Revised 2001

SMALL GRAINS IN 2001

The following are the small grain variety recommendations for Virginia in 2001. The recommendations are based on the agronomic performance in barley and wheat variety tests conducted by the Research and Extension Divisions of Virginia Tech in the various agricultural regions of the state.

SMALL GRAIN VARIETIES RECOMMENDED
Arranged in Order of Maturity
*** indicates that seed should be treated with Baytan®**

COASTAL PLAIN	PIEDMONT		WEST OF BLUE RIDGE
	South of James River	North of James River	
	Barley		
Callao	Callao	Callao	Callao
Nomini	Nomini	Nomini	Nomini
Starling	Starling	Starling	Starling
	Wheat		
FFR 518W	FFR 518W	FFR 518W	FFR 518W
SS 520	SS 520	SS 520	SS 520
USG 3209	USG 3209	USG 3209	USG 3209
Pioneer Brand 2684	Pioneer Brand 2684	Pioneer Brand 2684	Pioneer Brand 2684
AGS 2000	AGS 2000	AGS 2000	AGS 2000
Pioneer Brand 2580	Pioneer Brand 2580	Pioneer Brand 2580	Pioneer Brand 2580
Pioneer Brand 26R46	Pioneer Brand 26R46	Pioneer Brand 26R46	Pioneer Brand 26R46
----------	----------	Pocahontas	Pocahontas
Sisson	Sisson	Sisson	Sisson
Pioneer Brand 26R24	Pioneer Brand 26R24	Pioneer Brand 26R24	Pioneer Brand 26R24
Pioneer Brand 26R61	Pioneer Brand 26R61	Pioneer Brand 26R61	Pioneer Brand 26R61
Century II	Century II	Century II	Century II
Pioneer Brand 2643	----------	----------	----------
----------	----------	----------	NK Coker 9663
NK-Coker 9835*	----------	----------	----------
Featherstone 520	Featherstone 520	Featherstone 520	Featherstone 520
SS 550	SS 550	SS 550	SS 550
FFR 535	FFR 535	FFR 535	FFR 535
Jackson*	Jackson*	Jackson	Jackson
Roane*	Roane*	Roane	Roane

COMMERCIAL BARLEY ENTRIES

Virginia Tech and Virginia Crop Improvement Association, 9142 Atlee Station Road, Mechanicsville, VA 23116 - Callao, Nomini, Starling, and Wysor.

COMMERCIAL AND EXPERIMENTAL WHEAT ENTRIES

AGSouth Genetics, PO Box 88823, Dunwoody, GA 30356 - AGS 2000.
University of Arkansas, Dept. of Agronomy, 115 Plant Science, Fayetteville, AR494B-2-2, AR584A-3-1, and AR839-27-1-3.
Featherstone Seed Company, 13941 Genito Road, Amelia, VA 23002 - Featherstone 520.
University of Georgia, GA Station, 1109 Experiment Street, Griffin, GA 30223 - GA901146E15 and G/F91426E39.
Hoffman Seeds, Inc., 144 Main Street, Landisville, PA 17538 - Century II.
University of Kentucky, Kentucky Foundation Seed Project, PO Box 11950, Lexington, KY 40579 – KY 90C-292-4-1 and KY 91C-171-24.
North Carolina State University, 840 Method Rd, Unit 3, Box 7629, Raleigh, NC 27695-7629 – NC96-13965 and NC96-13156.
Novartis Seeds, Inc., Box 340, Hartsville, SC 29550 - NK Coker 9663, NK Coker 9835, NK Coker 9704, Coker 9025, and Coker BL940812.
Pioneer Hibred International, Inc., Eastern Division, Tipton, IN 47072 - Pioneer Brand 2580, Pioneer Brand 2643, Pioneer Brand 26R46, Pioneer Brand 26R61, Pioneer Brand 2684, Pioneer Brand 26R24, Pioneer Brand 26R38, XW586, and XW692.
Resource Seeds, Inc., 2355 Rice Pike, Union, KY 41091 - Trical 498, RSI Exp301, RSI Exp331, RSI Exp341, and RSI Exp351 (all triticales).
Southern States Cooperative, PO Box 26234, Richmond, VA 23260 - FFR 518W, FFR 522W, FFR 555W, FFR 566W, FFR 535W, SS520, and SS550.
Uni-South Genetics, 2640-C Nolensville Road, Nashville, TN 37211 - USG 3209.
Virginia Tech and Virginia Crop Improvement Association, 9142 Atlee Station Road, Mechanicsville, VA 23111 - Massey, Madison, Jackson, Pocahontas, Roane, and all lines prefixed by VA.

