IMPROVING WHEAT VARIETIES FOR NEBRASKA

2013 STATE BREEDING AND QUALITY EVALUATION REPORT

Report to the

NEBRASKA WHEAT DEVELOPMENT, UTILIZATION
AND MARKETING BOARD

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I. INTRODUCTION

Wheat variety development research in Nebraska is a cooperative effort between the Agricultural Research Division, IANR of the University of Nebraska-Lincoln, and the Agricultural Research Service/USDA, Northern Plains Area. Winter wheat breeding, which includes variety, line, and germplasm development, is a major component of the state's wheat improvement research. This report will deal only with the state portion of the total wheat breeding effort (located in the Department of Agronomy and Horticulture at the University of Nebraska-Lincoln). Very important contributions come from state and federal researchers in the department and from Nebraska research and extension centers, as well as from state and private researchers in South Dakota, Wyoming, Kansas, Oklahoma, Texas, and Colorado. Other important contributions come from researchers in the Department of Plant Pathology (both state and federal); plant pathologists located at the USDA Cereal Disease Laboratory in St. Paul, Minnesota and USDA entomologists in Manhattan, Kansas and Stillwater, Oklahoma. All of these programs invest time and funds into this program. Grants from the Nebraska Wheat Development, Utilization and Marketing Board provide key financial support for this research. Without the Wheat Board's support, much of the state breeding efforts would be curtailed and many of the wheat quality analyses to evaluate our breeding material would not be available.

II. THE 2012-2013 NEBRASKA WHEAT CROP

1. <u>Growing Conditions</u>

The 2012-2013 growing season was generally one of drought everywhere. Wheat planting occurred during dry conditions. However, it rained after the wheat planting in Alliance. Most fields in western NE emerged, but poorly. North Platte was the worse with no emergence in January and under snow in February. There was enough moisture for the seed to vernalize if it had survived drought. The weather was normal for NE and the season was slightly later than normal and certainly considerably later than the 2011-12 season (earliest in the past 28 years). In general, everything survived the winter that should have survived, but the winter was strong enough to kill anything with spring growth habit. Sidney emerged, but was lost to freeze and rain in early spring.

North Platte: early summer 2013

2. <u>Diseases</u>

The predominant disease in 2013 in eastern Nebraska was bacterial streak, a disease in which fungicides do not control. Other diseases included barley yellow dwarf virus, wheat soilborne mosaic virus, leaf rust, stripe rust, Septoria tritici blotch, tan spot, powdery mildew, and Fusarium head blight (scab) observed at trace to low levels. In western NE, barley yellow dwarf virus, wheat streak mosaic and related viruses, stripe rust, Septoria tritici blotch, and tan spot were observed at trace to low levels. Drs. Stephen Wegulo (plant pathologist), Jeff Bradshaw and Gary Hein (entomologists monitoring insect vectors of disease), and Satyanarayana Tatineni (USDA-ARS virologist) continue to be invaluable in disease identification, survey, and understanding.

3. Insects

Nebraska continues to have small outbreaks of Hessian fly and the diseases vectored by aphids or mites (specifically wheat streak mosaic virus and the other mite transmitted viruses and barley yellow dwarf virus) However the major concern remains the continued spread of wheat stem sawfly into Nebraska. This is an emerging pest and the only known resistance mechanism through plant breeding carries with it a yield drag. Hence, in collaboration with Montana State University and Colorado State University, we are looking for novel resistance genes and mechanisms. Unfortunately, breeding for this insect pest will require more time and resources in the future. We are past the stage of wondering if it will come and find a home in Nebraska.

4. Wheat Production

In 2012-2013 season, 1,470,000 acres of wheat were planted in Nebraska and 1,130,000 were harvested with an average yield of 35 bu/a for a total production of 39,550,000 bu. This was one of the smallest crops in the last 50 years and certainly highlighted the effect of drought. In 2012, 1,380,000 acres of wheat were planted in Nebraska and 1,300,000 were harvested with an average yield of 41 bu/a for a total production of 53,300,000 bu. In 2011, 1,500,000 acres of wheat were planted in Nebraska and 1,400,000 were harvested with an average yield of 45 bu/a for a total production of 63,000,000 bu. In 2010, 1,600,000 acres of wheat were planted in Nebraska and 1,490,000 were harvested with an average yield of 43 bu/a for a total production of 64,070,000 bu. Despite continued genetic improvement, the main determinant in wheat production seems to be acres harvested, government programs, the price of corn, and weather (which also affects disease pressure and sprouting). This is an economic reality in understanding wheat yields and productivity in NE.

5. Cultivar Distribution

Nebraska did not take a variety survey in 2013. However, using seed sales of certified seed, the top 10 lines were: Settler CL (15.4%), Overland (12.4%), Tam 111 (9.4%), AP502CL2 (6.3%), Winterhawk (5.6%), Wesley (5.1%), Pronghorn (5.0%), Infinity CL (4.3%), Art (3.6%), and Camelot (3.3%). In 2012, TAM 111 (12.8%) inched ahead of Overland (12.7%) as the most widely grown wheat cultivar in Nebraska, followed by Pronghorn (9.6%). Pronghorn and Goodstreak (5.1%) are tall (conventional height) wheat varieties that have consistently done well in the drought prone areas of western Nebraska. Buckskin (4.7%) decreased slightly, indicating that tall wheats, which are adapted to drought in the west, remain very popular (19.4% of the total state acreage). Settler CL acreage (4.7%) increased rapidly in 2012.

While no wheat listed below has all of the characteristics of an ideal wheat, the diverse wheat varieties provide the grower an opportunity to choose high yielding, high quality wheat varieties that have resistance or tolerance to the diseases or insects prevalent in his or her region. Cultivars developed by the University of Nebraska wheat improvement program occupied 65.6% of the state acreage in 2012. Other public varieties occupied 17.4% (largely due to TAM 111) and private varieties occupied 17.0% (note the private cultivars do not include TAM 111 which was developed by Texas A&M but is marketed by Agripro) of the state acreage. What is interesting is that no variety dominated the acreage. Variety diversity is useful, as it should reduce genetic vulnerability to disease and insect pests.

-------------------------------------Percent---------------------------------

Variety	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
2137	10.3	7.8	4.3	**3.5**	1.4	2.1	1.7			
2145				**1.0**	1.2	2.2				
Above				**1.3**						
Agripro Abilene	1.4	1.7	1.7		1.0					
Agripro Art								2.4	4.3	3.6
AgriPro AAP503 CL										1.1
AgriPro Dumas					1.4	1.2				
Agripro Hawken							1.2	2.1		
Agripro Jagalene		4.5	16.8	**23.8**	33.4	20.9	13.8	8.5	5.4	2.4
Agripro Ogallala	3.6	2.4	2.0	**1.4**	1.0	1.1				
Agripro Postrock						1.1	4.1	4.4	3.3	2.4
Agripro Thunderbird	1.8									
Agripro Thunderbird								1.1		
Agripro Thunderbolt	2.0	3.0	1.9	**1.9**	2.0	2.4	1.6	1.5	2.2	
Akron	1.2									
Alliance	11.5	13.6	10.1	**10.1**	7.2	6.1	6.1	6.0	3.9	3.7
Arapahoe	8.7	6.8	5.2	**2.9**	2.0	3.4	2.2	2.1	1.5	
Armour									1	2.6
Bond CL										1.1
Buckskin	7.3	4.9	3.7	**5.0**	3.5	3.4	3.3	4.5	5.9	4.7
Camelot									1.1	2.3
Centura	1.8	2.1	2.4	**1.9**	1.3	1.0				
Culver	2.5									
Goodstreak			1.7	**3.7**	3.6	5.1	5.0	6.5	4.4	5.1
Hatcher							1.2	1.5	1.8	2.1
Hawken									1.5	
Infinity CL						2.3	3.5	3.7	3.3	4.3
Jagger	3.9	2.8	3.1	**2.5**	1.7	1.5	1.1			
Karl/Karl 92	3.8	3.3	2.7	**2.7**	1.6	2.9	2.5	1.6	2.1	1.4
Millennium	6.1	11.1	10.7	**9.5**	7.2	9.4	13.2	11.9	7.6	5.9
Niobrara	5.4	3.5	2.2							
Overland							3.4	5.6	10.8	12.7
Overly					1.0	1.1				
Platte	1.0	1.3	1.6							
Pronghorn	10.3	10.4	11.4	**10.1**	12.2	10.6	12.1	13.7	10.4	9.6
Scout & Scout 66	1.1									
Settler CL										4.7
Siouxland	1.4									
TAM 111				**1.2**	1.6	3.2	6.5	7.4	8.1	12.8
TAM 112									1.2	
Vista	1.2									
Wahoo	1.8	1.7	1.8	**1.8**	1.1	1.5	1.1			
Wesley	3.6	5.9	5.5	**5.8**	7.2	7.7	4.8	4.1	4.2	2.0
Winterhawk									1.3	3
Z Other Private Varieties	3.4	4.4	4.0	**3.8**	2.8	4.1	5.0	3.6	5.4	4.5
Z Other Public	4.9	8.8	7.2	**6.1**	4.6	5.7	6.6	7.8	9.3	8.0

Varieties										
Total	100	100	100	**100**	100	100	100	100	100	100

6. New Cultivars

In 2013, NE06545 was formally released on January 30, 2013. NE06545 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 2013 by the developing institutions. It was released primarily for its superior adaptation to rainfed wheat production systems throughout Nebraska and in states north and west of Nebraska. NE06545 will be marketed as Husker Genetics Brand Freeman Hard Red Winter Wheat in honor of Daniel Freeman, who is recognized as the first person to file for a homestead under the Homestead Act of 1862, which celebrated its 150th anniversary in 2012.

NE06545 was selected from the cross KS92-946-B-15-1/Alliance where the pedigree of KS92-946-B-15-1 is ABI86*3414/Jagger/Karl 92. That cross was made in 2000. The F_1 generation was grown in the greenhouse in 2001 and the F_2 to F_3 generations were advanced using the bulk breeding method in the field at Mead, NE in 2002 to 2003. In 2004, single F_3-derived F_4 rows were planted for selection. There was no further selection thereafter. The $F_{3:5}$ was evaluated as a single four row plot at Lincoln, NE and a single row at Mead, NE. NE06545 was identified in 2006 as the experimental line and was selected for further testing.

NE06545 was evaluated in Nebraska replicated yield nurseries starting in 2007, in the Southern Regional Performance Nursery in 2009 and 2010, in the Northern Regional Performance Nursery in 2011, and in Nebraska cultivar performance trials in 2010, 2011 and 2012. In the Nebraska Intrastate Nursery (2008 to 2012), NE06545 performed well across Nebraska and was not significantly different from Husker Genetics Brand Overland, the most widely grown cultivar in Nebraska. These data are supported by the 2009 and 2010 USDA-ARS Southern Regional Performance Nursery where NE06545 ranked 2 and 34 region-wide of the 46 and 48 entries tested in those years (data available at http://www.ars.usda.gov/Research/docs.htm?docid=11932). NE06545 was also tested in the Northern Regional Performance Nursery in 2011 where it ranked second out of 29 entries tested region-wide in that year. In the three years that it has been tested in the Nebraska State Variety Trials (full data available at http://cropwatch.unl.edu/web/varietytest/wheat), NE06545 was among the highest yielding lines across the state and was the highest yielding line in western NE. Based upon these data, NE06545 is adapted to all of Nebraska, but particularly to rainfed western NE wheat production.

Other measurements of performance from comparison trials indicate that NE06545 is moderately early in maturity (146.6 d after Jan.1, data from 8 observations in eastern NE), about 2 d earlier flowering than Wesley and Goodstreak and 3 days earlier flowering than 'Overland'. NE06545 is a semi-dwarf wheat cultivar and contains the *RhtB1b* (formerly *Rht1*, data provided by Dr. Guihua Bai). The mature plant height of NE06545 (85 cm) is 5 cm shorter than Overland and 4 cm taller than Wesley. NE06545 has moderate straw strength (6% lodged), similar to Camelot (6%) and McGill (8%), but higher than Wesley (3%) and Overland (3%). The winter hardiness of NE06545 is good and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska.

NE06545 is resistant to soilborne wheat mosaic virus. It is moderately resistant to moderately susceptible to stem rust (caused by *Puccinia graminis Pers.: Pers. f. sp. tritici* Eriks & E. Henn.) in field nursery tests inoculated with a composite of stem rust races (RCRSC, QFCSC, QTHJC, RKQQC, and TPMKC) at St. Paul, MN, and using field stem rust races, in Kenya. In greenhouse seedling tests, it is resistant to races QFCSC, QTHJC, MCCFC, SCCSC, QCCSM, heterogeneous to RCRSC and RKQQC, but susceptible to race TMPKC and TTKSK (data provided by Y. Jin at the USDA Cereal Disease Laboratory). It is moderately resistant to moderately susceptible to leaf rust (caused by *P. triticina* Eriks, data provided by J. Kolmer at the USDA Cereal Disease Laboratory) and to stripe rust (caused by *P. striiformis* Westendorp f.

sp. t*ritici,* data obtained from field observations in the Great Plains). It is moderately susceptible to Fusarium head blight (caused by *Fusarium graminearum*, data from greenhouse and field observations in Nebraska). NE06545 is moderately susceptible to susceptible to Hessian fly (*Mayetiola destructor* Say, data provided by Ming-Shun Chen, USDA and Kansas State University). It is susceptible to *Barley yellow dwarf virus* and *Wheat Streak mosaic virus* (data obtained from the Southern Regional Performance Nursery and field observations in NE).

NE06545 is lower in grain volume weight (72.5 kg/hl), which is similar to Camelot (73.2 kg/hl) and Wesley (73.0 lbs/bu) and lower than Overland (75.0 kg/hl). The milling and baking properties of NE06545 were determined for five years by the Nebraska Wheat Quality Laboratory. In these tests, Wesley, an excellent milling and baking wheat, was used for comparison. The average wheat and flour protein content of NE06545 (134 and 109 g kg^{-1}) were lower than Wesley (142 and 121 g kg^{-1}) for the corresponding years. The lower grain protein content was confirmed by the Nebraska State Variety Trials; where NE06545 had 120 g protein kg^{-1} compared to Wesley's value of 128 g kg^{-1}. The average flour extraction on the Buhler Laboratory Mill for NE06545 (722 g kg^{-1}) was lower than Wesley (747 g kg^{-1}). The flour ash content (3.9 g kg^{-1}) was lower than Wesley (4.5 g kg^{-1}), as well. Dough mixing properties of NE06545 were acceptable (mixtime peak was 5.34 minutes and mixtime tolerance was scored as 4.2 on a scale of 1 to 7 with 1 being very low tolerance and 7 being high tolerance to mixing) which were stronger than Wesley (mixtime peak of 4.40 minutes and mixtime tolerance scored as 3.90). Average baking absorption (611 H_2O g kg^{-1}) was similar to Wesley (610 H_2Og kg^{-1}) for the corresponding years. The average loaf volume of NE06545 (799 cm^3) was lower than Wesley (849 cm^3). The scores for the internal crumb grain and texture were 3.6 and 3.8, which were lower than Wesley was (4.4 and 4.7, respectively). The overall end-use quality characteristics for NE06545 (scored as 3.8, where 3.0 is fair, 4.0 is good and 7.0 is excellent) was lower than Wesley (4.6) and similar to many commonly grown wheat cultivars. NE06545 should be acceptable to the milling and baking industries.

In positioning NE06545, based on performance data to date, it should be well adapted to most rainfed wheat production systems in southeastern, south-central, west-central, and western Nebraska and in adjacent areas of the Great Plains. NE06565 is not recommended for irrigated wheat production due to its average straw strength and does not have the yield potential of the best available irrigated wheat cultivars (data not shown). NE06545 has an excellent grain yield record in organic production systems in eastern NE (highest yielding line using the average of three years for the 22 lines tested in all three years). However, NE06545 is not recommended for organic production due to its quality characteristics. Where it is adapted, NE06545 should be a replacement for Camelot, Millennium, and Wesley (for rainfed production), though Wesley has better straw strength. Only NE06545, McGill, and Wesley have excellent wheat soilborne mosaic virus resistance, which is needed in southeastern and south-central NE for early-planted wheat or wheat that is planted at the recommended seeding date followed by a warm fall. NE06545 is genetically complementary to virtually all wheat cultivars grown in Nebraska except for Alliance and Karl 92.

NE06545 is an awned, ivory-glumed cultivar. Its field appearance is most similar to Wesley, but can be easily separated from Wesley because Wesley has a 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 light waxy bloom on the leaf sheath, with a little waxy bloom on the spike at anthesis and on the leaves. The leaves are glaborous. The spike is tapering, narrow, mid-long, and middense. The glume is long and wide, and the glume shoulder is oblique to round. The beak is long in length with an acuminate tip. Kernels are red colored, hard textured, and mainly ovate in shape. The kernel has no collar, a large brush of long length, rounded cheeks, mid-size germ, and a wide and mid-deep crease.

The Nebraska Crop Improvement Association provided technical assistance in describing the cultivar characteristics and accomplishing technology transfer. 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 2013. The U.S. Department of Agriculture will not have commercial seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. NE06545 will be submitted for plant variety protection under P.L. 10577 with the certification option. A research and development 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 has been deposited in the USDA-ARS National Small Grains Collection, Aberdeen, ID and seed is freely available to interested researchers.

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Development team: P. S. Baenziger (breeder-inventor), R. A. Graybosch, D. Rose, Lan Xu, S. Wegulo, T. Regassa, D. Santra, G. Kruger, Y. Jin, J. Kolmer, Ming-Shun Chen, Guihua Bai, G. Hein, and J. Bradshaw.

Two other lines were given to certified seed producers to see if they like the lines in their commercial fields. If they like the line, they will be released. The first line is NE05496 and it was given to three producers in southwestern Nebraska. Though it was difficult to determine it merit in 2013 due to the drought, the decision was to drop the line.

The second line was NE05548. Based upon seed producers input the lines was recommended for release and formally released in January 27, 2014. NE005548 was selected from the cross NE97426/NE98574 where the pedigree of NE97426 is BRIGANTINA/2*ARAPAHOE and the pedigree of NE98574 is CO850267/RAWHIDE. The cross was made in 1999. The F_1 generation was grown in the greenhouse in 2000 and the F_2 to F_3 generations were advanced using the bulk breeding method in the field at Mead, NE in 2001 to 2002. In 2003, single F_3-derived F_4 rows were planted for selection. There was no further selection thereafter. The $F_{3:5}$ was evaluated as a single four row plot at Lincoln, NE and a single row at Mead, NE in 2004. NE05548 was identified in 2005 as the experimental line and was selected for further testing.

NE05548 was evaluated in Nebraska replicated yield nurseries starting in 2006, in the USDA-ARS coordinated Northern Regional Performance Nursery in 2008 and 2009, and in the University of Nebraska Fall Sown Wheat Performance Trials in 2009 to 2013. In the Nebraska Intrastate Nursery (2007 to 2013), NE05548 performed well in western Nebraska where taller wheat cultivars are preferred. These data are supported by the 2008 and 2009 USDA-ARS Northern Regional Performance Nursery where NE05548 ranked 2 and 6 region-wide of the 31 and 25 entries tested in those years (data available at http://www.ars.usda.gov/Research/docs.htm?docid=11932). In the last five years, it has been tested in western Nebraska in the Nebraska State Variety Trials across 20 environments (full data available at http://cropwatch.unl.edu/web/varietytest/wheat). NE05548 (3527 kg/ha) had higher grain yield than comparable tall winter wheat cultivars (Goodstreak, 3393 kg/ha; Pronghorn, 3165 kg/ha; and Buckskin, 3111kg/ha). It was similar in grain yield to Overland (3480 kg/ha), but lower yielding than Robidoux (3709kg/ha) and Settler CL (3595 kg/ha). Based upon these data, NE05548 is adapted to rainfed wheat production in western NE.

Other measurements of performance from comparison trials indicate that NE05548 is moderately late in maturity (147.1 d after Jan.1, data from 6 observations in eastern NE) which is very similar to Overland (147.3 d after Jan.1). NE05548 is a semi-dwarf wheat cultivar and contains the *RhtB1b* (formerly *Rht1*,).

The mature plant height of NE05548 (80.3 cm) in western NE (20 environments) is 2 cm shorter than Goodstreak, 4 cm shorter than Pronghorn, and 5 cm shorter than Buckskin, the latter being three very popular tall wheat cultivars. NE05548 is 4 cm taller than Overland, and 5 cm taller than Wesley in western NE. NE05548 is the tallest semi-dwarf wheat cultivar released to date by the USDA-University of Nebraska Wheat Improvement Program. NE05548 has moderate straw strength for a taller wheat (7% lodged in 2009-2012 trials in southwestern NE where lodging is more common; 15 environments), which was lower than Goodstreak (10%), and Pronghorn (16%). The winter hardiness of NE05548 is good and comparable to other winter wheat cultivars grown in Nebraska.

NE05548 is resistant to *Soilborne wheat mosaic virus* in field nurseries in Nebraska and to stem rust (caused by *Puccinia graminis Pers.: Pers. f. sp. tritici* Eriks & E. Henn.) in field nursery tests at St. Paul, MN. In greenhouse seedling tests, it is resistant to races QFCS, QTHJ, MCCF, RCRS, RKQQ, and TMPK, but susceptible to race TTTT (). It is moderately susceptible to susceptible for leaf rust (caused by *P. triticina* Eriks,) and to stripe rust (caused by *P. striiformis* Westendorp f. sp. t*ritici,* data obtained from field observations in the Great Plains). NE05548 is considered as being moderately susceptible to Fusarium head blight (caused by *Fusarium graminearum*, data from greenhouse and field observations in Nebraska) and moderately resistant for DON accumulation. NE05548 is moderately resistant to moderately susceptible to Hessian fly (*Mayetiola destructor* Say,). It is susceptible to *Barley yellow dwarf virus*, and *Wheat streak mosaic virus* (data obtained from the USDA-ARS Southern Regional Performance Nursery and field observations in NE).

