in Nebraska.

Cultivar	Trial Number	Line Forage		NE426GT Forage		Percent of NE426GT		Trial Number	Line Grain		NE426GT Grain		Percent of NE426GT		Trial Number	Line Flowering		NE426GT Flowering		Percent of NE426GT		Trial Number	Line Height		NE426GT Height		Percent of NE426GT				
		Yield kg/ha	Yield kg/ha	Yield kg/ha	Yield kg/ha	Yield kg/ha	Yield kg/ha		Yield kg/ha	Yield kg/ha	Yield kg/ha	Yield kg/ha	Yield kg/ha	Yield kg/ha		Date after Jan.1	Date after Jan.1	Date after Jan.1	Date after Jan.1	Height cm	Height cm		Height cm	Height cm	Significance	Significance	Significance	Significance	Significance	Significance	Significance
NE422T	8	9596	9252	104	n.s.†	14	3280	3931	83.5	**	10	146.5	142.6	103	**	11	147	120	123	**	11	147	120	123	**	11	147	120	123	**	
NT05421	8	9704	9252	105	n.s.	14	4178	3931	106	n.s.	10	141.8	142.6	99.5	n.s.	11	135	120	113	n.s.	11	135	120	113	n.s.	11	135	120	113	**	
NT07403	8	9174	9252	99.2	n.s.	14	4355	3931	111	**	10	138.8	142.6	97.4	**	11	116	120	96.7	**	11	116	120	96.7	**	11	116	120	96.7	*	
NT09423	5	9193	9433	97.4	n.s.	12	4414	3854	115	**	8	143	141.9	101	n.s.	10	120	122	98.7	n.s.	10	120	122	98.7	n.s.	10	120	122	98.7	ns	
NT11406	5	8377	8950	93.6	*	9	3641	3395	107	n.s.	6	141.6	140.9	101	n.s.	8	121	121	100	n.s.	8	121	121	100	n.s.	8	121	121	100	ns	
NT11428	5	9323	8950	104	n.s.	9	3627	3395	107	n.s.	6	141.7	140.9	101	n.s.	8	135	121	112	n.s.	8	135	121	112	n.s.	8	135	121	112	**	
NT12414	1	8923	9736	91.7	n.s.	2	3462	3168	109	n.s.	1	148.4	148.3	100	n.s.	1	115	124	93	n.s.	1	115	124	93	n.s.	1	115	124	93	*	
NT12434	1	8144	9736	83.7	**	2	2811	3168	91	n.s.	1	148.6	148.3	100	n.s.	1	124	124	100	n.s.	1	124	124	100	n.s.	1	124	124	100	ns	
Cultivar	Trial Number	Line Height	NE426GT Height	Percent of NE426GT	Significance	Trial Number	Line Height	NE426GT Height	Percent of NE426GT	Significance	Trial Number	Line Height	NE426GT Height	Percent of NE426GT	Significance	Trial Number	Line Height	NE426GT Height	Percent of NE426GT	Significance	Trial Number	Line Height	NE426GT Height	Percent of NE426GT	Significance	Trial Number	Line Height	NE426GT Height	Percent of NE426GT	Significance	
		cm	cm				Streak (0-9)	Streak (0-9)				Streak (0-9)	Streak (0-9)				cm	cm				cm	cm								
NE422T	11	147.3	120.1	123	**	2	2.15	2.2	97.7	n.s.																					
NT05421	11	135.4	120.1	113	**	2	2.65	2.2	121	n.s.																					
NT07403	11	116.1	120.1	96.7	*	2	2.65	2.2	121	n.s.																					
NT09423	10	120.4	121.9	98.7	n.s.	2	1.3	2.2	59.1	n.s.																					
NT11406	8	120.7	120.7	100	n.s.	2	2.5	2.2	114	n.s.																					
NT11428	8	134.6	120.7	112	**	2	2.5	2.2	114	n.s.																					
NT12414	1	115.1	123.7	93	*																										
NT12434	1	123.7	123.7	100	n.s.																										

† n.s., *, **, not significantly different, significantly different at the P=0.05 and P=0.01 probability level, respectively.