NE05548 has lower grain volume weight (75.3 kg/hl), which is lower than Goodstreak (76.9 kg/hl), Pronghorn (77.0 kg/hl), and Buckskin (76.6 kg/hl). The grain protein content of NE05548 (11.6%) in western NE was similar to that of Wesley (11.5%). The milling and baking properties of NE05548 were determined for six years by the Nebraska Wheat Quality Laboratory. In these tests, Wesley, an excellent milling and baking wheat, was used for comparison. The average flour protein content of NE05548 (12.5%) was similar to Wesley (12.4%) for the corresponding years. The average flour extraction on the Buhler Laboratory Mill for NE05548 (774.7%) was slightly higher than Wesley (74.0 %). The flour ash content (0.43%) was similar to Wesley (0.42 %). Dough mixing properties of NE05548 were acceptable (mixtime peak was 3.72 minutes and mixtime tolerance was scored as 4.1 on a one to 7 scale where 7.0 is very tolerant) and weaker than Wesley (mixtime peak of 4.39 minutes and mixtime tolerance scored as 4.6). Average baking absorption (62.1 %) was higher than Wesley was (61.2 %) for the corresponding years. The average loaf volume of NE05548 (822 cm^3) was lower than Wesley was (841 cm^3). The scores for the internal crumb grain and texture were 3.7 and 3.7, which were lower than Wesley was (4.3 and 4.4, respectively). The overall end-use quality characteristics for NE05548 (scored as 3.8, where 3.0 is fair, 4.0 is good and 7.0 is excellent) was lower than Wesley (4.4) and similar to many commonly grown wheat cultivars. NE05548 should be acceptable to the milling and baking industries.

In positioning NE05548, based on performance data to date, it should be well adapted to most rainfed wheat production systems in western Nebraska and in adjacent areas of the Great Plains where taller wheat cultivars are preferred. However, NE05548 has a semi-dwarf coleoptile length similar to Camelot and shorter than Goodstreak (a tall wheat with a long coleoptile. NE05548 is not recommended for irrigated wheat production due to not having similar straw strength and comparable yield potential to the best available irrigated wheat cultivars (data not shown). Based on our data, NE05548 is also not adapted to or recommended for organic production. Where adapted, NE05548 should be a replacement for Goodstreak, Pronghorn, and Buckskin (under rainfed production). NE05548 is genetically complementary to virtually all wheat cultivars grown in Nebraska.

NE05548 is an awned, ivory-glumed cultivar. Its field appearance is most similar to Wesley, but can be easily separated from Wesley because Wesley has bronze chaff. After heading, the canopy is moderately closed and erect to inclined. The flag leaf is erect and twisted at the boot stage. The foliage is green with a waxy bloom on the leaf sheath, with little waxy bloom on the spike at anthesis and on the leaves. The leaves are glaborous. The spike is tapering, narrow, mid-long, and middense. The glume is medium long and medium wide, and the glume shoulder is square to elevated. The beak is very long in length with an acuminate tip. The spike is predominantly inclined at maturity with some erect spikes. Kernels are red colored, hard textured, and mainly ovate in shape. The kernel has no collar, a medium brush of medium length, rounded cheeks, midsize germ, and a narrow and shallow crease.

NE05548 has been uniform and stable since 2010. Less than 0.5 % of the plants were rogued from the Breeder's seed increase in 2010-13. 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 Crop Improvement Association provided technical assistance in describing the cultivar characteristics and accomplishing technology transfer. The Nebraska Foundation Seed Division, Department of Agronomy and Horticulture, University of Nebraska-Lincoln, Lincoln, NE 68583 had foundation seed available to qualified certified seed enterprises in 2012 with the first sale of certified seed in 2013. The U.S. Department of Agriculture will not have commercial seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. NE05548 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 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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III. FIELD RESEARCH

1. Increase of New Experimental Lines

Neither of the two lines (NE06607 and NI08708), previously under increase for possible release, were released. Though both lines had some good years, our recent releases, Overland, McGill, Freeman, Robidoux, and Panhandle were hard to beat in the major regions of Nebraska. Two lines are under increase for possible release in 2015. NE07531 is derived from the cross HBA142A/HBZ//Ale (=HBK0630-4-5)/3/NE98574 (=CO850267/Rawhide)/4/Hallam. The HB.. lines were lines gifted to Kansas State University by Pioneer when Pioneer reduced its hard red winter wheat breeding effort. NE07531 seems best suited for south central and southwestern Nebraska. It is moderately resistant to stem, leaf, and stripe rust, wheat soilborne mosaic virus, and acid soils. It is susceptible to wheat streak and triticum mosaic virus, and Hessian fly. NE09517 is derived from the cross Jagger/Thunderbolt//Jagalene. INE09517 seems best suited for central to western Nebraska. IKt is resistant to stem rust, moderately resistant to stripe rust, and moderately susceptible to leaf rust. It is susceptible to barley yellow dwarf virus, soilborne wheat mosaic virus, Septoria tritici, and bacterial leaf streak, Hessian fly, and acid soils.

Five lines (NE09517, NE10487, NE10589, NI09710H, and NE10718W) are under small-scale increase for possible release in 2016.

With the release of new varieties Overland, Camelot, Freeman, Goodstreak, McGill, Panhandle, Robidoux, and Settler CL, many of the most advanced current breeding lines are not expected to be released.

2. Nebraska Variety Testing

Numerous entries were included in some or all of the locations in the Fall Sown Small Grain Variety Tests in 2012. Twelve dryland, two dryland organic, and three irrigated locations (note Hemingford was partially damaged by hail which may affect the averaged results) in Nebraska were harvested for yield data.

In 2013, the top ten entries for dryland production (11 environments) were:

	Yield		Yield
Entry	bu/a	Entry	bu/a
LCS Mint	57.03	NE06607	55.07
Overland	55.82	NE08499	54.88
NE09517	55.28	T158	54.81
NE09521	55.24	NI08708	54.80
Freeman	55.17	BL11002	54.40

As would be expected the two lowest yielding lines were Scout 66 (44.38 bu/a) and Turkey (42.10 bu/a) which were 22% and 26% lower yielding (respectively) than the highest yielding line.

In 2012, the top ten entries for dryland production were:

	Yield		Yield
Entry	bu/a	Entry	bu/a
NE06545	59.31	WB Armour	55.38
SY Wolf	58.60	NI08708	55.13
McGill	56.44	NW0366	55.08
Overland	55.78	NE08659	55.06
Mattern	55.53	Settler CL	54.96

In 2011, the top ten entries for dryland production were:

	Yield		Yield
Entry	bu/a	Entry	bu/a
McGill	68.79	WB-Stout	66.43
NI08708	68.68	NW03666	66.00
Overland	68.23	Expedition	65.95
Robidoux	67.49	NE05496	65.45
NE02558	67.26	Infinity CL	65.00

3. Irrigated Wheat Trials:

(In 2013, only the site at Hemingford was harvested)

The top ten lines in 2013 were:

	Yield		Yield
Entry	bu/a	Entry	bu/a
SY Wolf	114	NW07505	110
NE09517	114	Mattern	108

LCH08-80	112	T163	108
Anton	110	NI06736	108
Armour	110	Panhandle (NE05548)	107

The irrigated data this year continues to show the benefits of having a dedicated irrigated wheat development nursery to select lines that have excellent performance (e.g. NI06736). Interestingly, Panhandle, a very tall semi-dwarf wheat, did well in this trial, which may indicate that it has a higher potential than our conventional tall wheat cultivars, when the conditions are right.

The top ten lines in 2012 were:

	Yield		**Yield**
Entry	bu/a	Entry	bu/a
WB-Aspen	86.87	NI07703	77.80
Brawl CL Plus	85.10	NE06430	77.80
Anton	82.63	SY-Wolf	76.57
WB- Armour	79.17	Byrd	76.47
Mattern	78.13	Settler CL	75.73

The top ten lines in 2011 were:

	Yield		**Yield**
Entry	bu/a	Entry	bu/a
SY-Wolf	99.47	NE06607	94.73
SY-Post Rock	97.03	NE06545	94.70
WB-Hitch	95.50	Wesley	94.53
WB-Cedar	95.33	NI07703	93.87
Expedition	95.00	Armour	93.83

As in the past, we have an experimental line irrigated nursery, which grows under irrigation in western Nebraska and under dryland conditions throughout the state. The goal of this nursery is to identify higher yielding lines under irrigation and under higher rainfall conditions, which periodically occur in Nebraska. In 2013 (next page), we were able to harvest two of the dryland sites (Lincoln and Alliance) and the irrigated site (Sidney, NE). We have made considerable progress in reducing height and lodging, but additional disease resistance is needed. The data is color coded with dark green having the greatest values and red having the lowest values. It should be noted that the tallest wheats will be coded red (undesirable for this nursery), while the highest yielding and test weights, will be in dark green. The yield data from Lincoln was not correlated with the data from Alliance or the irrigated site, however, the yield data from Alliance was weakly correlated with the data from the western irrigated site indicating some similarities among the sites.

Data from 2013:

Name	Lincoln bu/a	Alliance bu/a	Dryland Avg. bu/a	Rank	Sidney Irr. bu/a	Rank	Testweight lbs/bu	Height Avg in
Antelope	68.5	42.4	55.45	37	93.5	35	61.3	34.10
NI04421	66.5	52.7	59.60	18	111.1	2	62.9	34.13
NI06736W	81.5	48.3	64.90	5	99.5	25	61.7	32.30
NI06737W	72.2	42.1	57.15	32	101	23	62.4	33.70
NI07703	69.2	48.8	59.00	22	101.4	22	61.9	33.87
NI08707	67.8	53.3	60.55	15	109.9	3	60.8	32.67
NI08708	71.3	46.5	58.90	23	104.7	15	61.4	33.10
NI09707	65.3	48.7	57.00	33	109.7	4	61.6	31.73
NI09710H	76.8	49.7	63.25	7	95.3	33	60.1	33.23
NI10707	67.9	47.8	57.85	29	98.3	28	61.2	36.17
NI10712	64.3	49.0	56.65	34	107.7	6	61.4	35.50
NI10718W	67.5	54.6	61.05	13	107.1	7	62.5	34.43
NI10720W	68.5	50.8	59.65	17	112.3	1	62.8	33.43
WESLEY	74.0	48.2	61.10	12	103.8	17	61.2	33.17
Settler CL	69.8	46.9	58.35	28	106.2	13	61.8	32.83
NE09481	73.4	51.7	62.55	10	103.9	16	62.5	32.80
NW07534	65.1	48.2	56.65	34	106.3	12	61.2	31.37
NI12702W	84.9	45.8	65.35	2	85.8	38	61.6	34.33
NI12709	81.0	45.0	63.00	8	99.3	26	62.6	33.97
NI12713W	72.4	43.0	57.70	30	99.3	26	62.2	34.27
NI13701	58.5	44.8	51.65	39	76.7	40	61.3	36.57
NI13702	56.1	40.8	48.45	40	86.4	37	62.3	36.53
NI13703	73.1	52.7	62.90	9	106.9	9	63.4	33.87
NI13704	72.0	44.7	58.35	27	105.1	14	61.6	34.73
NI13705	72.6	47.5	60.05	16	106.6	10	63.7	34.90
NI13706	80.1	50.0	65.05	3	98.3	28	61.8	32.57
NI13707	69.5	48.2	58.85	24	103.3	18	62.6	31.43
NI13708	76.5	53.6	65.05	3	95.4	32	62.6	31.80
NI13709	68.3	41.1	54.70	38	94.3	34	60.8	35.10
NI13710	68.2	44.8	56.50	36	106.6	10	63.8	33.43
NI13711	71.4	49.7	60.55	14	107	8	62.9	34.97
NI13712	68.6	48.9	58.75	25	102.2	21	63.1	33.47
NI13713	71.6	47.6	59.60	19	102.4	20	63.5	33.70
NI13714	75.2	43.5	59.35	20	92	36	62	33.10
NI13715	68.0	46.5	57.25	31	100.6	24	61.5	35.93
NI13716	74.9	47.9	61.40	11	96	30	61.6	34.53
NI13717	81.3	48.3	64.80	6	108.7	5	62.4	35.33
NI13718	69.5	47.4	58.45	26	85.7	39	60.6	33.77
NI13719	71.0	47.5	59.25	21	95.5	31	61.1	34.80
NI13720	83.6	47.5	65.55	1	102.5	19	61.9	31.10
Mean	71.45	47.66	59.555		100.72		61.99	
LSD	7.87	9.11	8.49		11.44		1.1	
CV	6.74	11.75	9.245		6.94		1.09	
Heritability	0.98	0.52	0.75		0.98		0.98	

Data from 2012:

	Lincoln	N. Platte	Alliance	Kansas	**Average**	**Rank**	**NE. Avg.**	**NE-Rank**	Height	Anthesis	TestWT
name	bu/a	bu/a	bu/a	bu/a	bu/a		bu/a		(in)	(Julian day	lbs/bu
Antelope	44.70	46.10	48.20	60.00	**49.75**	**33**	**46.33**	**30**	36.44	125.5	63.98
TAM111	50.20	52.30	51.70	71.10	**56.33**	**10**	**51.40**	**13**	24.80	118.9	52.23
WESLEY	52.20	45.90	52.90	61.60	**53.15**	**21**	**50.33**	**16**	29.11	128.5	57.87
NI04421	61.30	56.80	55.00	71.00	**61.03**	**1**	**57.70**	**3**	20.57	123.1	48.89
NI06736W	39.90	52.20	44.60	79.30	**54.00**	**19**	**45.57**	**33**	32.52	117.4	60.97
NI06737W	41.00	41.60	46.00	74.40	**50.75**	**29**	**42.87**	**37**	36.29	117.2	63.50
NI07703	45.50	49.70	48.00	82.10	**56.33**	**10**	**47.73**	**24**	27.24	117.9	56.38
NI08707	56.40	41.20	50.30	75.50	**55.85**	**13**	**49.30**	**20**	27.43	117.8	55.08
NI08708	54.80	51.00	54.30	74.40	**58.63**	**6**	**53.37**	**8**	22.46	119.1	49.85
NI08714	38.20	34.30	52.20	61.60	**46.58**	**40**	**41.57**	**40**	40.52	117.3	65.94
NI09703	57.90	41.60	52.50	58.50	**52.63**	**23**	**50.67**	**15**	29.56	125.1	56.55
NI09707	49.20	44.30	48.40	69.80	**52.93**	**22**	**47.30**	**26**	31.77	116.1	57.96
NI09710H	58.10	48.60	50.30	72.90	**57.48**	**8**	**52.33**	**10**	23.44	122.7	52.05
NI10703	50.80	40.90	41.00	59.30	**48.00**	**37**	**44.23**	**35**	38.74	123.2	65.65
NI10705	50.50	34.10	51.40	50.90	**46.73**	**39**	**45.33**	**34**	39.44	129.6	67.68
NI10707	48.30	42.90	48.80	69.10	**52.28**	**24**	**46.67**	**28**	32.89	118.6	59.83
NI10712	51.30	46.20	49.10	73.60	**55.05**	**16**	**48.87**	**21**	28.62	124.4	58.01
NI10718W	60.20	51.70	51.70	69.30	**58.23**	**7**	**54.53**	**6**	22.51	124	50.84
NI10720W	52.10	43.20	49.00	62.90	**51.80**	**27**	**48.10**	**22**	32.37	127.5	60.62
Settler C	54.60	49.10	51.80	81.80	**59.33**	**3**	**51.83**	**12**	22.28	121.4	51.89
NE08402	51.70	31.80	42.00	73.50	**49.75**	**33**	**41.83**	**39**	37.94	118.8	65.25
NE08410	49.00	32.20	44.90	64.30	**47.60**	**38**	**42.03**	**38**	39.34	119.9	65.75
NE08509	59.20	46.70	52.20	58.20	**54.08**	**18**	**52.70**	**9**	26.57	124	53.19
NE09481	55.40	45.30	55.90	80.60	**59.30**	**4**	**52.20**	**11**	22.40	116.2	49.87
NE09499	57.10	37.20	49.30	65.20	**52.20**	**25**	**47.87**	**23**	31.96	119.7	58.22
NW07534	66.80	57.20	50.80	69.20	**61.00**	**2**	**58.27**	**2**	20.76	123.8	48.85
NI12701	56.50	45.70	47.60	57.30	**51.78**	**28**	**49.93**	**17**	31.64	124.5	57.71
NI12702	65.70	60.20	50.20	60.50	**59.15**	**5**	**58.70**	**1**	21.57	127.9	50.16
NI12703	71.20	46.10	43.90	61.30	**55.63**	**14**	**53.73**	**7**	24.91	124.7	52.20
NI12704	50.00	44.40	43.90	61.10	**49.85**	**32**	**46.10**	**31**	36.37	124.3	63.89
NI12705	59.20	50.70	54.30	50.00	**53.55**	**20**	**54.73**	**5**	26.58	127.2	52.93
NI12706	50.50	50.50	52.20	76.60	**57.45**	**9**	**51.07**	**14**	24.69	116.9	51.86
NI12707	45.00	45.60	50.80	65.90	**51.83**	**26**	**47.13**	**27**	33.38	120	60.13
NI12708	48.60	38.00	44.60	70.80	**50.50**	**30**	**43.73**	**36**	36.58	122.5	65.03
NI12709	49.50	47.80	51.40	76.40	**56.28**	**12**	**49.57**	**19**	26.86	121.8	55.89
NI12710	53.60	37.60	48.50	57.50	**49.30**	**35**	**46.57**	**29**	36.86	124.7	63.52
NI12711	69.50	45.20	53.60	52.70	**55.25**	**15**	**56.10**	**4**	25.03	126.7	51.91
NI12712	54.10	40.10	48.50	58.10	**50.20**	**31**	**47.57**	**25**	34.52	126.1	61.87
NI12713	57.30	46.30	45.60	69.00	**54.55**	**17**	**49.73**	**18**	28.24	118.3	54.85
NI12714	42.00	41.70	53.50	59.40	**49.15**	**36**	**45.73**	**32**	37.91	122.3	64.07
GRAND M	**53.23**	**45.10**	**49.52**	**66.67**	**53.63**		**49.28**		**30.08**	**122.14**	**57.57**

The 2011 yield data are (lines highlighted in yellow are released lines):

	Linc.	N.Platte	Alliance	**Dryland Average**	**Dryland Rank**	Kansas-IRR	**Alliance IRR**	**Irrigated Ave**	**IRR Rank**
	bu/a	bu/a	bu/a	**bu/a**		bu/a	bu/a	bu/a	
NI08707	63.53	41.15	70.75	**58.48**	**3**	96.82	72.94	84.88	**1**
Settler CL	55.34	47.54	62.26	**55.05**	**9**	92.27	76.56	84.42	**2**
NE03490	47.60	39.20	58.71	**48.50**	**33**	88.53	75.73	82.13	**3**
NI09710	65.66	48.36	61.87	**58.63**	**2**	87.48	76.39	81.94	**4**
NI09709	63.13	37.23	68.18	**56.18**	**6**	92.24	71.44	81.84	**5**
NI10702	47.06	41.18	58.81	**49.02**	**30**	84.16	79.20	81.68	**6**
NI10708	52.22	41.59	60.32	**51.38**	**20**	89.37	72.39	80.88	**7**
NI09715	55.84	39.64	66.29	**53.92**	**11**	84.58	74.59	79.59	**8**
NI10701	54.41	43.47	65.17	**54.35**	**10**	85.05	73.27	79.16	**9**

TAM111	57.57	45.53	63.43	55.51	7	92.43	65.02	78.73	10
NI08708	65.41	46.55	67.53	59.83	1	87.24	69.47	78.36	11
NI07703	53.85	33.01	58.89	48.58	32	88.15	68.28	78.22	12
NI10704	42.77	45.67	61.82	50.09	26	75.96	78.44	77.20	13
NI08714	49.12	42.16	63.41	51.56	18	81.27	72.30	76.79	14
NI10707	55.65	38.39	59.87	51.30	21	80.34	72.95	76.65	15
NI08715	54.14	48.30	53.60	52.01	15	87.18	66.09	76.64	16
NI10713	58.69	46.47	69.55	58.24	4	86.02	66.65	76.34	17
NI03427	49.47	40.76	58.75	49.66	27	78.79	72.99	75.89	18
NI09707	50.91	45.25	58.21	51.46	19	81.65	69.21	75.43	19
NI09714	44.43	47.95	63.72	52.03	14	87.23	63.58	75.41	20
NI10718	48.65	43.28	63.31	51.75	17	75.28	75.23	75.26	21
NI06737	46.10	41.65	54.52	47.42	34	85.00	63.33	74.17	22
NI10720	47.04	50.84	55.67	51.18	22	78.04	69.97	74.01	23
NI10717	44.93	37.86	63.29	48.69	31	85.80	60.46	73.13	24
WESLEY	43.83	40.53	62.73	49.03	29	77.65	67.90	72.78	25
NI09703	56.79	42.50	57.78	52.36	13	75.65	68.75	72.20	26
NI09706	56.06	40.43	69.97	55.49	8	75.98	67.99	71.99	27
NI06736	53.42	38.79	49.05	47.09	36	73.77	68.76	71.27	28
Antelope	46.42	31.49	54.57	44.16	39	73.00	67.53	70.27	29
NI10712	41.60	43.42	63.71	49.58	28	75.96	63.60	69.78	30
NI04421	58.04	47.82	68.12	57.99	5	79.40	60.04	69.72	31
NI10716	54.94	40.39	64.55	53.29	12	68.21	69.48	68.85	32
NI10705	52.80	41.23	61.86	51.96	16	74.96	62.21	68.59	33
NI10709	45.97	39.92	55.84	47.24	35	73.70	61.60	67.65	34
NE04490	52.13	41.60	58.66	50.80	24	71.57	63.64	67.61	35
Anton	41.14	34.78	55.62	43.85	40	68.38	65.93	67.16	36
NI06731	54.36	37.81	60.00	50.72	25	69.79	64.06	66.93	37
NI10711	53.57	40.30	58.76	50.88	23	73.78	57.65	65.72	38
NI10706	47.60	32.45	52.83	44.29	38	55.75	75.62	65.69	39
NI10703	42.09	41.13	56.10	46.44	37	59.57	69.68	64.63	40
AVERAGE	51.86	41.69	60.95			79.95	69.02	74.49	
LSD	7.63	6.34	8.43			16.29	16.23		
CV	7.53	7.78	7.08			10.42	12.03		

4. Nebraska Intrastate Nursery:

The 2013 Nebraska Intrastate Nursery (NIN) was planted at seven locations (Lincoln, Mead, Clay Center, McCook (added due to generous support from ConAgra), North Platte, Sidney, and Hemingford, NE). A collaborative site was in Kansas. The data from Sidney and North Platte were lost due to freeze damage and drought respectively. The averages are given for all locations in Nebraska and overall locations. The nursery means ranged from 42 bu/a at McCook to 72 bu/a at Clay Center. The yields at McCook were quite remarkable as the drought was severe hence are due to the skills of the grower. As in the past, the correlation between sites ranged from r= -0.10 n.s. (n= 60, McCook and Alliance) to a high of r =0.87** (n=60, Lincoln with Mead indicating in this year both sites provided similar data. The low correlation between sites emphasizes that it is important to continue testing at all of our sites to represent the possible growing areas for our advanced lines. Of the released lines, Freeman (NE06545) did well.

	Mead	Lincoln	C Center	McCook	Alliance	Average	Rank	Hutcheson	NE+KS Avg	Rank	Avg. L and CC	Average
								KS			Test Wt	Height
name	Bu/a	Bu/a	Bu/a	Bu/a	Bu/a	Bu/a		Bu/a			lbs/bu	(in)
WESLEY	70.0	66.6	73.3	43.1	56.5	61.9	46	61.7	61.9	47	56.95	39.2
OVERLAND	71.0	73.7	73.8	39.6	59.8	63.6	31	73.9	65.1	18	58.9	42.4
NE01481	70.6	71.1	67.4	38.9	49.8	59.6	53	66.0	60.5	51	57.75	42.7
NE06430	72.8	76.8	73.1	44.5	56.0	64.6	20	67.4	65.0	20	58.7	42.1
NE06545	80.6	82.4	72.4	40.6	61.2	67.4	5	64.3	67.0	6	56.4	40.9
NE06607	76.5	74.8	76.7	46.6	58.6	66.6	7	64.0	66.3	10	58.45	41.1
NE07486	75.9	72.8	79.6	46.7	52.8	65.6	14	71.9	66.5	7	59.4	41.5
NE07531	77.8	77.5	83.3	43.4	60.4	68.5	3	68.9	68.5	2	58.7	41.6
NE08499	76.5	77.4	74.5	44.5	57.6	66.1	10	57.8	64.9	22	59.45	42.5
NE08659	59.5	60.3	71.7	32.2	54.5	55.6	57	66.5	57.2	57	57.6	42.4
NE09517	73.4	73.1	82.4	39.6	60.7	65.8	11	64.3	65.6	14	60	43.3
NE09521	75.4	70.8	77.5	36.1	62.5	64.5	22	65.6	64.6	23	58.05	42.0
NE10418	70.7	72.1	71.4	40.2	55.2	61.9	44	67.2	62.7	42	59.45	43.8
NE10442	79.8	77.4	66.8	39.1	58.6	64.3	23	61.7	64.0	29	60.25	42.2
NE10478	74.3	77.9	81.3	45.7	56.5	67.1	6	69.8	67.5	4	60.9	40.3
NE10507	79.2	82.2	73.7	41.8	55.5	66.5	8	65.7	66.4	9	56.95	41.5
NE10589	79.8	80.4	71.4	46.6	68.5	69.3	1	65.2	68.7	1	59.1	41.6
NE10625	73.4	71.7	71.3	40.3	61.8	63.7	30	57.8	62.9	39	58.75	41.6
NI04421	69.2	71.1	67.5	53.0	55.6	63.3	35	67.1	63.8	30	58.1	41.4
NE05496	66.1	67.5	78	54.0	54.8	64.1	24	66.6	64.4	24	57.85	42.1
NE10683	78.9	84.0	77.2	40.5	58.0	67.7	4	70.0	68.0	3	57.1	41.6
NE11415	71.2	76.9	74.7	41.8	55.0	63.9	27	65.6	64.2	26	59.5	40.5
NE11455	69.5	77.2	73.1	37.6	55.8	62.6	39	65.2	63.0	37	60.35	42.2
NE11472	74.2	76.6	73.3	44.4	55.9	64.9	18	67.1	65.2	15	59.65	41.8
NE11482	74.7	76.5	74.3	44.6	57.3	65.5	17	62.9	65.1	17	58.85	43.1
NE11499	73.4	72.7	71.3	49.0	49.8	63.2	36	65.3	63.5	31	60.2	39.9
NE11536	73.8	60.6	74.6	43.6	58.2	62.2	43	66.0	62.7	41	58.35	40.8
NE11560	75.6	80.8	74.3	31.1	57.5	63.9	28	60.8	63.4	34	58.05	40.5
NE11607	73.2	72.1	61.4	45.7	57.1	61.9	45	64.8	62.3	43	54.5	42.7
Camelot	71.3	65.9	76.9	46.5	61.8	64.5	21	68.4	65.0	19	58.45	42.7
NH10665	76.6	70.0	71.6	43.4	56.0	63.5	33	61.1	63.2	36	59.3	43.6
NH11489	72.2	77.6	73.9	44.2	59.6	65.5	16	71.6	66.4	8	59.15	41.3
NH11490	74.7	81.7	74.1	49.6	62.6	68.5	2	61.1	67.5	5	60.95	40.8
NH11563	77.0	73.7	73.6	35.9	58.6	63.8	29	66.3	64.1	27	59.05	43.8
NH11565	76.2	74.8	76.8	31.3	53.0	62.4	41	66.5	63.0	38	59.25	39.7
NH11668	64.7	69.0	72.9	37.6	56.7	60.2	52	58.9	60.0	52	59.2	42.0
NHH09655	67.6	65.3	71.7	32.9	50.0	57.5	56	57.3	57.5	56	55.7	39.9
NHH11569	68.6	68.7	74.6	46.6	53.9	62.5	40	59.8	62.1	44	59.5	43.3
NHH11638	78.0	78.9	70.9	48.4	51.4	65.5	15	68.2	65.9	11	60.15	42.9
Settler CL	67.9	68.0	72.7	52.4	56.0	63.4	34	69.2	64.2	25	58.7	41.0
NI04420	77.7	76.7	75.2	40.4	58.5	65.7	12	60.3	64.9	21	59.7	42.0
NI07703	73.7	65.8	71.6	42.4	59.9	62.7	37	63.8	62.8	40	57.9	41.5
NI08708	70.3	69.0	74.5	41.4	62.6	63.6	32	60.9	63.2	35	57	41.0
NI09710H	71.9	69.1	76.8	42.9	67.8	65.7	12	66.9	65.9	12	55.25	40.2
NI10712	66.2	63.3	68	36.2	59.8	58.7	54	61.2	59.1	55	55	41.5
NI10718W	72.0	67.6	70	38.0	54.6	60.4	50	62.1	60.7	50	57.15	41.4
NI12702W	73.7	73.0	72.2	44.7	60.3	64.8	19	59.7	64.1	28	59.85	42.4
NW03666	75.0	67.2	80.8	50.8	57.8	66.3	9	61.6	65.6	13	58.8	42.3
NW07505	71.0	70.1	75.1	42.0	61.9	64.0	26	60.4	63.5	32	57.6	42.6
NW09627	57.1	62.4	77.8	45.5	64.5	61.5	47	60.3	61.3	48	57	40.3
NW10487	53.0	54.9	67.7	41.7	59.1	55.3	58	61.0	56.1	58	55.55	42.0
NW11510	72.7	76.9	62.6	40.0	53.4	61.1	48	67.1	62.0	46	59.05	41.6
NW11511	78.5	73.6	64.3	46.6	57.2	64.0	25	71.6	65.1	16	57.55	40.5
NW11590	70.0	68.9	67.5	40.4	54.9	60.3	51	54.2	59.5	53	58.65	42.0
NW11598	69.1	74.4	72.6	40.4	56.9	62.7	37	68.1	63.5	33	58.7	41.0
NE05548	68.0	66.6	72.1	38.4	59.9	61.0	49	59.8	60.8	49	57.95	44.8
NE11688	76.2	78.3	64.6	38.4	54.4	62.4	42	60.3	62.1	45	55.95	42.1
GOODSTREAK	64.2	59.6	66.5	40.4	62.2	58.6	55	64.7	59.5	54	58.7	43.8
SCOUT66	51.2	47.7	60	37.9	51.0	49.6	59	52.0	49.9	59	58	44.4
CHEYENNE	41.1	39.1	56	40.0	44.3	44.1	60	53.4	45.4	60	57.85	47.1
GRAND MEAN	**71.4**	**71.22**	**72.45**	**42.21**	**57.37**	**62.932**		**63.99**				
LSD	8.54	6.42	8.79	11.27	8.38			7.2				
CV	**7.37**	**6.45**	**7.5**	**13.17**	**7.55**			**6.93**				
Heritability	**0.99**	**0.99**	**0.72**	**0.98**	**0.98**			**0.98**				

Our newer experimental lines have performed very well compared to the previously released lines, as we would hope, if continual progress was being made. Cheyenne and Scout 66 were the lowest yielding lines as expected.

Fifty-three wheat samples in 2013 NIN were analyzed were analyzed for wheat milling and breadmaking end-user quality after harvesting in 2013. There were significant differences in kernel characteristics among these cultivars. The kernel hardness indexes were 57.2±9.7. Less than half (45%) cultivars including checks (Overland, Camelot, Settle CL, and Cheyenne) had good hardness indexes, which were between 60.0 and 80.0, and other cultivars had low hardness (< 60.0) including checks (Wesley, Goodstreak and Scout66). Six cultivars were classified as mixed, two cultivars were soft, and the rest of cultivars were classified as hard. The kernel diameters and weights were 2.6±0.1 mm and 29.7±1.8 mg, respectively. All cultivars, including all checks, got diameters ≥ 2.4 mm. However, only 47% cultivars including checks (Camelot, Settle CL, and Scout66) got big weights (≥ 30.0 mg), and the remaining cultivars, including all checks (Wesley, Overland, Goodstreak and Cheyenne), got small weights (< 30.0 mg).

There were significant differences in milling properties among these cultivars. The flour, bran and short yields were 70.5±2.1%, 31.7±6.4%, and 3.2±1.0%, respectively. 94% cultivars, including all checks, produced high flour yield (≥ 68.0%). The bran, short and milling scores were 3.0±0.8, 2.8±0.8, and 2.5±1.3, respectively. 63% cultivars, including all checks (except Scott66), gave fair or better bran cleaning.

There were significant differences in ash contents among these cultivars. The ash contents of white flour at 14% mb were 0.40±0.05%. Except of NE10478, all cultivars including all checks had low ash contents (< 0.50%).

There were significant differences in protein contents among these cultivars. The protein contents of whole wheat at 12% mb were 14.4±0.6%. All cultivars including all checks got high protein contents of whole wheat (≥ 12.0%). The protein contents of white flour at 14% mb were 12.9±1.3%. After milling, protein contents were lost 1.2±1.0%. All cultivars including all checks had high protein contents of white flour (≥ 11.0%).

There were significantly differences in dough rheology and most samples had good dough rheological properties among these cultivars. The flour water absorptions (abs) at 14% mb were 65.3±2.0%. All cultivars including all checks had abs ≥ 60.0%, except of NE06545 and NI04421, other cultivars including checks had high water abs (≥ 62.0%). The mixography peak times (PT), which indicated dough extensibility, were 4.11±1.00 min. 85% cultivars, including checks (Wesley, Camelot, Settler CL, Scoutt66 and Cheyenne), obtained good dough extensibility so PT were between 4.0 and 6.0 min. 13% cultivars, including checks (Overland and Goodstreak), obtained very small dough extensibility (PT < 3.0 min), and the others obtained very large dough extensibility (PT ≥ 6.0 min). The mixograph peak torque (PQ), which were dough max strengths, were 42.3±3.9 %TQ. Only 20% cultivars including checks (Wesley and Scoutt66) gave good dough max strengths that PV were between 45.0 and 55.0 %TQ, and all other cultivars including checks (Overland, Camelot, Settler CL, Goodstreak and Cheyenne) gave weak dough max strengths (PV < 45.0 %TQ). The mixograph areas in 8 min, which were dough resistances to extension for mixing (REM) 132±26 %TQ·min, respectively. 89% cultivars including checks (Wesley, Overland, Camelot, Settler CL, Scoutt66 and Cheyenne) got good dough REM that areas were between 100 and 200 %TQ·min. The mixing tolerance scores (TS) were 4.1±0.9. 89% cultivars including checks (Wesley, Camelot, Settler CL, Scoutt66 and Cheyenne) had fair or better TS and the other cultivars including checks (Overland and Goodstreak) had poor TS.

The 2012 data are presented below:

name	Kansas	Mead	Linc.	Clay Cen.	N. Platte	McCook	Sidney	Heming.	Avg.	NE Avg.	Rank	NE Rank
	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a
WESLEY	56.2	66.3	50.1	42.4	42.1	71.9	62.3	26.5	52.23	51.66	38	41
Overland	61.9	78.6	57.6	63.3	47.0	76.6	66.4	22.4	59.23	58.84	7	6
NE05496	62.4	57.6	50.0	48.6	38.6	77.3	69.9	25.3	53.71	52.47	29	36
NE05548	41.1	60.0	47.6	50.5	36.7	59.4	63.0	23.6	47.74	48.69	55	54
NE06430	59.8	63.0	49.6	51.6	45.1	79.3	65.6	25.5	54.94	54.24	21	23
NE06545	62.1	72.0	59.8	64.5	54.2	82.0	60.5	26.6	60.21	59.94	5	3
NE06607	57.5	65.8	51.9	54.4	44.0	75.4	60.0	25.2	54.28	53.81	25	26
NE07486	79.0	67.0	51.3	60.8	52.1	79.8	67.3	24.7	60.25	57.57	4	11
NE07531	55.7	60.6	50.7	51.7	42.2	79.9	60.5	26.1	53.43	53.10	32	30
NE07627	45.4	66.9	51.0	54.4	44.2	69.9	61.9	25.5	52.40	53.40	36	28
NE08457	55.2	57.4	50.5	49.2	40.6	58.3	49.9	24.4	48.19	47.19	53	56
NE08476	50.3	62.9	51.7	61.5	38.5	54.7	61.9	23.7	50.65	50.70	45	45
NE08499	61.1	66.7	51.3	54.4	46.8	75.3	66.7	26.4	56.09	55.37	15	14
NE08527	49.7	68.5	54.7	55.1	32.9	62.0	52.2	25.3	50.05	50.10	48	48
NE08555	63.6	62.3	50.4	59.2	42.8	65.9	56.2	26.6	53.38	51.91	33	38
NE08659	41.1	64.2	55.1	60.1	27.4	64.2	61.5	25.1	49.84	51.09	49	43
NE09491	49.6	64.6	45.2	53.4	37.9	65.4	59.3	26.5	50.24	50.33	47	46
NE09495	28.2	69.3	56.0	26.3	47.0	73.6	61.6	21.7	47.96	50.79	54	44
NE09499	53.2	64.2	55.0	43.7	36.7	67.4	59.2	23.3	50.34	49.93	46	50
NE01481	51.7	78.9	63.0	57.1	47.7	73.4	63.2	25.0	57.50	58.33	11	9
NE09517	67.0	63.3	49.2	64.6	50.5	74.9	46.7	25.8	55.25	53.57	20	27
NE09521	61.6	73.8	51.0	61.4	54.8	75.5	65.1	27.2	58.80	58.40	9	8
NE09637	34.9	62.8	52.4	39.3	29.3	68.3	53.3	25.4	45.71	47.26	58	55
NE10418	60.8	62.1	43.5	50.5	47.7	75.9	63.9	24.4	53.60	52.57	31	34
NE10431	54.5	65.4	54.4	55.5	46.0	79.2	58.1	25.2	54.79	54.83	22	18
NE10442	72.2	60.6	42.2	55.8	48.6	79.5	58.2	25.3	55.30	52.89	19	32
NE10449	46.2	60.8	53.3	56.9	34.1	61.6	53.8	24.2	48.86	49.24	51	52
NE10478	81.6	67.9	48.4	61.1	51.7	87.2	65.8	30.7	61.80	58.97	1	5
NE10507	67.3	72.5	62.1	71.3	49.1	81.5	62.7	25.8	61.54	60.71	3	2
NI04421	59.6	68.8	59.3	64.4	54.9	76.7	64.9	26.0	59.33	59.29	6	4
Camelot	48.0	58.8	47.4	50.4	40.8	61.7	62.4	23.3	49.10	49.26	50	51
NE10509	44.9	71.1	63.6	49.8	42.6	66.9	62.9	28.3	53.76	55.03	28	16
NE10514	49.0	61.9	47.9	57.8	42.8	72.2	59.2	30.8	52.70	53.23	35	29
NE10517	56.6	67.6	44.6	54.8	41.1	63.3	58.1	28.1	51.78	51.09	42	42
NE10522	46.3	58.4	41.0	48.3	42.9	64.3	61.2	27.1	48.69	49.03	52	53
NE10529	50.4	75.2	60.6	64.6	48.3	65.8	61.2	27.9	56.75	57.66	13	10
NE10559	60.6	61.8	43.5	51.5	41.2	63.4	64.7	26.0	51.59	50.30	43	47
NE10589	59.0	74.4	64.8	71.0	53.4	81.0	61.9	27.7	61.65	62.03	2	1
NE10609	40.0	58.4	56.8	52.6	39.7	74.7	58.1	26.6	50.86	52.41	44	37
Settler CL	70.5	64.9	52.1	45.4	45.5	81.6	69.9	24.9	56.85	54.90	12	17
NE10625	49.7	72.2	45.1	52.0	44.5	77.5	65.3	26.4	54.09	54.71	27	21
NE10628	53.7	65.4	49.7	56.0	45.3	64.6	57.9	23.5	52.01	51.77	40	40
NE10638	54.1	54.7	43.9	50.4	37.2	52.1	53.9	23.8	46.26	45.14	57	58
NE10683	50.4	59.8	66.0	58.2	42.5	74.3	58.8	24.0	54.25	54.80	26	19
NH09563	58.2	62.1	47.6	56.9	45.2	76.6	65.2	26.0	54.73	54.23	23	25
NH10665	61.3	69.9	55.1	68.5	51.0	70.9	70.0	24.6	58.91	58.57	8	7
NHH09655	57.1	62.2	50.8	54.7	50.1	69.7	65.7	26.5	54.60	54.24	24	24
NI04420	65.7	66.9	49.1	61.8	51.0	75.9	63.2	31.1	58.09	57.00	10	12
NI08708	63.1	59.2	46.6	52.2	44.9	75.0	60.2	25.3	53.31	51.91	34	39
NI09706	51.6	51.1	42.7	37.4	34.7	74.6	58.4	25.0	46.94	46.27	56	57
NI09709	69.7	62.3	47.8	55.6	47.6	72.4	69.5	28.2	56.64	54.77	14	20
NI09714W	66.3	64.1	53.1	67.0	46.3	62.4	61.1	26.2	55.81	54.31	17	22
NW03666	58.1	64.9	49.2	55.6	37.4	74.2	65.6	24.0	53.63	52.99	30	31
NW07505	55.3	71.0	54.3	61.4	39.1	72.1	62.5	27.8	55.44	55.46	18	13
NW09627	65.7	51.0	45.7	51.0	40.9	70.5	62.5	27.9	51.90	49.93	41	49
NW10401	60.4	70.1	50.7	59.1	43.4	73.8	64.7	25.2	55.93	55.29	16	15
NW10487	48.8	65.2	51.4	49.3	39.2	73.7	62.5	27.0	52.14	52.61	39	33
GOODSTREAK	43.9	50.6	46.6	45.3	38.1	47.8	53.0	24.5	43.73	43.70	59	59
SCOUT66	43.5	38.8	31.2	33.3	32.4	56.2	49.5	19.6	38.06	37.29	60	60
CHEYENNE	50.6	59.0	54.4	53.1	42.1	73.1	58.4	27.5	52.28	52.51	37	35
GRAND MEAN	55.71	64.12	51.2	54.46	43.38	70.9	61.15	25.73	53.33	52.99		

Data for the 2011 NIN are:

	Linc.	C. Center	N. Platte	Alliance	McCook	**NE Avg. (including Mead Org.)**		Mead Org.	Sidney Org.	**Org. Avg.**		Kansas

name	Yield	Yield	Yield	Yield	Yield	**Yield**	Rank	Yield	Yield	**Yield**	Rank	Yield
	(bu/a)	(bu/a)	(bu/a)	(bu/a)	(bu/a)	**(bu/a)**		(bu/a)	(bu/a)	**(bu/a)**		(bu/a)
NE07531	74.4	60.4	40.1	71.6	81.8	**64.5**	**1**	58.8	55.7	57.2	**11**	93.0
NI08708	66.4	58.3	44.9	65.5	96.6	**64.3**	**2**	54.3	26.0	60.1	**1**	92.4
NE09499	62.7	61.3	41.1	73.2	84.3	**62.8**	**3**	54.1	51.8	51.1	**40**	73.5
NI04421	66.9	62.8	42.3	68.2	83.9	**62.7**	**4**	52.0	51.8	53.1	**28**	79.8
NE06545	66.5	57.8	45.1	76.5	69.4	**62.6**	**5**	60.3	47.0	58.5	**7**	84.7
NI04420	70.4	58.4	39.7	79.9	74.3	**62.4**	**6**	51.5	46.0	51.0	**42**	76.2
NE09517	71.9	55.3	39.0	74.9	79.8	**61.3**	**7**	47.0	54.3	50.5	**45**	76.3
Overland	61.8	58.3	40.6	71.9	76.7	**61.1**	**8**	57.3	50.8	59.5	**3**	81.5
NE06607	66.0	51.6	40.9	71.5	79.3	**61.1**	**9**	57.1	49.7	54.0	**24**	78.8
NE09521	64.3	56.1	44.5	70.4	77.2	**60.8**	**10**	52.5	52.6	59.1	**5**	92.3
NH09563	63.2	57.7	40.5	66.8	77.5	**60.7**	**11**	58.5	54.5	55.2	**17**	85.9
NHH09655	55.1	53.1	46.9	62.2	81.6	**60.0**	**12**	61.4	57.5	60.0	**2**	78.3
NE07486	75.8	56.3	38.4	61.9	74.2	**60.0**	**13**	53.5	56.7	55.9	**14**	95.8
NE09637	67.9	67.3	47.7	65.8	64.2	**59.7**	**14**	45.3	50.9	45.1	**52**	62.7
NE09495	66.8	59.3	42.7	64.1	72.0	**59.3**	**15**	51.0	65.5	53.8	**25**	78.2
NE09417	70.9	54.5	41.0	65.5	69.9	**58.8**	**16**	50.7	50.4	48.4	**48**	77.3
NE01481	68.4	55.7	38.2	61.4	78.6	**58.7**	**17**	49.8	58.3	50.8	**43**	83.3
NE06430	60.5	52.7	39.3	69.7	82.4	**58.6**	**18**	46.9	54.8	50.7	**44**	89.5
WESLEY	76.3	47.2	35.4	62.5	77.6	**58.6**	**19**	52.4	55.1	57.2	**12**	79.5
NE09491	59.7	53.2	38.2	63.0	82.9	**58.2**	**20**	52.3	55.7	59.3	**4**	65.8
NW09627	60.0	57.5	42.4	73.3	62.0	**58.2**	**21**	53.9	55.4	54.1	**22**	78.8
NE08499	66.2	55.7	41.2	66.9	68.4	**58.1**	**22**	50.4	51.5	51.3	**34**	75.1
NE06469	63.7	56.4	37.5	64.5	69.7	**58.1**	**23**	56.6	55.2	57.0	**13**	77.1
NE09498	59.5	56.5	42.4	64.9	70.9	**58.0**	**24**	54.0	60.9	51.2	**38**	72.8
NE08509	62.1	56.9	39.1	64.8	67.7	**57.9**	**25**	56.6	42.9	54.4	**19**	74.9
NW07534	60.2	53.4	40.6	60.8	80.7	**57.8**	**26**	51.0	50.6	53.8	**25**	73.0
NE09527	73.6	57.1	40.8	67.8	61.4	**57.7**	**27**	45.4	52.3	41.6	**57**	65.8
NE08659	60.2	57.2	42.9	57.1	77.3	**57.6**	**28**	50.8	52.2	51.1	**39**	75.1
NE07627	59.6	49.4	41.8	66.7	68.2	**57.5**	**29**	59.2	57.7	57.3	**10**	84.9
NE08402	67.7	48.5	36.2	63.4	71.5	**57.5**	**30**	57.4	55.4	54.4	**18**	79.5
NE07520	63.1	54.1	36.7	63.0	77.5	**57.5**	**31**	50.3	51.5	52.7	**29**	81.1
NE09426	68.0	56.7	31.3	68.6	66.2	**57.4**	**32**	53.4	46.0	51.2	**37**	91.0
NW07505	64.4	58.2	37.0	67.9	64.7	**57.3**	**33**	51.3	49.0	55.3	**16**	83.7
NE08457	69.9	52.4	38.2	67.8	63.2	**57.2**	**34**	51.7	53.4	47.3	**51**	79.9
NE05548	58.1	53.4	39.0	66.7	75.8	**57.2**	**35**	49.9	47.9	51.3	**35**	69.3
NW03666	62.9	51.8	34.4	63.4	81.8	**57.0**	**36**	47.9	47.3	48.9	**47**	77.7
Settler CL	62.2	52.1	42.0	61.4	69.1	**56.9**	**37**	54.4	54.1	58.9	**6**	87.8
NE09481	73.4	52.7	34.2	70.9	73.8	**56.7**	**38**	35.4	46.0	41.4	**58**	100.2
GOODSTREAK	62.5	53.0	36.6	63.7	66.0	**56.5**	**39**	57.0	66.4	54.4	**19**	66.3
NE08410	69.6	50.7	37.4	60.3	66.8	**56.3**	**40**	53.2	56.6	54.2	**21**	79.6
NE09482	65.8	51.3	34.0	60.1	74.2	**56.3**	**41**	52.5	48.4	53.3	**27**	89.0
NE02558	56.1	50.2	39.3	64.3	77.3	**56.1**	**42**	49.4	48.1	48.2	**49**	79.2
NE08452	62.2	53.3	31.9	65.2	69.4	**56.1**	**43**	54.5	53.9	57.7	**9**	78.8
NE08527	65.0	54.4	42.4	61.7	66.6	**56.0**	**44**	45.7	65.7	51.7	**32**	53.2
NE08555	65.6	52.2	43.3	60.2	64.4	**55.9**	**45**	49.4	37.7	52.4	**30**	77.6
NE05496	53.1	45.5	38.5	65.0	77.2	**55.7**	**46**	54.9	44.9	52.3	**31**	84.5
NE09437	56.6	51.1	38.6	67.3	70.8	**55.5**	**47**	48.7	47.8	51.1	**41**	86.0
NE09684	56.1	54.8	39.9	65.5	68.1	**55.4**	**48**	48.2	52.0	48.0	**50**	71.9

NE07409	58.7	53.5	38.6	57.1	73.7	**55.3**	**49**	50.1	58.6	57.8	**8**	78.1
NE08476	53.5	55.6	35.4	64.0	70.2	**55.2**	**50**	52.3	50.5	51.4	**33**	77.3
NE05426	55.8	52.6	36.4	68.2	66.8	**54.7**	**51**	48.2	54.1	51.3	**36**	73.7
NE05430	68.6	51.3	40.0	60.4	67.2	**54.5**	**52**	39.3	65.9	45.0	**53**	68.1
NE09483	60.6	51.5	30.7	62.9	78.2	**54.3**	**53**	42.1	49.8	44.1	**56**	78.1
NE07487	50.3	47.3	38.9	60.8	70.4	**53.9**	**54**	56.0	59.4	55.4	**15**	77.4
NE07444	62.2	48.7	34.2	66.3	61.0	**53.5**	**55**	48.8	56.6	49.6	**46**	79.6
NE09477	55.2	47.5	34.8	63.9	76.6	**53.2**	**56**	41.1	54.4	44.5	**55**	68.8
NE04490	58.6	43.8	38.8	65.2	67.2	**52.9**	**57**	43.7	61.8	44.8	**54**	69.9
Camelot	56.6	47.6	32.0	58.8	59.4	**51.2**	**58**	52.6	30.4	54.1	**22**	77.7
SCOUT66	40.2	39.7	27.1	50.9	58.3	**41.9**	**59**	35.4	63.3	32.9	**59**	61.0
CHEYENNE	34.0	31.6	33.4	50.0	66.6	**41.8**	**60**	35.5	61.9	30.7	**60**	50.6
AVERAGE	**62.3**	**53.4**	**38.8**	**65.1**	**72.5**			**50.9**	**52.8**			
LSD	**8.27**	**6.33**	**5.99**	**8.75**	**16.91**			**8.80**	**11.65**			**15.04**
CV	**9.49**	**6.13**	**7.98**	**6.94**	**9.59**			**8.93**	**16.26**			**9.96**
HERITABILITY	**0.99**	**0.99**	**0.99**	**0.99**	**0.99**			**0.99**				**0.99**

Data from 2010 to 2012 (three year average) from the Nebraska Intrastate Nursery for Grain Yield (bu/a)

		MEAD	Linc.	C. Center	N. Platte	SIDNEY	Alliance	McCook	NE Avg.	Rank
		Yield	Yield	Yield	Yield	Yield	Yield	Yield	Yield	
		(bu/a)	(bu/a)	(bu/a)	(bu/a)	(bu/a)	(bu/a)	(bu/a)	(bu/a)	
2011-2013	NW03666	71.90	64.48	71.08	48.61	64.90	50.68	70.48	63.83	1
2011-2013	NE06545	76.30	69.57	64.97	49.65	60.50	54.77	63.99	63.49	2
2011-2013	NE07531	69.20	67.52	65.35	41.13	60.50	52.71	68.38	62.45	3
2011-2013	NI04420	75.75	64.01	63.12	49.67	65.10	52.04	64.37	61.98	4
2011-2013	NI08708	68.60	62.83	65.03	45.37	63.20	57.87	63.87	61.73	5
2011-2013	Settler CL	73.25	62.47	65.86	43.81	66.40	50.10	68.56	61.59	6
2011-2013	NE07486	71.45	66.63	64.65	45.24	67.30	46.46	66.91	61.30	7
2011-2013	NE06607	71.15	64.23	62.03	42.46	60.00	51.77	67.09	61.00	8
2011-2013	NW07505	65.10	61.03	62.66	44.88	60.20	50.89	71.18	60.91	9
2011-2013	NE09517	70.05	63.54	64.94	43.98	66.70	51.32	61.11	60.45	10
2011-2013	NE06430	67.90	62.29	59.87	42.20	65.60	50.39	68.73	60.08	11
2011-2013	NE01481	74.75	67.50	60.60	42.94	63.20	45.40	63.62	59.55	12
2011-2013	NI04421	65.70	58.99	58.45	48.51	65.70	48.10	68.08	59.10	13
2011-2013	OVERLAND	71.00	64.15	63.97	38.06	62.50	51.85	58.81	59.07	14
2011-2013	NE09521	69.80	62.04	65.45	35.16	61.50	48.24	59.21	58.27	15
2011-2013	NHH09655	65.45	62.12	63.14	44.76	46.70	50.24	62.52	58.27	16
2011-2013	NW09627	61.00	58.18	61.31	35.88	65.60	50.63	67.17	57.68	17
2011-2013	NE05496	61.85	56.88	56.75	38.57	69.90	48.37	69.50	57.35	18
2011-2013	NE08499	66.95	65.92	59.40	39.39	49.90	49.93	55.33	57.33	19
2011-2013	NE05548	64.00	57.43	58.81	37.84	63.00	50.06	57.87	56.12	20
2011-2013	Camelot	65.05	56.64	57.31	36.40	62.40	47.96	55.86	54.67	21
2011-2013	NE08659	61.20	55.18	62.53	36.93	61.90	47.40	52.37	53.94	22
2011-2013	GOODSTREAK	57.40	56.22	55.15	37.33	53.00	50.12	51.41	52.92	23
2011-2013	SCOUT66	51.10	51.15	56.46	41.63	62.50	50.74	56.80	52.90	24
2011-2013	WESLEY	54.40	46.01	47.34	29.73	49.50	42.35	52.54	47.19	25
2011-2013	CHEYENNE	50.05	42.49	47.20	37.77	58.40	40.60	59.89	46.64	26
	Mean	66.17	60.36	60.90	41.45	61.39	49.65	62.53	58.07	

As can be seen from the excellent three-year yields of released lines (NI04421= Robidoux, NE06545 = Freeman, Settler CL, and Overland) our released lines continue to do well, but we have many experimental lines with excellent grain yields in the east, central, or west parts of Nebraska. Robidoux continues to build its reputation as being a drought tolerant wheat under rainfed conditions that can respond well to moisture under irrigation. Both broadly and more narrowly adapted lines have value in wheat production.

5. Nebraska Triplicate Nursery (NTN):

The same comments about the NIN data apply to the NTN. In this nursery, the check lines performed relatively well Overland, Camelot, and Goodstreak (for a tall wheat) compared to the experimental lines. Camelot did particularly well. There are a number of lines that have promise for continued testing toward new cultivar releases. The lines in the NTN have less performance history, so it is expected that some experimental lines will out-yield the checks, but most lines will have poorer performance. As in the NIN, there were low but positive correlations among the closer locations (the best being Lincoln and Mead), which could explain, but not in all cases. The variation in one location could explain at most 75% of the variation in the other location. However, most locations explained less than 10% of the variation at the other locations. This result again indicated the value of extensive testing in NE.

The data for the 2013 TRP:

name	Mead Yield bu/a	Lincoln Yield bu/a	C. Center Yield bu/a	McCook Yield bu/a	Alliance Yield bu/a	NE. Avg. Yield bu/a	Rank	KS Yield bu/a	Rank
NE12406	67.7	71.0	73.2	48.0	51.0	62.18	44	55.2	55
NE12408	71.7	75.1	84.9	54.5	54.5	68.14	10	58.2	48
NE12409	72.9	72.1	76.5	48.5	59.7	65.94	29	60.3	36
NE12416	72.7	66.5	72.3	45.2	53.6	62.06	46	61.5	30
NE12417	75.9	75.9	69.2	48.0	62.9	66.38	24	56.1	54
NE12429	78.4	77.0	73.8	47.5	64.0	68.14	11	60.7	34
NE12430	77.1	77.7	82.2	51.5	64.3	70.56	2	60.1	42
NE12435	65.1	70.3	68.6	43.2	56.9	60.82	51	60.2	39
NE12438	74.4	73.1	86.4	48.5	69.4	70.36	4	65.3	10
NE12439	74.3	77.3	79.1	52.5	64.3	69.50	7	66.4	8
NE12443	78.0	79.0	84.6	47.6	56.6	69.16	8	69.2	2
NE12444	73.2	68.3	76.5	50.0	65.9	66.78	21	58.1	49
NE12450	65.0	87.3	76.1	46.5	63.1	67.60	14	61.9	27
NE12456	60.3	71.2	72.7	41.7	56.7	60.52	55	54.3	56
Camelot	73.0	70.6	78.9	48.9	64.7	67.22	18	60.7	34
NE12459	71.7	72.8	72.4	46.6	57.9	64.28	36	62.4	20
NE12461	76.6	82.1	79.1	47.5	54.9	68.04	12	68.5	4
NE12464	75.9	75.6	81.3	44.9	66.4	68.82	9	64.5	12
NE12467	64.3	74.4	70.9	33.8	56.3	59.94	56	54.0	57
NE12480	62.4	60.8	77.9	34.9	61.6	59.52	59	61.1	32
NE12482	68.6	67.2	70.9	34.9	64.2	61.16	50	62.4	20
NE12483V	70.3	63.2	78.2	49.5	69.6	66.16	26	72.9	1
NE12486	70.5	71.3	63.5	37.6	60.5	60.68	53	61.8	28
NE12488	68.9	78.3	75.7	46.4	60.9	66.04	27	60.2	39
NE12503	70.7	78.2	76.4	44.2	66.5	67.20	19	62.4	20
NE12509	69.7	69.4	70.9	49.6	51.0	62.12	45	62.7	19
NE12510	73.4	76.8	78.2	46.7	53.9	65.80	30	65.1	11
NE12518	75.2	70.1	79.6	51.8	59.6	67.26	17	62.4	20
NE12521	63.5	63.1	77.0	42.9	56.4	60.58	54	51.8	59
GOODSTREAK	72.3	61.6	71.1	47.5	61.9	62.88	42	62.1	25

NE12524	75.8	73.4	77.2	55.3	67.3	69.80	6	57.7	50
NE12538	66.7	69.7	67.2	45.3	54.8	60.74	52	64.4	13
NE12539	63.3	69.0	64.6	40.0	55.4	58.46	60	51.5	60
NE12550	69.8	75.4	75.2	39.8	58.2	63.68	38	67.1	6
NE12561	71.7	76.1	80.1	45.2	62.1	67.04	20	59.7	45
NE12563	69.3	73.5	81.5	42.4	57.4	64.82	35	65.5	9
NE12568	73.6	67.6	65.3	42.3	59.5	61.66	48	61.0	33
NE12571	75.0	75.5	76.1	53.7	53.0	66.66	22	66.9	7
NE12578	75.8	72.1	75.7	43.3	52.1	63.80	37	64.4	13
NE12580	71.8	76.1	79.3	56.1	54.3	67.52	15	62.3	24
NE12582	67.6	73.2	74.0	41.9	56.1	62.56	43	53.9	58
NE12583	64.0	71.2	75.2	44.3	55.5	62.04	47	62.0	26
NE12585	68.9	71.3	78.3	46.3	59.6	64.88	33	58.5	47
NE12589	78.5	77.1	86.4	45.0	62.7	69.94	5	67.5	5
OVERLAND	73.6	78.3	84.4	42.5	53.8	66.52	23	59.9	44
NE12595	64.8	61.6	78.3	36.4	58.2	59.86	58	61.8	28
NE12596	64.1	64.1	72.2	39.3	60.0	59.94	56	58.7	46
NE12598	70.1	72.4	76.5	41.7	55.8	63.30	41	56.2	53
NE12630	67.4	65.7	78.6	52.8	65.3	65.96	28	57.7	50
NE12634	70.9	69.4	77.2	50.6	57.2	65.06	32	60.3	36
NE12637	68.4	74.8	80.1	46.8	57.8	65.58	31	63.9	15
NE12639	62.4	65.8	72.9	45.7	60.0	61.36	49	63.4	16
NE12659	74.8	72.2	75.1	45.8	56.5	64.88	34	60.2	39
NE12662	78.8	78.6	81.9	50.9	62.5	70.54	3	63.1	17
NE12668	72.4	74.5	72.2	49.7	63.0	66.36	25	60.3	36
NE12675	69.2	73.9	72.8	44.0	57.2	63.42	40	57.1	52
NE12685	73.7	70.7	73.1	45.9	55.0	63.68	38	61.5	30
NE12686	73.3	75.4	89.5	57.2	61.6	71.40	1	68.8	3
NE12689	72.7	74.1	80.9	47.3	63.2	67.64	13	60.1	42
NH12615	73.2	70.7	84.0	47.2	61.7	67.36	16	63.0	18
MEAN	**70.92**	**72.35**	**76.39**	**46.09**	**59.43**			61.35	
LSD	**8.18**	**7.48**	**9.19**	**8.38**	**9.18**			**5.98**	
CV	**5.96**	**6.37**	**7.44**	**8.89**	**9.52**			**6.01**	
Heritability	**0.99**	**0.99**	**0.7**	**0.99**	**0.97**			**0.99**	

The data for the 2012 TRP:

name	KS (bu/a)	Mead (bu/a)	Linc. (bu/a)	Clay C. (bu/a)	N. Platte (bu/a)	McCoo (bu/a)	Sid (bu/a)	Allian. (bu/a)	Mean (bu/a)	Rank	Flower date
Camelot	41.3	58.0	48.2	50.7	37.7	63.2	63.7	46.0	51.1	52	**125.7**
GOODSTREAK	36.4	49.4	43.2	39.2	31.7	51.5	57.1	48.8	44.7	60	**125.4**
Overland	47.8	76.6	52.0	64.5	42.7	75.4	65.6	51.6	59.5	6	**129.0**
NE11415	66.9	51.7	41.9	51.9	43.4	82.6	63.1	49.6	56.4	16	**117.7**
NE11423	64.0	53.3	42.1	46.4	39.5	66.4	58.4	45.4	51.9	46	**123.1**
NE11426	45.4	65.2	49.7	51.9	41.9	72.4	57.6	47.1	53.9	30	**117.6**
NE11440	61.2	60.7	39.4	55.2	37.0	64.7	60.8	49.2	53.5	36	**122.0**
NE11443	51.9	59.2	46.2	51.4	38.3	60.1	61.4	38.8	50.9	54	**117.6**
NE11455	64.0	63.5	45.4	46.2	39.4	82.2	65.8	40.9	55.9	20	**119.3**
NE11461	60.9	54.8	52.1	47.8	43.3	66.2	62.9	47.7	54.5	25	**122.0**

NE11464	52.7	55.3	49.5	47.1	38.3	77.9	54.2	45.9	52.6	42	**119.7**
NE11470	58.9	55.2	46.5	55.0	44.5	72.2	63.4	51.2	55.9	21	**117.7**
NE11472	62.1	60.6	50.2	58.6	44.1	78.6	60.4	47.2	57.7	12	**119.7**
NE11480	55.1	56.5	47.4	45.7	39.2	68.7	59.6	43.3	51.9	46	**121.5**
NE11482	48.9	59.3	47.7	53.2	43.7	72.7	66.6	52.2	55.5	22	**126.3**
NH11489	60.4	57.7	50.3	55.4	43.7	88.2	64.8	47.1	58.5	9	**123.1**
NH11490	48.2	63.6	49.1	52.5	41.6	75.2	64.6	44.7	54.9	24	**123.7**
NE11499	62.4	67.5	52.4	54.8	40.8	77.9	65.7	46.1	58.5	8	**121.3**
NW11510	67.0	51.1	38.8	49.7	41.6	85.9	57.6	38.4	53.8	32	**117.7**
NW11511	68.1	53.1	48.1	55.3	50.3	88.8	59.1	41.4	58.0	11	**116.1**
NW11514	57.6	61.7	38.0	50.6	40.3	75.0	62.8	45.2	53.9	31	**119.1**
NE11522	52.6	64.1	44.6	48.3	36.9	63.9	55.0	45.1	51.3	49	**121.6**
NE11527	52.2	64.6	51.5	51.4	40.0	69.0	64.3	47.1	55.0	23	**124.4**
NE11530	45.9	63.7	52.6	50.3	35.8	60.8	56.3	49.3	51.8	48	**124.1**
NE11536	41.2	65.9	49.1	61.0	48.6	69.5	65.2	50.6	56.4	16	**127.7**
NE11543	41.2	61.1	50.1	40.8	38.6	67.9	59.0	50.8	51.2	50	**126.7**
NE11560	69.3	60.8	56.8	59.6	53.5	83.3	70.0	48.4	62.7	1	**120.6**
NH11563	56.6	64.4	52.0	51.4	51.1	77.5	65.9	42.6	57.7	13	**126.0**
NH11565	62.6	63.7	57.9	59.5	44.3	85.8	60.0	51.1	60.6	2	**122.7**
NHH11569	56.3	59.0	45.3	54.3	39.6	63.4	58.2	44.9	52.6	41	**122.4**
NE11581	51.7	61.9	48.2	44.9	39.2	64.1	59.8	53.3	52.9	39	**122.0**
NW11588	34.3	62.1	55.3	52.4	41.4	65.4	60.7	50.4	52.8	40	**126.3**
NW11589	33.0	54.1	48.7	45.7	31.4	53.8	57.4	41.2	45.7	59	**124.7**
NW11590	58.8	67.4	54.7	60.0	48.1	81.9	64.6	48.3	60.5	3	**121.9**
NW11593	49.0	55.5	40.9	47.5	39.4	71.9	59.3	45.9	51.2	51	**119.3**
NW11598	61.2	57.2	53.5	57.4	47.0	78.6	68.6	43.3	58.4	10	**123.7**
NE11607	45.9	75.0	59.9	71.6	46.9	73.4	53.9	51.6	59.8	5	**129.4**
NE11608	40.7	65.7	54.3	51.4	40.5	65.9	56.6	50.0	53.1	38	**129.3**
NE11610	32.1	62.0	51.0	57.1	43.9	67.1	62.7	52.2	53.5	37	**127.7**
NE11612	35.7	59.9	56.0	62.9	43.5	64.6	59.8	46.9	53.7	33	**130.0**
NE11613	39.6	59.3	50.7	60.6	41.4	65.0	59.0	43.5	52.4	43	**125.7**
NH11631	44.5	71.0	58.9	47.9	39.8	84.6	59.2	41.5	55.9	19	**129.3**
NHH11638	34.6	71.3	59.6	54.4	47.9	90.0	57.4	46.1	57.7	14	**127.6**
NHH11639	34.6	65.9	56.7	53.6	44.9	83.2	64.8	43.9	56.0	18	**128.9**
NE11642	37.6	66.1	47.2	52.0	37.0	59.6	56.5	51.5	50.9	53	**130.0**
NE11643	40.0	62.5	47.2	67.3	36.9	59.0	59.0	46.5	52.3	44	**129.6**
NW11645	43.8	63.4	52.5	53.8	33.0	66.3	50.3	53.9	52.1	45	**129.0**
NE11652	45.3	69.1	51.1	59.6	39.9	59.6	60.4	49.6	54.3	26	**129.6**
NE11653	27.3	74.4	56.0	60.1	36.7	67.4	62.6	48.9	54.2	29	**128.7**
NE11654	46.6	68.0	63.1	64.9	43.2	71.9	65.4	51.6	59.3	7	**129.2**
NE11655	31.9	65.2	51.9	47.1	38.3	67.9	55.7	44.8	50.4	55	**129.9**
NH11663	37.1	71.3	56.6	50.5	35.4	73.8	63.1	46.4	54.3	27	**130.6**
NH11664	40.0	75.1	52.6	49.9	38.4	72.7	59.5	40.5	53.6	34	**130.4**
NH11668	41.3	73.6	57.9	52.3	39.4	78.8	61.6	47.4	56.5	15	**129.4**
NE11684	32.1	69.6	55.1	64.1	43.2	67.7	54.2	42.6	53.6	35	**130.9**
NE11688	41.6	73.7	61.9	73.3	49.9	70.1	65.4	46.7	60.3	4	**128.3**
NE11690	27.8	60.2	49.1	43.7	33.9	69.1	59.9	42.2	48.2	58	**128.6**
NH11691	35.1	54.4	54.1	45.8	40.1	79.3	46.1	46.3	50.2	56	**130.6**
NW11696	33.4	61.9	46.3	47.4	36.2	63.5	59.0	47.0	49.3	57	**127.6**
NE11697	60.7	56.0	42.8	50.2	44.8	62.7	62.7	54.3	54.3	27	**120.0**

Mean	47.9	62.6	50.5	53.5	41.2	71.4	60.6	46.9	54.3		**124.8**

The 2011 data are:

	Conventional								Organic		
	Linc.	Clay Center	McCook	N. Platte	Alliance	**Avg (with Mead Org.)**		Sidney	Mead	**Avg.**	
	Yield	Yield	Yield	Yield	Yield	**Yield**	Rank	Yield	Yield	Yield	Rank
	bu/a	bu/a	bu/a	bu/a	bu/a	**bu/a**		bu/a	bu/a	**bu/a**	
Camelot	42.0	48.0	68.1	29.3	64.6	**50.6**	**55**	59.9	51.7	**55.8**	**13**
Goodstreak	49.8	53.6	66.5	35.8	66.5	**54.7**	**30**	56.0	56.2	**56.1**	**10**
NE10415	60.4	54.6	57.4	28.8	60.5	**51.7**	**51**	44.9	48.5	**46.7**	**50**
NE10418	59.9	54.3	73.7	32.6	64.6	**56.7**	**11**	45.7	55.0	**50.4**	**34**
NE10431	59.6	55.9	77.9	37.9	72.7	**59.1**	**5**	34.3	50.3	**42.3**	**55**
NE10433	55.2	47.7	65.2	39.9	58.8	**52.5**	**45**	42.1	48.3	**45.2**	**53**
NE10442	68.4	53.8	69.1	33.0	63.0	**56.7**	**10**	41.6	52.9	**47.3**	**48**
NE10449	54.4	56.8	70.1	37.7	63.8	**56.2**	**15**	50.6	54.5	**52.5**	**22**
NE10451	45.7	45.4	65.8	30.5	66.7	**50.2**	**57**	50.5	47.1	**48.8**	**39**
NE10456	67.9	51.7	60.3	34.3	62.2	**55.2**	**26**	41.9	55.1	**48.5**	**42**
NE10460	56.0	60.3	69.5	39.5	60.9	**55.4**	**24**	50.2	46.1	**48.1**	**45**
NE10464	60.7	46.9	55.3	33.9	61.7	**50.2**	**56**	38.3	42.9	**40.6**	**58**
NE10466	66.0	56.2	57.1	31.9	65.6	**53.8**	**38**	32.1	46.1	**39.1**	**60**
NE10467	60.7	49.8	60.4	37.4	67.4	**53.2**	**42**	34.8	43.5	**39.2**	**59**
NE10474	50.1	50.2	70.1	36.1	58.0	**52.2**	**49**	33.3	48.7	**41.0**	**57**
NE10475	53.7	48.9	36.0	34.9	65.0	**49.0**	**60**	48.7	55.8	52.2	**25**
NE10478	67.3	62.1	74.0	33.9	64.1	**59.3**	**4**	41.4	54.3	**47.8**	**47**
NE10506	48.6	50.2	66.5	35.3	61.0	**51.3**	**53**	50.1	46.2	**48.1**	**46**
NE10510	53.3	54.2	69.8	40.1	65.7	**55.9**	**19**	44.6	52.6	**48.6**	**41**
NE10513	60.1	53.9	65.3	31.4	60.1	**53.4**	**39**	37.2	49.7	**43.5**	**54**
NE10514	52.1	52.5	75.1	39.4	68.0	**56.2**	**16**	47.2	50.2	**48.7**	**40**
NE10517	50.3	54.0	75.2	38.0	62.1	**56.1**	**18**	61.9	56.7	**59.3**	**3**
NE10522	55.4	51.9	70.3	40.0	70.5	**55.9**	**20**	44.5	47.2	**45.9**	**52**
NE10527	51.8	47.6	43.8	31.4	65.3	**49.8**	**58**	50.6	59.1	**54.9**	**15**
NE10528	48.7	53.3	66.9	33.6	59.7	**52.5**	**46**	51.3	52.7	**52.0**	**26**
NE10529	58.4	60.3	87.8	39.6	65.2	**62.2**	**2**	57.8	61.7	**59.8**	**2**
NE10535	55.1	54.5	78.1	35.6	59.6	**55.8**	**21**	40.4	51.9	**46.1**	**51**
NE10536	55.9	48.5	68.6	36.7	59.1	**54.6**	**31**	47.0	58.7	**52.9**	**21**
NE10549	55.6	48.3	66.7	39.2	55.2	**53.3**	**41**	55.4	54.6	**55.0**	**14**
NE10558	52.1	53.4	68.3	35.8	66.1	**55.0**	**27**	50.6	54.5	**52.5**	**23**
NE10559	53.2	50.0	78.3	33.1	63.2	**56.1**	**17**	55.8	58.5	**57.1**	**5**
NE10574	53.9	53.4	66.8	35.8	63.7	**55.0**	**28**	44.2	56.5	**50.4**	**35**
NE10575	50.7	52.6	70.2	30.7	64.6	**54.4**	**35**	44.4	57.4	**50.9**	**32**
NE10577	47.6	53.1	73.4	33.1	59.1	**53.3**	**40**	53.1	53.7	**53.4**	**18**
NE10582	53.5	52.5	72.2	38.5	60.6	**54.9**	**29**	42.3	51.7	**47.0**	**49**
NE10586	49.0	48.1	69.4	34.8	74.1	**55.7**	**22**	53.5	58.9	**56.2**	**9**
NE10589	73.6	65.1	60.6	36.9	71.0	**61.8**	**3**	50.3	63.9	**57.1**	**6**
NE10609	62.9	62.1	83.0	35.2	65.2	**62.2**	**1**	40.9	65.0	**53.0**	**19**
NE10610	55.3	53.0	67.2	37.5	64.4	**55.5**	**23**	52.2	55.8	**54.0**	**17**

NE10614	62.4	49.6	56.0	39.1	58.4	**53.8**	37	55.3	57.6	**56.4**	7
NE10615	41.9	47.3	69.4	39.5	61.4	**51.9**	50	47.6	51.9	**49.7**	37
NE10625	47.5	51.8	90.6	33.7	61.7	**56.5**	13	49.6	53.9	**51.8**	28
NE10628	67.9	60.1	62.1	37.7	62.3	**57.1**	6	47.0	52.5	**49.8**	36
NE10638	56.5	55.0	67.7	43.3	63.7	**56.3**	14	45.9	51.8	**48.8**	38
NE10642	51.6	51.6	58.6	35.5	63.9	**52.8**	44	47.3	55.8	**51.6**	30
NE10645	51.9	48.8	66.1	36.4	68.2	**54.5**	32	49.2	55.6	**52.4**	24
NE10671	42.6	48.9	63.9	36.0	54.2	**49.4**	59	46.1	50.8	**48.4**	43
NE10676	41.4	49.2	68.6	35.5	63.8	**52.5**	47	58.2	56.2	**57.2**	4
NE10677	43.5	48.3	68.3	37.0	57.4	**51.4**	52	49.2	53.5	**51.3**	31
NE10684	57.7	49.8	73.3	39.1	56.4	**54.4**	34	53.4	50.1	**51.8**	28
NH10665	52.2	53.9	68.3	38.3	63.8	**57.0**	7	47.3	65.5	**56.4**	8
NH10669	45.7	50.9	77.3	41.0	54.9	**54.5**	33	51.7	57.3	**54.5**	16
NW10401	63.2	51.2	58.0	32.0	66.5	**55.3**	25	63.7	61.1	**62.4**	1
NW10487	54.1	54.7	72.4	33.4	64.6	**56.8**	9	50.4	61.5	**55.9**	11
NW10498	45.0	52.8	60.8	35.4	66.8	**52.3**	48	50.9	52.9	**51.9**	27
NW10499	51.9	51.6	74.1	38.2	68.2	**56.9**	8	54.6	57.1	**55.8**	12
NW10500	51.8	52.2	68.5	34.3	63.6	**54.3**	36	50.7	55.1	**52.9**	20
NW10501	58.1	52.1	52.5	35.9	65.5	**51.0**	54	40.0	42.1	**41.1**	56
NW10566	42.9	55.3	68.5	38.0	60.0	**53.0**	43	47.9	53.4	**50.7**	33
Overland	49.5	58.7	73.7	38.5	69.4	**56.7**	12	46.0	50.4	**48.2**	44
AVERAGE	**54.23**	**52.71**	**67.64**	**35.94**	**63.40**			**47.9**	**53.67**		
LSD	**8.95**	**5.40**	**20.83**	**5.16**	**6.42**			**10.6**	**7.51**		
CV	**8.52**	**5.32**	**12.88**	**7.42**	**7.46**			**16.30**	**7.23**		

6. Regional Nurseries

In 2013, we continued to combine into one larger nursery the Southern Regional Performance Nursery (SRPN) and the Northern Regional Performance Nursery (NRPN). These were planted at Lincoln, North Platte (lost to drought), Sidney (lost to freezing rain in the spring), and Alliance (of which we lost about one-half of the trial due to a flash rain in the midst of harvest). At Clay Center, only the SRPN was planted. To fill out the nursery, we added a few other lines mainly to compare selections out of research for scab tolerance or drought tolerance to determine if they had merit. The NRPN and SRPN data from all locations is available at… http://www.ars.usda.gov/Research/docs.htm?docid=11932 . It was useful to see Kharkof and Scout 66, older wheat cultivars, continue to be very low yielding, indicating that breeding progress has been made.

7. Multiple-Location Observation Nursery

Seven replications (locations) in Nebraska (Lincoln, Mead, Clay Center, North Platte, McCook, Sidney, and Alliance) were planted and 5 were harvested (Lincoln, Mead, Clay Center, McCook, and Alliance). Two more locations were collaboratively planted and harvested in Kansas. Both Kansas sites were very high yielding with one treated with fungicides and given very high fertility–to maximize grain yield. The seven locations and the five in Nebraska were used for selection. . The table below gives the grain yields for all of the harvested locations, the line average, and the rank of the top 10 highest yielding lines**.** In this nursery, we continued to use marker-assisted selection for line advancement. For the second year, we used genotyping by sequencing (GBS). Genotyping by sequencing was done in collaboration with Dr. Jesse Poland, USDA-ARS, because it is much less costly (less than 1/3 of the cost of other marker systems). We will continue to do to this (though we hope to use GBS in earlier generations) to better understand our germplasm in this gateway nursery. One novel twist that Jesse added was we are now reanalyzing the GBS data over years, thus creating a "training" population and tying all of our datasets together. Genotyping has many missing data points, but this approach has really helped us understand our materials. The 2013 data were quite interesting because the two Kansas sites were quite different from the five Nebraska sites, so every effort was made to try to keep the higher yielding lines from all seven sites, while making sure that the best lines for Nebraska were also kept. Lines that did well in both sets should be very broadly adapted. One change that we will add is a stratified selection where we will ensure that the highest yielding tall wheat lines, disease resistant wheat lines, etc. are maintained. If you select predominantly on grain yield, you tend to select semi-dwarf lines.

Name	Alliance	Kansas 1	Clay Cen.	Mead	Kansas 2	McCook	Lincoln	Ave.	Rank	Ave.NEB.	Rank NEB
2013	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a		bu/a	
NE13565	58.61	63.27	80.98	58.23	175.80	61.47	64.85	80.46	1	64.83	41
NE13625	48.41	67.77	95.93	86.88	90.55	66.92	82.77	77.03	2	76.18	141
NE13434	61.11	66.12	82.93	78.78	94.45	57.57	79.73	74.38	3	72.02	6
NW13516	44.91	71.47	80.18	85.63	90.85	66.17	81.27	74.35	4	71.63	89
NE13687	48.31	72.97	78.38	74.78	109.30	61.72	74.11	74.22	5	67.46	222
NE13510	59.06	61.27	86.48	75.23	98.80	57.37	78.88	73.87	6	71.40	158
NW13596	47.46	68.62	89.18	88.08	81.05	53.22	86.64	73.46	7	72.91	36
NW13518	47.56	64.37	88.08	73.33	109.00	49.02	79.10	72.92	8	67.42	54
NE13443	48.21	70.72	83.53	85.28	76.50	71.37	74.18	72.83	9	72.51	5
NE13660	47.01	72.27	85.68	67.18	90.95	66.82	76.18	72.30	10	68.57	155
NE13412	61.49	63.57	85.98	84.83	79.10	54.87	76.18	72.29	11	72.67	4
NW13494	48.06	67.42	91.73	74.98	97.35	40.37	82.70	71.80	12	67.57	11
NW13493	57.19	68.67	67.03	87.38	82.05	68.27	71.14	71.68	13	70.20	3
NW13502	49.76	73.87	91.73	72.93	74.95	63.57	74.60	71.63	14	70.52	67
NE13425	49.11	55.87	78.08	72.53	96.15	69.72	79.61	71.58	15	69.81	17
NW13461	49.96	53.87	83.68	78.08	95.50	64.77	74.96	71.54	16	70.29	160
NE13511	50.76	66.07	78.98	83.88	88.15	60.47	72.20	71.50	17	69.26	40
NE13430	37.31	58.67	89.38	70.43	85.45	82.32	76.05	71.37	18	71.10	10
NE13604	53.41	70.57	77.33	76.53	90.90	59.57	70.55	71.26	19	67.48	84
NW13570	44.01	66.92	91.63	69.23	91.40	55.67	79.96	71.26	20	68.10	43

8. <u>Early Generation Nurseries</u>

a. Single-plot Observation Nursery

Seventeen hundred seventy-two lines were evaluated at Lincoln in 2013. Of the 1772 lines and checks, 1515 were red or mixed red and white seeded and 257 where white seeded. The lines included 71 one and two gene herbicide tolerant lines (mainly two gene), 270 possible FHB tolerant lines, 101 possible lines with WSMV tolerance, and 83 Hessian fly tolerant lines. All 1772 lines were harvested, as I have not liked visual selection. Those lines with acceptable yield were then test weighed and if the test weight was good, their protein was measured. Five fifty one lines with god yield, test weight, and protein content were sent to the Seed Quality laboratory for micro quality evaluations. Two hundred seventy lines were advanced. We will try to be more selective in this nursery so that harvesting all the plots will be very efficient.

b. Headrow Nursery

In 2012-13, 44,100 (41,500 were red or red/white, 8100 were for Fusarium head blight tolerance and diversity, 2600 were white, and 2200 were herbicide tolerant) headrows were planted at Lincoln. In general, the headrow nursery was average in size. We harvested over 1800 lines and planted in 2013-2014. 1572 were selected for advancement. The main selection criteria for discarding headrows was black point or poor seed quality. Of the red and white wheat lines, 238 were sent to Scottsbluff for planting in our irrigated observation nursery.

c. F_3 bulk hybrids

The F_3 bulk hybrid nursery contained 986 red, red and white segregating, or white seeded bulks. In addition, we planted 54 herbicide tolerant bulks (planted at Lincoln). Most bulks were planted at Mead (our main and best winter killing site) and many of those were planted at Sidney as a backup site in case of disaster at Mead. The number of F_3 bulks is our new normal. Over 48,000 head rows were selected for fall planting in 2013. The headrows were planted on time. In general, their emergence and stands were very good in the fall. The project goal remains to have sufficiently good segregating F_3 material to select about 40 - 45,000 headrows.

d. F_2 bulk hybrids

The F_2 bulk hybrid nursery contained 1134 bulks and check plots that were planted at Mead NE. Forty-eight F_2 bulks with one or two genes for herbicide resistance were planted at Lincoln for selection. Twenty-four bulks were for wheat streak mosaic virus, 61 for new stem rust resistance genes, and 123 for scab tolerance. The bulks generally survived the winter, but some were winterkilled (those involving winter tender parents). We continued not sharing our bulk populations this year as the new Wheat Workers Material Transfer Agreement (WWMTA) require prior approval of bulk sharing for any subsequent segregating generation. There is no approved bulk sharing form attached to the WWMTA and the paperwork will continue to a major hurdle. As such, the path of least resistance is simply to not share bulks except with those that we have pre-existing bulk sharing agreements (e.g. CIMMYT). No bulk is shared that includes parental germplasm that requires approval. While this curtailment of bulk sharing is unfortunate and in many ways a waste of resources (groups making the same crosses or not having access to crosses they wished they had made), the alternative concern is that some programs prefer not to share their segregating germplasm with other institutions and businesses.

9. <u>Winter Triticale Nursery</u>

In 2013, no new triticale lines were recommended for release; however, we selected seven lines for increase as possible replacements or to complement NE426GT and NE422T, which continue to perform well. Because triticale is a small market crop, we are carefully deciding how best to release new triticale cultivars so as to not cause inventory problems with the previously released cultivars. Our current thoughts are that we will most likely partner with a triticale seed supplier to merchandise our next release. We also expanded our collaborative testing area into New York, Kansas, and New Mexico.

In 2013, 11 lines (including NE426GT and NE422T) we recommended for increase or re-increasing. It appears that NE422T has good forage potential for the Southern Great Plains. We are beginning to move to higher and more consistent grain yield levels, but identifying excellent forage types requires forage harvesting which is expensive and difficult for widespread trials. Though the markets for biofuels fluctuate with the price of oil and other geologically based fuels, we believe that there is a future for triticale in a biobased energy system. Triticale can be grown over the winter as forage or grain crop in areas where maize cannot be grown successfully. The grain will substitute for maize in animal rations and the forage can be used as forage, cellulosic ethanol feed stocks, or as a ground cover.

The triticale-breeding program has not received its royalties for 2013 as of this writing. We received $20250.50 in 2012 compared to $6847.75 in 2011 and $10060.50 in research and development fees for 2010. We believe that new merchandising arrangements can improve the impact of these varieties. These funds will be extremely important in developing a sustainable triticale-breeding program.

The 2013 grain yields from Nebraska and a collaborative site in KS are:

	Llincoln	Llincoln	Lincoln	Llincoln	Mead	**NEB.**	Rank	Kansas	**NE + KS**	Rank
2013	Height	Heading Date	Grain Yld	Test Weight	Grain Yld	**Avg. Yield**		Grain Yld	**Avg. Yield**	
name	(in)	Julian	Lbs/a	Lbs/bu	Lbs/a	**Lbs/a**		Lbs/a		
NE422T	60.3	150	2622	50.09	3826	**3224.0**	23	2512	**2986.5**	23
NE426GT	48.7	148	2482	47.16	3180	**2831.0**	29	2810	**2824.0**	29
NT01451	49.0	149	2641	47.30	3482	**3061.5**	26	2474	**2865.7**	26
NT05421	57.3	149	3550	50.89	4620	**4085.0**	7	2964	**3711.5**	7
NT05429	48.7	147	3870	48.85	3692	**3781.0**	13	2467	**3342.9**	13
NT06422	51.7	148	4186	47.49	3854	**4020.0**	9	2691	**3577.1**	9
NT06427	49.7	148	3005	46.86	3566	**3285.5**	22	2447	**3006.1**	22
NT07403	48.0	146	4291	52.14	4652	**4471.5**	3	2424	**3789.2**	3
NT09404	53.3	148	3116	47.82	3689	**3402.5**	18	2475	**3093.4**	18
NT09423	50.0	149	3768	49.88	4298	**4033.0**	8	2586	**3550.7**	8
OVERLAND	42.0	150	2867	58.71	3859	**3363.0**	19	2527	**3084.4**	19
NT10417	52.3	148	3429	45.53	3960	**3694.5**	16	2275	**3221.2**	16
NT10429	55.7	149	3274	51.57	5055	**4164.5**	6	2124	**3484.2**	6
NT10441	48.7	149	3532	48.30	3964	**3748.0**	14	1880	**3125.3**	14
NT11404	53.0	148	3411	47.16	3195	**3303.0**	21	2403	**3003.0**	21
NT11406	48.7	149	3342	46.58	3929	**3635.5**	17	1712	**2994.4**	17
NT11410	51.0	147	3763	47.34	4131	**3947.0**	10	1609	**3167.8**	10
NT11428	55.3	149	3708	49.03	3996	**3852.0**	11	1966	**3223.4**	11
NT11444	56.3	150	3276	48.91	4191	**3733.5**	15	3170	**3545.7**	15
NT12403	50.0	147	4002	53.28	4902	**4452.0**	4	2515	**3806.3**	4
NT12404	49.3	146	4230	49.95	4812	**4521.0**	2	2602	**3881.4**	2
NT12406	50.7	147	3728	50.36	3964	**3846.0**	12	1985	**3225.7**	12
NT12411	46.0	148	2275	46.20	3683	**2979.0**	28	2760	**2906.0**	28
NT12412	52.3	149	2784	48.82	3875	**3329.5**	20	2532	**3063.6**	20

The 2013 forage yields from Nebraska (thanks to Dr. Ken Vogel, USDA-ARS) and collaborative sites in Kansas and Oklahoma are:

	Mead	KS	OK		Rank
2013	Forage YLD	Forage YLD	Forage YLD	Aver For	Forage
name	lbs/a	lbs/a	lbs/a	lbs/a	
NE422T	8502	6975	2859	6111.8	15
NE426GT	8700	7827	4084	6870.3	2
NT01451	8385	8669	3403	6819.1	3
NT05421	8944	7502	3403	6616.4	7
NT05429	8864	6401	3539	6267.9	11
NT06422	8725	8803	4220	7249.2	1
NT06427	8597	6517	3539	6217.6	13
NT07403	8528	4874	3948	5783.3	21
NT09404	8154	5490	4220	5954.6	17
NT09423	7955	5711	4084	5916.4	18
OVERLAND	7156	3402	2723	4427.0	24

NT10417	8239	6874	3675	6262.8	12
NT10429	8916	6097	3812	6274.9	10
NT10441	8894	5659	3948	6166.8	14
NT11404	8282	7010	3948	6413.3	9
NT11406	7883	5674	3403	5653.5	23
NT11410	8859	7306	3403	6522.7	8
NT11428	8745	5045	3812	5867.0	19
NT11444	8652	5345	3403	5800.0	20
NT12403	8706	5679	3812	6065.4	16
NT12404	8214	5435	3539	5729.5	22
NT12406	8885	6642	4356	6627.5	6
NT12411	7969	8787	3675	6810.5	4
NT12412	8608	7666	3812	6695.3	5

The forage results from New York in 2013 are:

Variety	T/A DM
NT05429	3.56
NT06422	4.00
NT07403	2.88
NT0422T	3.61

The forage data from Sidney NE (thanks to Dr. Dipak Santra) are:

2013	Height	Forage	Rank	Dry Matter
Name	in	DM Lbs/a		%
NE422T	52.4	4885	3	0.325
NT01451	39.5	4467	8	0.337
NT05421	47.3	5184	1	0.358
NT05429	41.3	4547	5	0.34
NT06422	41.0	4294	9	0.336
NT06427	40.3	5156	2	0.357
NT07403	42.5	4494	7	0.358
NT09404	42.0	4873	4	0.347
NT10429	46.0	4514	6	0.345
NT10441	40.0	4093	10	0.342
Avearge	43.21	4650.5		0.344
LSD	7.0	535.8		0.019
CV	11.1	7.9		3.9
Heritability	0.33	0.41		0.29

The 2012 forage results from Wisconsin were:

		Seeding Rate		Yield	
Variety		(seeds/packet)		Kg/ha	Rank
NE03T416		4400		4954	5
NT01451		4400		4813	7
NT05421		4400		5135	4
NT05429		4400		5215	2
NT06422		4400		5465	1
NT06427		4400		4862	6
NT07403		4400		5157	3
815		4400		4558	8

815 is a local check and it is clear that our lines can compete with the local lines in Wisconsin based on this year's data.

The forage data from North Platte in 2012 are (thanks to Dr. Jerry Volesky):

Triticale Plots 2012	
	2012
Entry	**- - - Tons/acre - - -**
Wheat Border	5.07
1010 Triticale	5.39
NT05429	5.97
NE03T416	6.08
Syn Exp	6.20
NT07403	6.21
NT05421	6.23
NT06427	6.23
NT06422	6.39
TriCal 348	6.58
ATR-626	6.59
NE422T	7.17
NT01451	7.29

Again our lines did very well compared to the local check 1010 Triticale.

The results for the 2012 forage trial at Sidney were (thanks to Dr. Dipak Santra):

name	Yield	NDF	ADF	Prot	RFV	TDN
	lbs/a					
GOODSTREAK	6312	54.6	35.6	11.8	104	62
NE422T	6193	52.15	32.8	11.4	113	65.2
NE426GT	6212	53.75	35.6	10.75	106	62
NT01451	6786	53.95	34.2	12.1	108	63.6
NT05421	6863	54.4	34.15	11.15	107	63.6
NT06427	6793	56.8	36.4	11.5	100	61.1
NT07403	6200	54.8	34.55	12.05	105	63.2
NT09404	7114	54.9	35.15	11.4	104	62.5
NT09423	6905	57.2	37.85	11.6	97	59.4
NT10441	7065	56.2	36.7	11.3	100	60.8
NT10418	7016	56.85	36.15	11.5	100	61.3
NT10429	6319	55.3	35.3	11.35	103	62.3
GRAND MEAN	6648.19	55.08	35.37	11.49	103.63	62.23
LSD	1240.4	3.33	2.71	1.52	9.04	3.06

The results for the 2012 forage triticale trial at Mead, NE are (thanks to Dr. Ken Vogel):

Name	Yield	IVDMD	NDF	ADF	ADL	NITROGEN	DM %
	Lbs/a						
OVERLAND	10108	70.22	54.45	31.65	4.39	1.55	0.4
NE422T	12454	68.6	61.44	36.89	5.04	1.36	0.34
NE426GT	12951	70.48	56.05	32.19	4.38	1.47	0.34
NT01451	12521	69.72	58.58	34.56	4.77	1.48	0.33
NE03T416	11809	70.99	54.77	32.69	4.37	1.38	0.35
NT05421	12638	68.59	58.61	34.62	4.81	1.39	0.35
NT05429	11780	70.88	52.51	31.36	4.16	1.39	0.37
NT06422	11863	70.46	53.42	31.72	4.29	1.39	0.38
NT06423	12090	68.26	57.81	34.59	4.8	1.4	0.36
NT06427	12372	69.58	56.72	33.41	4.51	1.44	0.35
NT07403	13075	71.14	52.02	30.42	4.02	1.44	0.4
NT08414	13083	69.22	56.13	33.59	4.48	1.37	0.33
NT08425	12359	70.43	54.79	32.07	4.31	1.47	0.35
NT09404	12892	70.1	56.79	33.36	4.64	1.57	0.34
NT09423	11698	69.67	58.38	34.4	4.63	1.49	0.33
NT10444	12955	70.93	54.49	32.26	4.4	1.44	0.35
NT10441	11509	69.83	55.79	32.37	4.52	1.41	0.35
NT10417	12236	70.32	55.5	33.11	4.44	1.31	0.36
NT10418	12670	69.1	56.56	33.28	4.41	1.37	0.36

NT10429	11199	68.29	59.09	34.93	4.64	1.45	0.36
NT10443	11951	68.24	61.18	37.01	4.87	1.36	0.35
NT11404	12088	70.02	56.46	33.3	4.54	1.5	0.34
NT11406	12924	69.98	57.33	33.68	4.59	1.38	0.33
NT11408	13906	69.67	55.87	33.2	4.51	1.39	0.35
NT11410	12771	70.1	55.73	33.53	4.47	1.36	0.34
NT11419	12596	68.6	57.78	34.15	4.74	1.27	0.35
NT11428	13220	68.73	59.29	34.97	4.62	1.42	0.34
NT11430	13203	70.49	55.66	32.76	4.39	1.32	0.35
NT11438	12609	69.05	57.14	34.3	4.6	1.32	0.35
NT11444	13567	68.18	59.06	35	4.54	1.32	0.35
GRAND MEAN	12437	69.66	56.65	33.51	4.53	1.41	0.35
LSD	1588	1.63	2.54	1.62	0.31	0.19	0.02
CV	9.05	1.65	3.18	3.42	4.9	9.75	4.07

The results for the 2012 grain triticale trials are:

	Grain Yield (lbs/a)	Grain Yield (lbs/a)	Grain Yield (lbs/a)	**State Avg Yield lbs/a**	**Rank**	**State Avg. Hdate (d after Jan.1)**	**State Avg. Height (in)**
name	Linc.	Mead	Sidney				
Overland	3100	4127	3139	**3455**	**25**	**129.7**	**38.0**
NE422T	3965	3732	1868	**3188**	**28**	**131.0**	**55.0**
NE426GT	4497	4593	3213	**4101**	**4**	**128.2**	**46.3**
NT01451	4312	4152	2785	**3750**	**20**	**129.5**	**44.5**
NE03T416	4520	4327	2708	**3852**	**14**	**122.2**	**46.8**
NT05421	4380	4680	2569	**3876**	**12**	**124.8**	**49.9**
NT05429	4087	4392	2967	**3815**	**17**	**121.2**	**43.4**
NT06422	4421	4794	3061	**4092**	**6**	**121.7**	**48.2**
NT06423	4266	4045	3235	**3849**	**16**	**128.2**	**48.9**
NT06427	4161	3880	2781	**3607**	**23**	**125.2**	**44.5**
NT07403	4482	4200	3372	**4018**	**9**	**119.4**	**45.0**
NT08414	3886	4369	2944	**3733**	**21**	**127.5**	**44.4**
NT08425	4392	4222	3106	**3907**	**11**	**128.0**	**47.2**
NT09404	4334	4392	2865	**3864**	**13**	**129.2**	**48.4**
NT09423	4826	5060	3183	**4356**	**1**	**129.9**	**44.6**
NT10444	4191	3960	3118	**3756**	**18**	**125.5**	**45.0**
NT10441	4516	4551	3086	**4051**	**7**	**129.0**	**45.3**
NT10417	4597	4964	2993	**4185**	**3**	**125.5**	**46.8**
NT10418	4128	3765	2319	**3404**	**27**	**124.0**	**51.3**
NT10429	4154	3695	2377	**3409**	**26**	**129.9**	**52.9**
NT10443	3760	3143	1678	**2860**	**30**	**131.4**	**50.8**
NT11404	4517	4586	2989	**4031**	**8**	**126.5**	**44.7**
NT11406	4747	4956	3075	**4259**	**2**	**129.4**	**46.6**
NT11408	4361	4472	2714	**3849**	**15**	**125.9**	**51.4**
NT11410	4276	4643	2960	**3960**	**10**	**126.5**	**44.3**

NT11419	4354	3575	2926	**3618**	**22**	**129.3**	**50.2**
NT11428	5144	4492	2662	**4099**	**5**	**129.2**	**50.9**
NT11430	4008	4328	2280	**3539**	**24**	**127.2**	**49.7**
NT11438	3595	3901	1544	**3013**	**29**	**129.0**	**52.1**
NT11444	4638	4244	2371	**3751**	**19**	**130.7**	**52.0**
LSD	865.19	678.46	538.78				
CV	10.23	9.64	11.93				
MEAN	**4287**	**4275**	**2763**	**3775**		127.1	47.6

The results for the 2011 grain triticale trial at Lincoln (the only valid location) are:

Entry	Variety	Flowering Date d after April 30	Height (in)	Grain Yield lbs/a	Rank
1	Overland	29.4	39.7	4040	30
2	NE422T	29.2	58.4	4595	27
3	NE426GT	25.5	50.2	5597	9
4	NT01451	26.8	48.3	5311	17
5	NT02421	24.8	50.7	5315	16
6	NE03T416	23.5	49.7	5517	13
7	NT04424	24.8	51.3	5243	18
8	NT05421	24.2	53.9	5016	22
9	NT05429	23.1	46.1	5660	7
10	NT06422	22.5	49.0	5671	6
11	NT06423	25.9	52.9	5392	14
12	NT06427	25.9	48.5	4965	23
13	NT07403	22.3	45.7	5720	4
14	NT08414	24.3	46.6	5049	21
15	NT08425	24.7	49.1	5602	8
16	NT09404	28.1	51.3	5541	11
17	NT09411	25.1	48.4	5819	3
18	NT09420	27.1	52.6	5132	20
19	NT09423	27.4	48.0	5931	2
20	NT09428	27.5	50.5	5356	15
21	NT10444	24.7	50.2	5531	12
22	NT10441	26.6	47.0	5698	5
23	NT10417	24.8	52.8	6016	1
24	NT10445	29.1	61.6	4284	29
25	NT10418	24.6	57.4	4879	25
26	NT10442	29.8	56.0	5211	19
27	NT10429	28.4	57.1	5596	10
28	NT10443	29.5	57.7	4743	26
29	NT10413	24.4	55.4	4905	24
30	NT10432	30.2	59.7	4353	28
	AVERAGE	**26.1**	**51.5**	**5256**	
	LSD	**1.7**	**2.4**	**616**	
	CV	**3.9**	**2.9**	**7.1**	

These trial results indicate that: 1. triticale produces more biomass and grain yield than wheat; 2. there is considerable GxE for forage yield; and 3. it very difficult to couple grain yield with forage yield. The comparison likely was affected by different stages of harvest as seen by the different dry matter contents. Of the lines tested in all the grain and forage trials, NT07403 had good grain yield across the state, excellent forage yield in western NE, but poor forage yield in eastern NE. This highlights the need for testing our forage triticale lines in grain and forage trials across and beyond Nebraska.

The three-year (2010-2013) grain yield data summary for locations where we were able to harvest trials is presented below:

		Linc.	Mead	Sidney	St. Avg.	State	Avg.	Avg
	name	lbs/a	lbs/a	lbs/a	lbs/a	Rank	hdate	height
2011-13	NE422T	3727	3779	1868	3206.2	14	131.0	55.0
2011-13	NE426GT	4192	3887	3213	3466.0	10	128.2	46.3
2011-13	NT01451	4088	3817	2785	3405.6	13	129.5	44.5
2011-13	NT05421	4315	4650	2569	3980.7	4	124.8	49.9
2011-13	NT05429	4539	4042	2967	3798.2	7	121.2	43.4
2011-13	NT06422	4759	4324	3061	4056.0	3	121.7	48.2
2011-13	NT06427	4044	3723	2781	3446.4	11	125.2	44.5
2011-13	NT07403	4831	4426	3372	4244.8	1	119.4	45.0
2011-13	NT09404	4330	4041	2865	3633.1	9	129.2	48.4
2011-13	NT09423	4842	4679	3183	4194.7	2	129.9	44.6
2011-13	NT10417	4681	4462	2993	3939.6	5	125.5	46.8
2011-13	NT10429	4341	4375	2377	3786.6	8	129.9	52.9
2011-13	NT10441	4582	4258	3086	3899.5	6	129.0	45.3
2011-13	Overland	3336	3993	3139	3409.2	12	129.7	38.0
	Mean	**4329**	**4175**	**2876**	**3748**		**126.7**	**46.6**

It is clear that we have made great progress in grain yields in triticale. Marketing remains the major limitation to improving triticale's impact in modern agriculture.

10. Collaborative Research on Wheat Diseases

Dr. Stephen Wegulo, Department of Plant Pathology, and his staff continue to inoculate our experimental lines with wheat stem rust and Fusarium head blight (FHB, research funded by the U.S. Wheat and Barley Scab Initiative), and as time permits with wheat leaf rust. We continue to improve the greenhouse tests for stem rust. With the advent of the new race of stem rust, Ug99 (which can overcome some of the previously very durable resistance genes in wheat which were the main genes used in our program), we have greatly increased our efforts to introgress and pyramid new genes with our existing genes. (*Sr2, SrAmigo, SrTmp, SrR, Sr6, Sr22, Sr 24, Sr25, Sr26, Sr 36, Sr39*, and *Sr 40*).

Work continues on introgressing the resistance from *Agropyron* (*Wsm1*, the first real resistance/tolerance to wheat streak mosaic virus [WSMV] developed by Dr. Joe Martin, Kansas State University at Hays, Kansas and his co-workers) into adapted wheat varieties. The newer source for resistance/tolerance, *Wsm2*, developed by Scott Haley (CSU) in collaboration with KSU is also being introgessed. It seems to have less effect on agronomic performace, but also may not be as effective in Nebraska as *Wsm1*. A number of lines that may have this source of resistance were given to Gary Hein who is testing them in the field. The frequency of lines carrying virus resistance remains far lower than expected. There appears to be a genetic segregation distortion in heterozygous plants with the progeny often not carrying the gene or that the lines are lost during selection for better agronomic types. However, we continue make numerous crosses as this is a key trait for Nebraska. The field assay is by far the best method to determine the tolerance to this virus. With the continued spreading of wheat soilborne mosaic virus into our Lincoln fields (a key early generation testing site), we are now able to select for wheat soilborne mosaic virus resistant lines and many of lines have this beneficial trait.

11. Understanding the Stem Rust Resistance in 'Gage' Wheat: T. Kumsa, P.S. Baenziger, S. Wegulo, M. Rouse, and Y. Jin.

Wheat (*Triticum spp.*) stem rust, caused by *Puccinia graminis* f. sp. *tritici* Eriks. & E. Henn. (*Pgt*) re-emerged as a devastating disease of wheat because of virulent race Ug99 (TTKSK). Many bread wheat (*T. aestivum* L.) cultivars grown in North America are susceptible to Ug99 or its derivative races that carry additional virulence. 'Gage' was released in 1963 mainly for its excellent field resistance to leaf rust (caused by *Puccinia triticina* Eriks) and stem rust. However, Gage's resistance has not been genetically characterized, which would facilitate its use in breeding programs. To better define the nature of the resistance in Gage, we created an F_2 population and the corresponding $F_{2:3}$ and $F_{4:5}$ families from crosses between Gage and stem rust susceptible cultivar 'Bill Brown'. Inheritance of resistance to *Pgt* race QFCSC and molecular marker analysis indicated that *Sr2* and additional genes explain the stem rust resistance of Gage. Using seedling plant infection types from the F_2, $F_{2:3}$ and $F_{4:5}$ families, we found that at least one dominant and most likely one recessive gene are involved in Gage's resistance. Seedling resistance genes acted independently of *Sr2* since *Sr2* is effective only at the adult plant stage. Adult plants without *Sr2*-linked marker gwm533 but with a resistant adult plant disease response indicated that at least one other gene is involved in adult plant resistance. By the end of May 2013, we obtained F_6 seed, which will give a recombinant inbred line population after one more generation of selfing. (Completed in May 2104).

12. Association Mapping for Important Biotic & Abiotic Related Traits in a Structured Wheat Breeding Population. I. Salah, D. Wang, K. Eskridge, J. Crossa, and P.S. Baenziger

This research focuses on applying genomic selection methods in our breeding program using different statistical approaches to build new applicable protocols that will be used to improve our selection. We are specifically interested in effectively building the genotype by environment interaction into our models because we occasionally have years like 2012 (the earliest in the last 29 years) which are very unrepresentative for phenotypic selection and our main early generation selection nurseries are in eastern Nebraska when most of our wheat is grown in western Nebraska. Hence, having estimated breeding values for genes in western Nebraska that can help select when our breeding material is in eastern Nebraska will be very helpful. Our preliminary results indicated that when factors such as heritability, relative costs of genotyping versus field evaluation, and the number of cycles of selection per year, are taken into account, the efficiency of GS becomes favorable in comparison with phenotypic selection. Furthermore, we are comparing the predictability of different markers systems i.e. SNP and GBS in a genomic selection framework. So far, it appears GBS will be very cost effective for breeding purposes and that SNP will be effective for gene mapping. One of the difficulties with genomic selection that we have is that cost effective marker platforms are constantly improving and it is important to be able to compare allele values over time and with different marker platforms, however innovative approaches by Dr. Jesse Poland are reducing this concern.

13. Fusarium Headblight (FHB) Research: Ali Bakhsh, Stephen Wegulo, Guihua Bai, Bill Berzonsky, P. S. Baenziger

In previous research, we found *Fhb1*, a major gene for scab (syn. Fusaium head blight) tolerance, was not pleiotropic or linked to genes that reduce grain yield. The difficulty with creating high yielding *Fhb1* lines is most likely due to the wide diversity and poor adaptation of many of parents lines used as *Fhb1* sources. In a second study, we evaluated a number of Wesley backcross 2 lines with the *Fhb1* gene. We identified seven high yielding Wesley *Fhb1* lines for use as parents in crossing. We are using high yielding lines from the first and the Wesley study in our crossing block. For the first time, we are seeing lines in our multiple-location observation nursery that contain *Fhb1*, indicating our breeding strategy is beginning to work. In addition, Dr. Guihua Bai has created a number of Overland backcross *Fhb1* lines, which are also extensively being used in the greenhouse-crossing block. Overland has a native tolerance which with the added tolerance conveyed by Fhb1 could be extremely valuable in creating new cultivars with tolerance to scab. Of course, Overland has been a very popular and high yielding cultivar in Nebraska, which makes it use as a parent very attractive.

14. Breeding for Organic Systems: Richard Little, P. S. Baenziger, Dipak Santra, Teshome Regassa

Organic State Winter Wheat Variety yield trials were conducted at Clay Center (SCAL) with 13 cultivars and 23 experimental lines and at Sidney (HPAL) with 15 cultivars and 19 experimental lines. A project funded by CERES Organic Trust entitled "Investigating Nitrogen Use Efficiency for Winter Wheat Quality [NUEQ] in Organic Rotations in Nebraska" funded by CERES Organic Trust was initiated at SCAL with 12 promising lines planted and harvested at two stages of the rotation—after soybeans and after alfalfa. The purpose is to identify lines with excellent bread-making quality at lower protein content, and to determine if soil N not utilized for wheat protein is conserved for future crops.

In the NUEQ trials, protein content was one percent higher (in absolute values) after alfalfa than after soybeans. This appeared to be the effect of drought stress and lower yields. Treatments of manure in a previous year and application of 20 lbs. N per acre of Chilean nitrate increased protein content less dramatically. The purpose of these unreplicated plots was to obtain flour at different protein levels, not to obtain agronomic data. Thom Leonard, a flour quality consultant for Heartland Mill, developed a standard whole-wheat sourdough baking protocol and assembled a group of artisan bakers to test stoneground flour of 12 lines at three protein content levels. Arstisan baking results will be compared with results of white flour baking tests by the UNL Grain Quality Lab and farinograph tests conducted by Baystate Milling, and whole-wheat mixographs performed by project staff.

The top-yielding lines at HPAL were Mace, NE06545, NW07505, Karl92, NW03666, Hatcher, NI08708, and Overland, respectively. Mace excels for yield only when WSMV or TrMV infections are severe. Lines in the top yield group (significantly greater than all other lines) at SCAL were NE08659, NE02558 and NE06545. Yield and protein data are available at http://cropwatch.unl.edu/web/varietytest/wheat.

In the SCAL variety trial, conditions converged—late planting into cool soils– for infection of seedlings with common bunt (*Tilletia sp*.) spores. Three of our most promising experimental lines, NE05425, NE05496 and NW03681, plus Karl 92, had severe common bunt. Common bunt and black point ratings based on the percent of infected kernels is provided in the following table where 1.0 is resistant/tolerant and 9.0 is susceptible. Lines that were tested less than three years in organic trials may have escaped infection, because common bunt is a seed-borne disease that is readily controlled by fungicidal seed treatments, which are often used in our conventional trials.

ID	Years tested in organic plots	Bunt Count per 10000 seeds	Bunt Severity Score 1-9	Percent Blacktip Seeds	Blacktip Severity Score 1-9	Note
ALLIANCE	5	5	1	2	2	
CAMELOT	5	18	2	1	1	
EXPEDITION	3	9	1	2	1	
KARL 92	4	143	9	4	3	
LYMAN	2	8	1	5	4	
MCGILL	5	17	2	18	9	
MILLENNIUM	5	443	9	2	1	
NE02558	2	16	2	5	4	
NE03490	5	95	6	5	4	
NE04424	5	319	9	4	4	
NE05425	5	181	9	3	3	
NE05496	3	16	2	3	2	Extreme bunt in NUEQ samples
NE05548	4	27	2	2	2	
NE06469	4	12	2	4	4	Extreme bunt in NUEQ samples
NE06545	2	50	4	3	2	
NE06607	3	2	1	4	4	
NE07444	2	36	3	12	9	
NE07531	1	4	1	5	4	
NE08457	2	30	3	5	5	
NE08509	1	12	2	2	2	
NE08659	1	11	2	1	1	
NE99495	5	15	2	4	3	
NI08708	2	13	2	4	4	
NW03666	4	6	1	2	2	
NW03681	5	286	9	3	2	
NW05M6011-10-2	1	22	2	2	1	
NW05M6011-22-3	1	7	1	1	1	
NW07505	3	2	1	10	8	
NX04Y2107	1	0	1	9	8	
OVERLAND	5	65	5	5	4	
PRONGHORN	5	28	3	2	2	
SCOUT 66	1	15	2	9	8	
SD07165	2	76	5	2	2	
TURKEY	1	11	2	2	1	
WAHOO	5	38	3	5	4	
WESLEY	5	67	5	3	3	

We submitted a new organic proposal for USDA funding entitled "Breeding for Resistance and Preventing the Spread of Common Bunt of Winter Wheat in Organic Systems in Nebraska" due the concerns that we have about common bunt affecting seed and grain quality in organic systems. Our long-term goal is to provide organic farmers in Nebraska and similar climates with disease resistant winter wheat adapted to their farming systems and markets. Our intermediate goal is to improve organic hard winter wheat by incorporating durable resistance to two key diseases: common bunt (CB) and Fusarium head blight (FHB). Our immediate goal is to prevent the contamination and spread of CB in the seed of organic wheat cultivars through breeding and biologically based management strategies. We will achieve these goals through the following objectives: #1 Develop foundation hard winter wheat populations and lines adapted to organic systems in two Nebraska ecozones that possess multiple sources of resistance to CB and FHB, through a partnership between Utah State University (USU), University of Nebraska-Lincoln (UNL) and Nebraska organic farmers. #2 Advance an effective strategy for preventive control of CB by screening National Organic Program (NOP)-compliant methods and demonstrating effective bunt control strategies.

15. Grain Mineral Concentrations in Great Plains Hard Winter Wheat. Mary Guttieri, Katherine Frels, P. Stephen Baenziger, D. Brian Arnall, Brett F. Carver, and Brian M. Waters.

In their efforts to feed the growing world population, wheat breeders have focused primarily on grain yield. As grain yields have increased, concentrations of important minerals have tended to decrease due to a "dilution effect." Substantial segments of the world population suffer from hidden hunger caused by mineral-deficient diets, and increasing atmospheric CO2 concentration may further decrease mineral concentrations. The purpose of this study was to assess variation for grain mineral concentration within the Hard Winter Wheat Association Mapping Panel (originating from breeding programs across the Great Plains) and to explore relationships with grain protein concentration (GPC) that may be used for selection within breeding programs. We evaluated grain mineral concentration in this panel from trials grown in Nebraska and Oklahoma in 2012 and 2013. Mineral concentrations were measured by ICP-MS. We found a general trend toward reduced grain concentrations of Zn, Fe, P, and S in cultivars released since 1960; however, significant variation persists within the germplasm pool accessible for breeding. The low to moderate heritabilities for iron and zinc concentration will challenge direct breeding efforts, particularly within low-yield environments where the traits have poor expressivity. However, the interrelationship between GPC and grain Fe and Zn concentrations may be exploited in breeding strategies that incorporate measurement of GPC to select among genotypes based on positive deviation from the grain protein-yield relationship. Selection for positive grain protein deviation (GPD) in multiple environments may provide yield-neutral direct selection for increased GPC and indirect selection for increased grain Fe and Zn concentration. Improvement in grain Fe and Zn concentrations in positive GPD genotypes is of the same magnitude as the decline in Fe and Zn reported under elevated CO2. Selection for GPD provides an economical approach to improve mineral nutritional quality of wheat for a growing world population in a changing climate.

16. Genome Wide Association Mapping of Grain Cadmium in Hard Winter Wheat. Mary Guttieri, Katherine Frels, Peter Baenziger and Brian M. Waters.

Pollution-safe cultivars of bread wheat (*Triticum aestivum* L.) can reduce cadmium consumption and the corresponding risks to human health. Cadmium contamination of agricultural soils is widespread and rapidly worsening in China, raising concern about the safety of the Chinese grain supply since cereals are dominant sources of Cd in human diets. Variation in Cd concentration in durum wheat (*Triticum turgidum* L. var. durum Desf.) is well documented and has been associated with a major QTL on chromosome 5B, but genetic variation in Cd accumulation in hexaploid bread wheat is less well characterized. Grain mineral concentration was measured in a 299-genotype hard winter wheat association mapping panel grown in 2012 and 2013 near Ithaca, NE (on the site of a decommissioned munitions factory) and Tifton, OK. In Nebraska trials, grain Cd concentration averaged 0.230 mg kg^{-1} in 2012 and 0.157 mg kg^{-1} in 2013; Cd concentrations ranged from 0.080 to 0.580 mg kg^{-1} in 2012. In contrast, mean Cd concentration in Oklahoma trials was 0.014 mg kg^{-1}. The low-Cd phenotype was heritable and amenable to selection in the high-Cd Nebraska environment. Genome-wide association analysis with 92K SNP markers identified a major QTL on chromosome 5A in each environment and across environments. Syntenic relationships with the barley genome sequence were used to determine that this QTL likely is homeologous to the 5B QTL for *Cdu1* in durum wheat. The high-Cd allele was present in 29% of the genotypes in the AM panel. Similar to results in durum, a second weaker QTL on 5A, present in only 9% of the genotypes in the panel, had a significant additive effect on grain Cd concentration. In the highest Cd trial (2012), the two QTLs had a significant epistatic interaction. These results provide a foundation for further genetic studies exploring grain Cd accumulation in bread wheat.

17. Evaluation of Airborne Hyperspectral Imaging For Use In Nitrogen Use Efficiency Phenotyping in Hard Winter Wheat. Katherine Frels, Mary Guttieri, Laura Dotterer, Fares Al-Aboud, Rick Perk, Bryan Leavitt, Brian Wardlow and P. Stephen Baenziger.

As nitrogen fertilizer costs and environmental concerns rise, the need to breed nitrogen use efficient (NUE) crops is increasing. However, traditional phenotyping methods for NUE traits are labor intensive and destructive. Numerous publications have highlighted the use of remote sensing of canopy spectral reflectance (CSR) as a proxy for physical sampling. Hyperspectral CSR measures reflectance of incident light reflected by the plant canopy. Reflectance values for specific wavelengths are selected and used to calculate vegetation indices, such as Normalized Vegetation Differential Index (NDVI) or Chlorophyll Index (CI). These indices correlate with physical plant characteristics such as biomass and chlorophyll content and indicate plant nitrogen status. While less labor intensive than physical sampling, ground based CSR is slow and gives a narrow, though finely detailed, window of observations at the plot level. These detailed data sets are useful for relatively small studies, but are difficult to manage in larger breeding nurseries. Airborne hyperspectral imaging systems such as AISA Eagle provide lower spectral and spatial resolution and generate a broader view of a large trial at a specific time point. However, small plot breeding nurseries reach the limits of aerial imagery spatial resolution. During the 2012 growing season, the USDA-NIFA Triticeace Coordinated Agricultural Project (TCAP) supported ground based CSR phenotyping in the 299-genotype hard winter wheat association mapping panel grown near Ithaca, NE. The trial was imaged by the AISA Eagle airborne system of the University of Nebraska's Center for Advanced Land Management Information Technologies' (CALMIT). Moderate correlation between aerial and proximal indices were found, and the aerial data showed predictive ability for traits such as biomass, grain protein yield, and nitrogen content. With improvements to the data capture and extraction methodology, it is expected that airborne hyperspectral imagining can become a useful tool for evaluating NUE in breeding nurseries.

18. Genomic Selection for Nitrogen Use Efficiency Using Canopy Spectral Reflectance in Hard Winter Wheat. Katherine Frels Mary Guttier, Ibrahim S. El-Basyoni P. Stephen Baenziger

The need to breed nitrogen use efficient (NUE) crops is growing due to increasing nitrogen costs and environmental concerns. However, traditional phenotyping methods for NUE are labor intensive and destructive. Canopy spectral reflectance (CSR) can be used as a proxy for physical sampling. During the

2012 growing season, the USDA-NIFA Triticeace Coordinated Agricultural Project (TCAP) supported proximally based CSR phenotyping in the 299-genotype hard winter wheat association, mapping panel grown near Ithaca, NE. CSR data was collected once a week for a five week period during grain fill, using a dual-fiber optic system with two inter-calibrated Ocean Optics USB 2000+ spectrometers allowing for adjustment to incident light. This system has 0.4 nm spectral resolution from 350.02 to 1011 nm. Vegetation indices measuring chlorophyll content and biomass such as NDVI, CI, and EVI were used to investigate plant productivity parameters associated with NUE. Of the vegetation indices investigated, Enhanced Vegetation Index (EVI) showed the best correlation with biomass, grain yield, and grain N quantity. A G-BLUP prediction model using SNP markers was applied on the weekly EVI and max EVI value for each entry. Prediction accuracy was estimated using 10 fold cross validation replicated 100 times. Accuracy for EVI phenotypes ranged from 0.38 for week 1 EVI to 0.57 for week 5 EVI. We concluded that genomic selection combined with CSR data was successful in predicting unphenotyped lines within same year. Further investigation will be done to study the prediction accuracy of genomic selection and CSR data across years/environments.

19. Hybrid Wheat (P. S. Baenziger, Amir Ibrahim, MengYuan Wang, and friends)

In 2010, we began a small hybrid wheat program using two cytoplasmic male sterile systems. The goal of this effort is to provide a publicly available system for hybrid wheat. Hybrid wheat and traits (syn. transgenes, genetically modified wheat) are two of the last great frontiers in wheat research. However, while there is considerable private and public sector research in traits, there is relatively little public sector research in hybrid wheat. Hence we decided to begin a program so that should hybrid wheat become a reality, there would be public sector research looking at heterosis and heterotic pools, hybrid production systems, and pollinators. Most of work involves *timopheevi* cytoplasmic male sterile (e.g. the male steriles are fully sterile). The restorer lines look fully restored as inbred lines and will restore our CMS female line, but the genetics of restoration appear to be quite complex (e.g. there are many partially restored progeny in the early generation segregating populations). Unfortunately, almost all hybrid sources are spring growth habit, so we are converting them into winter male sterile lines (we are currently up to the third backcross) and winter restorer lines. Hence, we are creating the key components of a viable hybrid system. Our second cytoplasmic male sterile system may be under some environmental control. In the winter, the male sterile and restored lines looked excellent. However in our spring greenhouse, the male sterile lines looked "leaky"—more seed set than expected; or the outcrossing in the greenhouse was higher than expected. The second system, if leaky, may be a good system for recurrent selection. Both hybrid systems are still under evaluation, but it appears that we have made progress. The next step will be to develop strategies to develop heterotic pools to create hybrid vigor using chemical hybridizing agents (negotiations are underway) and molecular markers (e.g. GBS). While this research may be criticized because if successful, it will almost assuredly lead to a greatly reduced role for public wheat breeders, the fundamental question of how to create heterotic pools should provide a more systematic foundation for pure line breeding also. A collaborative grant with Texas A&M University to develop a public platform for hybrid wheat breeding was submitted to the USDA NIFA program.

Though not directly related to hybrid wheat breeding we continue creating a dominant male sterile based open pollinated population for possible recurrent selection experiments.

IV. GREENHOUSE RESEARCH

In 2012, the majority of F_1 wheat populations were grown at Yuma, AZ. Mainly populations needing additional crosses are being grown in the Lincoln Greenhouses. This change reduced our greenhouse space and greenhouse labor, and provided much greater quantities of F_2 seed. We made over 100 triticale crosses, over 100 barley crosses and over 1000 wheat crosses in last year's fall, winter, and spring greenhouses.

V. PROPRIETARY RESEARCH

Public Private (University of Nebraska) Collaborations:

In 2009, the University of Nebraska decided to sustain the wheat breeding project via enhanced collaborations with commercial companies spanning the value chain. The University of Nebraska-Lincoln (UNL) has had a long-standing arrangement with BASF, providing access to the Clearfield technology. Infinity CL and Settler CL are outcomes of this research. We are now concentrating on two-gene herbicide tolerant wheat cultivars. In 2009, UNL began a collaboration with ConAgra. They support our McCook Nursery and provide valuable information on the end-use quality of our lines at that site, which is a key sourcing site for their Colorado mills. In 2010, UNL developed a collaboration with Bayer Crop Science that allows non-exclusive access to UNL germplasm and is in accordance with the principles for collaboration approved by the National Association of Wheat Growers and with the U.S. Wheat Associates Joint Biotechnology Committee. This collaboration has led to extensive collaborations and interactions on genetics, plant breeding, and crop physiology. Having their excellent staff in Lincoln has been very advantageous to our students and their interactions also. In 2012, we evaluated over 900 doubled haploid lines created in collaboration with Limagrain and are evaluating 60 lines in replicated trials at numberous locations. We continue to develop germplasm exchange agreement with private companies as their germplasm is becoming increasingly relevant. Our goal continues to be the "People's University" and to work will all public and private wheat researchers in a manner compatible with the landgrant mission.

USDA-ARS projects at the University of Nebraska are not party to these agreements.

We received our eleventh year of research and development fees from an agreement with Paramount Seed Farms (a commercial seed company) for the exclusive release of our winter barley germplasm. We are fortunate that they took the initial risk of building a market for our germplasm when no one else was interested.

P-845 is a winter barley (*Hordeum vulgare* L.) cultivar developed by the Nebraska Agricultural Experiment Station and was formally released in 2013 by the developing institution. It was released primarily for its superior grain yield and adaptation to rainfed small grains production systems in Nebraska and in states south of Nebraska. P-845 was selected from the cross Krasnodar 'K304/2'/NB90701, where the Krasnodar line K304/2 was developed in southern Russia and used as a parent for its diversity and expected winterhardiness and the pedigree of NB90701 is NE80725 sel./OK77422. The pedigree of NE80725 is Sabbaton/Meimi*2/Decatur/3/Dundy//Nebar sel./Dundy. The pedigree of OK77422 is CI 13855/NC 6005-15. The cross was made in 1993. The F_1 generation was grown in the greenhouse in 1994 and the F_2 to F_3 generations were advanced using the bulk breeding method in the field at Mead, NE in 1995 and 1996. In 1996, single F_3-derived F_4 rows were planted for selection in 1997. There was no further selection thereafter. The $F_{3:5}$ was evaluated as a single four row plot at Lincoln, NE in 1998. P-845 was identified in 1999 as the experimental line and NB99845 was selected for further testing.

P-845 was evaluated in Nebraska replicated yield nurseries starting in 2001 to 2011 and in the USDA-ARS Uniform Winter Barley Yield Trial in 2010. In the Nebraska Barley Variety Trial (2004 to 2011, Table 1), P-845 performed well across Nebraska and in western Kansas. Compared to the four commercially available cultivars, P-845 was the highest yielding line at Lincoln, NE and Colby, KS. It was the second and third highest yielding line at Mead and Sidney, NE respectively. These data are supported by the 2010 USDA-ARS Nursery where P-845 ranked 6th, region-wide of the 16 entries tested. It was not significantly (P<0.05) lower than the highest yielding lines in the nursery. Based upon these data, P-845 is adapted to Nebraska and western Kansas and adjacent areas of the Great Plains.

Other measurements of performance from comparison trials indicate that P-845 is moderately early in maturity (flowering 136.6 d after Jan.1), about 1 d later flowering than TAMBAR 501 and 1 day earlier flowering than P-713, P-721, and P-954. P-845 is a relatively short winter barley cultivar (26.7 in tall) which is similar to P-721 and P-954, but one inch shorter than TAMBAR 501 and 2 inches shorter than P-713. P-845 has moderate straw strength (8% lodged) which was lower than the comparison cultivars. The winter hardiness of P-845 is good and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska and Kansas.

In Nebraska, winter barley is mainly affected by winter injury and there are relatively few diseases on the crop. Based upon data from the USDA-ARS Uniform Winter Barley Yield Trial in 2010 using field races, P-845 is moderately resistant to moderately susceptible to net blotch (incited by *Pyrenophera* Drechs. F. *teres* Smedeg.), moderately susceptible to powdery mildew (*Blumeria graminis* f. sp. *hordei* Speer) and susceptible to stripe rust (incited by *Puccinia striiformis* Westend. f. sp. *hordeii* Eriksson). P-845 has average grain volume weight (44.2 lbs/bu) which is similar to P-713 (44.7 lbs/bu), lower than P-721 (45.1 lbs/bu) and P-954 (45.3 lbs/bu), and higher than TAMBAR 501 (42.8 lbs/bu) in comparison trials.

In positioning P-845, based on performance data to date, it should be well adapted to most rainfed small grains production systems in southeastern, south central, west central, and western Nebraska, in western Kansas, and in adjacent areas of the Great Plains. P-845 has not been tested under irrigation, so its performance in that production system in unknown. P-845 is genetically complementary to virtually all barley cultivars grown in Nebraska and Kansas except for P-721 that also has Dundy as a parent.

P-845 is a straight, tan-glumed winter barley cultivar that has long and rough awns with many teeth. The juvenile growth habit is prostrate. The plant color at heading is green and anthrocyanin is absent from the stem and leaf sheath. The leaf is glossy. The auricle is white. The spike is six-row, square headed, and erect at maturity. The glume is one-half of the lemma and has no hairs. The rachis is pubescent. The lemma is long. The seed is slightly wrinkled, hulled,or covered, and the rachilla has short hairs. The aleurone is colorless.

P-845 has been uniform and stable since 2010. Less than 0.5 % of the plants were rogued from the Breeder's seed increase in 2010-12. The rogued variant plants were taller in height (5 - 15 cm) or were awnless. Up to 1% (10:1000) variant plants may be encountered in subsequent generations. Paramount Seed Farms, 7682 County Road Z, Quinter, KS 67752 has the exclusive rights to market P-845 and will have seed available to qualified growers in 2013. The Nebraska Foundation Seed Division, Department of Agronomy and Horticulture, University of Nebraska-Lincoln, Lincoln, NE 68583 will not have foundation seed. A research and development fee will be assessed on all seed sales. Small quantities of seed for research purposes may be obtained from the P. S. Baenziger and the Department of Agronomy and Horticulture, University of Nebraska-Lincoln for at least 5 yr from the date of this release. In addition, a seed sample has been deposited into the USDA-ARS National Small Grains Collection, Aberdeen, ID and seed is freely available to interested researchers. Collaborative work with Mr. Pat Evans of KSU at Colby, KS is outstanding and allows us to greatly improve our understanding of Great Plains adaptation. Dipak Santra is the key person in western NE for timely barley harvest.

With the current level of private sector investments in research, additional public-private interactions are to be expected and we are developing relationships with many other organizations. A key goal will be to develop working relationships that benefit the producer, the customer, and the public good.

The 2013 barley data:

	Colby			Lincoln				Mead					
	Plant Height	Grain Yield	Test Weight	Heading Date	Plant Height	Lodging (rate)	Grain Yield	Heading Date	Plant Height	Lodging (rate)	Grain Yield	Mean Yield	
Name	**Inch**	**lbs/a**	**lbs/bu**	**After April 1**	**Inch**	**0-9**	**lbs/a**	**After April 1**	**Inch**	**0-9**	**lbs/a**	**lbs/a**	**Rank**
NB12437	22	1505	45	19	33	0	5212	22	31	2	5664	**4127**	**1**
NB11430	23	1700	45	18	34	0	5369	20	31	1	5242	**4104**	**2**
NB10425	21	1946	47	19	33	0	5329	24	33	1	4993	**4089**	**3**
P-845 (NB99845)	18	1670	45	19	31	0	5247	23	30	0	5240	**4052**	**4**
NB09404	21	1720	46	18	35	0	5084	20	33	0	5242	**4015**	**5**
NB12424	18	1576	45	19	31	0	5144	23	32	0	5278	**3999**	**6**
NB12419	20	1890	48	20	31	0	4784	23	32	0	5237	**3970**	**7**
NB12434	20	1551	47	17	31	0	5155	21	30	2	5082	**3929**	**8**
NB09409	19	1782	47	19	32	0	5057	23	33	2	4942	**3927**	**9**
NB09410	21	1665	50	19	36	0	4968	22	33	0	5047	**3893**	**10**
NB10444	20	1724	49	18	29	0	4946	21	30	2	4973	**3881**	**11**
NB12431	18	1266	45	18	30	0	5485	22	30	1	4795	**3849**	**12**
NB12426	20	1609	43	19	34	0	4822	24	33	2	5062	**3831**	**13**
TAMBAR 501	19	1518	39	18	31	0	5328	20	31	1	4646	**3831**	**14**
NB12421	19	1661	45	20	30	0	4938	24	30	2	4892	**3830**	**15**
NB10417	19	1621	44	18	32	0	5429	19	30	2	4304	**3785**	**16**
NB09437	21	1463	47	19	36	0	5246	22	31	1	4550	**3753**	**17**
NB11416	20	1585	42	19	33	0	4990	22	30	4	4670	**3748**	**18**
NB10403	23	1251	43	15	34	0	5216	18	33	1	4774	**3747**	**19**
NB12425	20	1746	47	20	31	0	4709	23	33	3	4762	**3739**	**20**
NB11414	19	1859	42	18	32	0	4804	25	32	0	4456	**3706**	**21**
NB09425	18	1453	44	19	29	0	4789	23	28	1	4838	**3693**	**22**
NB10420	21	1434	36	15	35	0	5027	19	33	0	4584	**3682**	**23**
P-713	20	1638	49	19	34	0	4567	22	35	3	4724	**3643**	**24**
P-954	17	1472	38	19	31	0	4602	23	31	4	4831	**3635**	**25**
NB12422	19	1732	46	19	31	0	4307	22	31	2	4794	**3611**	**26**
NB12436	21	1713	44	20	34	2	4451	22	33	2	4622	**3595**	**27**
NB10440	21	1577	52	17	32	0	4772	21	33	1	4388	**3579**	**28**
NB12433	19	1137	33	18	31	0	4609	21	33	0	4907	**3551**	**29**
NB12408	17	1412	37	19	31	0	5041	22	26	0	4129	**3527**	**30**
NB09441	20	1063	31	18	34	0	5083	21	30	0	4420	**3522**	**31**
NB08428	22	1516	37	19	31	0	4687	23	30	2	4335	**3513**	**32**
NB11418	17	1481	37	19	30	0	4904	22	29	1	4128	**3504**	**33**
NB12440	19	1295	38	19	34	0	4544	27	32	0	4637	**3492**	**34**
NB11438	21	1360	42	18	32	0	4215	21	32	0	4857	**3477**	**35**
NB12417	17	1826	47	23	28	0	3899	27	28	2	4687	**3471**	**36**
NB12418	19	1165	45	17	31	0	4932	19	32	1	4169	**3422**	**37**
NB10409	19	1546	35	18	35	1	4124	20	32	1	4581	**3417**	**38**
P-721	19	1487	53	19	31	2	3494	22	29	3	4492	**3158**	**39**
NB12403	24	687	32	18	32	0	4240	22	33	0	4055	**2994**	**40**
Mean	**20**	**1532**	**43**	**19**	**32**	**0**	**4839**	**22**	**31**	**1**	**4751**	**3707**	
CV %	**7**	**17**	**22**	**1**	**4**	**252**	**7**	**1**	**5**	**126**	**9**		
LSD 5%	**2**	**368**	**13**	**1**	**2**	**1**	**516**	**2**	**3**	**3**	**673**		

Winter Barley Variety Trial (BVT) 2012 Summary for Lincoln and Mead, NE

VARIETY	Lincoln				MEAD				Across Locations	
	Anthesis	PHT	YLD	Rank*	Anthesis	PHT	YLD	Rank	YLD	Rank
	(after April1)	Inch	lbs/a		(after April1)	Inch	lbs/a		Lbs/a	
P-713	19	35	4784	15	24	35	5563	3	5173	7
P-721	21	31	3908	36	26	32	4786	25	4347	33
P-954	23	32	3218	39	25	32	4564	33	3891	39
TAMBAR 501	16	34	4772	17	21	35	5375	9	5073	11
NB08428	20	33	4332	27	23	34	5385	8	4859	18
NB09404	20	34	4732	18	24	36	5493	5	5113	9
NB09405	16	32	3668	38	22	35	4570	32	4119	36
NB09409	20	32	4608	21	25	35	5254	11	4931	15
NB09410	19	35	5216	5	23	37	5842	2	5529	2
NB09425	19	30	4811	14	25	32	5200	13	5006	13
NB09427	24	32	4185	30	27	35	5253	12	4719	24
NB09430	14	33	4064	32	21	37	4888	21	4476	28
NB09432	22	33	4083	31	26	35	4236	39	4160	35
NB09433	21	32	4242	29	26	34	4627	28	4434	31
NB09434	20	33	4295	28	25	32	4833	24	4564	25
NB09437	20	36	5321	3	24	36	6064	1	5692	1
NB09439	20	32	4636	19	24	33	4886	23	4761	21
NB09440	13	33	3935	34	21	35	4285	37	4110	37
NB09441	18	34	4903	12	21	36	5017	17	4960	14
NB10403	13	34	4951	9	21	38	4740	27	4846	19
NB10404	14	34	4556	22	21	35	4241	38	4399	32
NB10409	15	37	5023	8	22	38	4760	26	4892	16
NB10417	15	31	5077	6	21	35	5177	14	5127	8
NB10420	14	33	4774	16	21	36	5000	18	4887	17
NB10421	18	34	4934	11	24	35	4508	34	4721	23
NB10425	20	37	4951	9	25	35	5075	15	5013	12
NB10440	15	33	4891	13	22	35	5265	10	5078	10
NB10444	16	31	5536	1	21	35	5435	6	5486	3
NB11404	16	34	2848	40	21	35	3200	40	3024	40
NB11405	19	35	4516	23	25	37	4589	29	4552	26
NB11414	19	32	5488	2	23	35	4887	22	5188	6
NB11416	20	34	5035	7	24	35	5543	4	5289	5
NB11418	16	32	4611	20	22	33	4952	20	4782	20
NB11419	19	32	4335	26	22	34	4583	30	4459	29

NB11427	18	31	4033	33	22	33	4983	19	4508	27
NB11429	21	34	3782	37	23	33	4425	36	4104	38
NB11430	17	35	5219	4	21	36	5423	7	5321	4
NB11431	20	31	3911	35	25	31	4582	31	4247	34
NB11432	19	33	4398	25	24	34	4489	35	4443	30
NB11438	17	33	4459	24	22	35	5050	16	4755	22
Mean	**18.18**	**33.22**	**4526.1**		**23.10**	**34.68**	**4925.7**			
Coeff Var	**1.05**	**1.38**	**7.57**		**4.52**	**3.02**	**8.44**			
Root MSE	**1.47**	**1.38**	**342.45**		**1.05**	**1.05**	**415.61**			
R-Square	**0.91**	**0.68**	**0.81**		**0.81**	**0.78**	**0.70**			
LSD (p=0.05)	**1.71**	**2.37**	**556.66**		**1.69**	**1.70**	**675.58**			
P-value	**<0.0001**	**<0.0001**	**<0.0001**		**<0.0001**	**<0.0001**	**<0.0001**			

The 2011 data are:

Winter Barley Variety Trial (BVT) 2011 Summary for Lincoln (NE) and Colby (KS)

ENTRY	VARIETY	Lincoln					Colby			Across Locations	
		Anthesis	PHT	YLD	WinSur	Rank*	PHT	YLD	Rank	YLD	Rank
		(after May	Inch	lbs/a	%		Inch	lbs/a		Lbs/a	
1	P-713	14	34	3498	90	4	21	2282	2	2890	1
2	P-721	15	31	2553	90	33	20	1928	19	2241	28
3	P-954	16	31	2796	83	26	22	2035	11	2415	19
4	TAMBAR 5	15	31	3211	77	13	22	1585	28	2398	20
5	NB03437	19	33	2405	70	38	20	1260	37	1833	39
6	NB99845	20	31	3152	53	15	20	1456	33	2304	23
7	NB99875	19	35	3201	63	14	19	1295	36	2248	25
8	NB07410	16	37	2956	80	22	23	1500	31	2228	29
9	NB07411	19	34	3613	70	3	20	770	40	2192	31
10	NB07412	18	34	2398	60	39	19	1052	39	1725	40
11	NB08428	17	31	3406	83	5	18	1597	27	2501	14
12	NB09404	16	34	2417	73	37	21	1904	21	2161	32
13	NB09405	15	35	2815	73	25	26	1380	35	2098	35
14	NB09409	15	34	2742	93	27	21	1880	23	2311	22
15	NB09410	16	39	2279	83	40	24	1915	20	2097	36
16	NB09425	16	29	2603	90	31	20	1957	16	2280	24
17	NB09427	18	36	3399	87	6	24	2111	8	2755	6
18	NB09430	13	35	2697	87	29	24	1555	30	2126	33
19	NB09432	16	36	2428	90	35	22	1490	32	1959	38
20	NB09433	16	31	3087	87	17	24	1757	26	2422	18
21	NB09434	17	33	3380	83	9	21	2012	12	2696	7
22	NB09437	16	34	3399	87	6	23	2202	4	2801	4
23	NB09439	16	31	2697	90	29	20	2238	3	2468	16
24	NB09440	13	33	2428	83	35	21	2055	9	2242	27
25	NB09441	13	34	3087	87	17	25	1880	24	2483	15
26	NB10403	13	34	3380	80	9	22	1872	25	2626	9
27	NB10404	12	33	3000	87	20	20	1450	34	2225	30
28	NB10406	15	34	2587	80	32	22	1903	22	2245	26
29	NB10409	16	35	3397	80	8	24	1943	17	2670	8
30	NB10410	15	33	2726	73	28	23	1968	14	2347	21
31	NB10417	14	31	3126	77	16	23	2115	7	2621	10
32	NB10419	14	31	2933	73	23	21	1962	15	2447	17
33	NB10420	12	36	3616	93	2	24	1969	13	2793	5
34	NB10421	16	34	3054	70	19	22	1174	38	2114	34
35	NB10425	15	35	3629	93	1	25	2040	10	2834	3
36	NB10434	15	31	2919	77	24	23	2177	5	2548	13
37	NB10437	16	33	2488	70	34	22	1566	29	2027	37
38	NB10439	16	34	2993	87	21	25	2143	6	2568	12
39	NB10440	14	35	3356	83	11	26	2343	1	2850	2
40	NB10444	15	32	3248	73	12	24	1943	17	2596	11
	Mean	**15.57**	**33.33**	**2959.94**	**80.25**		**22.10**	**1791.68**			

VI. ALLIED RESEARCH

The wheat breeding or variety development project is only one phase of wheat improvement research at the University of Nebraska-Lincoln. The project interacts and depends on research in wheat germplasm development, wheat quality, wheat nutritional improvement, wheat cytogenetics, plant physiology and production practices, and variety testing. Much of the production research is located at the research and extension centers. All components are important in maintaining a competitive and improving wheat industry in Nebraska. The allied research is particularly necessary as grain classification and quality standards change and as growers try to reduce their production costs.

The program also depends on interactions and collaborations with the Wheat Board, Nebraska Wheat Growers Association, regional advisory boards, Foundation Seeds Division, Nebraska Crop Improvement Association, the milling and baking industry, the malting and brewing industry, and other interested groups and individuals. The Nebraska Seed Quality Laboratory cooperates closely with the Wheat Quality Council to bake the large-scale cooperator samples. ConAgra also provides excellent milling and large loaf baking data to support our small loaf testing procedures. Numerous groups have visited the laboratory and participated in discussions on quality and marketing. Through these interactions, the program is able to remain focused and dedicated to being a premier provider of quality varieties, information, and technologies to help maintain the Nebraska Wheat Industry. We also wish to highlight the generosity of Mr. Martin Stumpf who recently donated one section of rainfed and irrigated land for an International Wheat Research Center in Grant, NE and the funds to build a building on the site. Grant is one of the finest wheat producing regions in Nebraska and this location will be a huge benefit to the Nebraska wheat producer. We hope our program will live up the high expectations of the donor.

VII. COMING AND GOINGS

All projects are more than crosses, selections, evaluations, data, and seed. At its heart, it is the people that make this research possible. Dr. Tadele Tadessa completed his Ph.D. degree and Dr. Ibrahim Salah El Baysoni completed his postdoctoral studies and returned to Egypt, and we are quite fortunate to have him continue on a retainer to help with our genomic selection work. Mr. Nicholas Garst and Mr. Waseem Hussain, an Indian Council of Agricultural Research scholar (very prestigious award) joined the program as M.S. and Ph.D. students respectively. Ms. Golnaz Komaei Koma joined our program in 2013, but for personal reasons left in 2014. We are extremely grateful for the excellent work that the team has and continues to do.

Summary:

In 2012-2013 season, 1,470,000 acres of wheat were planted in Nebraska and 1,130,000 were harvested with an average yield of 35 bu/a for a total production of 39,550,000 bu. This was one of the smallest crops in the last 50 years and certainly highlighted the effect of drought. In 2012, 1,380,000 acres of wheat were planted in Nebraska and 1,300,000 were harvested with an average yield of 41 bu/a for a total production of 53,300,000 bu. In 2011, 1,500,000 acres of wheat were planted in Nebraska and 1,400,000 were harvested with an average yield of 45 bu/a for a total production of 63,000,000 bu. In 2010, 1,600,000 acres of wheat were planted in Nebraska and 1,490,000 were harvested with an average yield of 43 bu/a for a total production of 64,070,000 bu. In 2009, 1,700,000 acres of wheat were planted in Nebraska and 1,600,000 were harvested with an average yield of 48 bu/a for a total production of 76,800,000 bu.

Using seed sales of certified seed, the top 10 lines grown in Nebraska were: Settler CL (15.4%), Overland (12.4%), Tam 111 (9.4%), AP502CL2 (6.3%), Winterhawk (5.6%), Wesley (5.1%), Pronghorn (5.0%), Infinity CL (4.3%), Art (3.6%), and Camelot (3.3%). In 2013, NE06545 winter wheat was formally released, as was P-845 winter barley. The decision to release these two lines was made in 2012 and their descriptions can be found in the 2012 and 2013 reports.

Based upon grower interest, NE05548 was released as Panhandle winter wheat. NE005548 was selected from the cross NE97426/NE98574 where the pedigree of NE97426 is BRIGANTINA/2*ARAPAHOE and the pedigree of NE98574 is CO850267/RAWHIDE. NE05548 was evaluated in Nebraska replicated yield nurseries starting in 2006, in the USDA-ARS coordinated Northern Regional Performance Nursery in 2008 and 2009, and in the University of Nebraska Fall Sown Wheat Performance Trials in 2009 to 2013. In the Nebraska Intrastate Nursery (2007 to 2013), NE05548 performed well in western Nebraska where taller wheat cultivars are preferred. In the last five years, it has been tested in western Nebraska in the Nebraska State Variety Trials across 20 environments. NE05548 (3527 kg/ha) had higher grain yield than comparable tall winter wheat cultivars (Goodstreak 3393 kg/ha; Pronghorn 3165 kg/ha; and Buckskin 3111kg/ha). It was similar in grain yield to Overland (3480 kg/ha), but lower yielding than Robidoux (3709 kg/ha) and Settler CL (3595 kg/ha). Based upon these data, NE05548 is adapted to rainfed wheat production in western NE.

Other measurements of performance from comparison trials indicate that NE05548 is moderately late in maturity. It is a semi-dwarf wheat cultivar, though the mature plant height of NE05548 (80.3 cm) in western NE (20 environments) is 2 cm shorter than Goodstreak, and 4 cm shorter than Pronghorn, and 5 cm shorter than Buckskin, the latter being three very popular tall wheat cultivars. NE05548 is the tallest semi-dwarf wheat cultivar released to date by the USDA-University of Nebraska Wheat Improvement Program. NE05548 has moderate straw strength for a taller wheat. The winter hardiness of NE05548 is good and comparable to other winter wheat cultivars grown in Nebraska.

NE05548 is resistant to *Soilborne wheat mosaic virus* in field nurseries in Nebraska and to stem rust (caused by *Puccinia graminis Pers.: Pers. f. sp. tritici* Eriks & E. Henn.) in field nursery tests at St. Paul, MN. In greenhouse seedling tests, it is resistant to races QFCS, QTHJ, MCCF, RCRS, RKQQ, and TMPK, but susceptible to race TTTT It is moderately susceptible to susceptible for leaf rust (caused by *P. triticina* Eriks,) and to stripe rust (caused by *P. striiformis* Westendorp f. sp. t*ritici,* data obtained from field observations in the Great Plains). NE05548 is considered as being moderately susceptible to Fusarium head blight (caused by *Fusarium graminearum*, data from greenhouse and field observations in Nebraska) and moderately resistant for DON accumulation. NE05548 is moderately resistant to moderately susceptible to Hessian fly (*Mayetiola destructor* Say,). It is susceptible to *Barley yellow dwarf virus*, and *Wheat streak mosaic virus* (data obtained from the USDA-ARS Southern Regional Performance Nursery and field observations in NE). NE05548 tends to has lower grain volume weight, acceptable grain protein content, and acceptable milling and baking quality

The generous support of the Nebraska Wheat Board is gratefully acknowledged.