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Conducted and summarized by the following Virginia Tech employees: Dr. Daniel E. Brann, Extension Agronomist, Grains; Dr. Carl Griffey, Small Grains Breeder; Mr. Harry Behl, Agricultural Supervisor; Ms. Elizabeth Rucker and Mr. Tom Pridgen, Research Associates. Location Supervisors: Mr. Tom Custis (Painter); Mr. Bobby Ashburn (Holland); Mr. Bob Pitman, Mr. Mark Vaughn, and Mr. Charles Sanford (Warsaw); Mr. Bill Wilkinson III and Mr. Bud Wilmouth (Blackstone); Dr. Carl Griffey and Mr. Tom Pridgen (Blacksburg); Mr. Robert A. Clark, Mr. Tom

Stanley, and the Beckenstrater Family (Shenandoah Valley); Mr. David Starner and Mr. Denton Dixon (Orange).

INTRODUCTION

The attached tables present results from barley and wheat varietal tests conducted in Virginia in 1999-2001. Yield data are given for individual locations; yield and other performance characteristics are averaged over the number of locations indicated. Performance of a given variety often varies widely over locations and years which makes multiple location-year averages a more valid indication of expected performance than data from a single year or location. All tests in 2000-2001 were grown in seven-inch rows planted at 22 seeds per row foot with the exception of Blacksburg and Warsaw which were grown in six-inch rows at 22 seeds per row foot. The plots were trimmed during the winter to 9 feet in length. Details about management practices for barley and wheat are included in the bulletin.

BARLEY VARIETIES

Virginia is an excellent place to produce barley. It fits well into cropping systems and has a yield potential in excess of 120 bushels per acre as shown by the three year averages of current varieties and Virginia Tech lines.

Hulled barley makes good feed for horses, dairy animals, beef, sheep, and some laying hens. The problem is that these industries in Virginia and the mid-Atlantic region use only limited quantities of barley. Profitable barley production on over 50,000 acres in Virginia is going to require revival of international market opportunities and/or development of barley varieties that the poultry and swine feeders want to buy.

Revival of international markets is going to be tough regardless of actions taken by producers **but if we do not start producing quality barley we will not be able to meet international barley standards and we will be unable to compete**.

Virginia and the mid-Atlantic region have produced low test weight, poor quality barley for too many years. No one wants to buy barley with 43-45 pound test weight like we have been growing with awnletted varieties such as Wysor, Nomini, or Starling. The genetic test weight of these varieties is about 48 pounds/bushel but it decreases rapidly with drought during grain fill or rainfall during harvest. **Cash grain barley producers must switch from varieties such as Nomini and Starling to Callao or its replacement that will be released this year. This is the only way we can possibly compete in export markets. This plea is made for the entire mid-Atlantic region since the Perdue facility at Norfolk receives grain from the whole region. It will not be sufficient for Virginia farmers to switch since their grain will be blended with barley from the entire mid-Atlantic region.**

The good news is that producers do not have to sacrifice yield to switch to Callao. Callao has yielded similar to Nomini in the cash grain areas of the coastal plains as shown by three year average yields of 139 bu/acre for Nomini and 138 bu/acre for Callao at the Warsaw location. In 2001 at Painter, Callao yielded 127 bu/acre and Nomini yielded 119 bu/acre. Callao lodges more than Nomini but 10-15 less pounds of nitrogen/acre or the growth regulator Cerone® will largely solve the lodging problem. Starling is a good variety for silage or hay but its low test weight makes it a relatively poor choice for cash grain barley. Nomini is also a good choice if the barley will be harvested as silage or hay.

I am glad to report that in the near future there will be choices other than Callao to produce high test weight barley. Virginia Tech will be releasing the line VA 96-44-321 this fall with seed available to producers by fall of 2003. This line has similar test weight to Callao and has yielded about 3-5 bu/acre more than Callao. More importantly, it has much better standability than Callao being similar in standability to Nomini.

Another exciting area in barley is the availability of hulless lines. Hulless barley grows and looks like regular barley until it is almost mature. When almost mature the glumes start to separate. The grain is completely separated from the glumes when combined. Hulless barley grain looks more like wheat than traditional barley. As you can see in Table 1 the yields of hulless barley are less than hulled barley but remember that the hull normally makes up 10-15 percent of the weight of hulled barley. The lines beginning with "SC" are lines obtained from South Carolina and lines beginning with VA are lines developed by Dr. Carl Griffey's program at Virginia Tech. The best hulless line produced 120 bu/acre (at 48 lbs/bu) at one location and averaged 96 bu/acre.

What will we do with hulless barley? Research feeding trials with swine and poultry have shown hulless barley to be excellent feed. There is also interest in hulless barley as an energy source for ethanol. Hopefully at least one of these potential markets will become a reality. As you can see in Table 4 most of the current hulled lines are several days later than Callao barley but still much earlier than wheat. Test weight of the hulless lines is generally in the 57-59 lbs/bu range. Standability of current lines is good.

Barley may still have a bright future in Virginia and the mid-Atlantic region **if** we strive to produce what the customer wants. Let's improve our barley quality and see what happens. We have a great deal to lose if barley becomes obsolete and no longer is a viable crop in our rotation system.

SUMMARY OF BARLEY MANAGEMENT PRACTICES FOR THE 2001 HARVEST SEASON

Blacksburg - Planted October 4, 2000. Preplant fertilizer was 25-100-120 October 2, 2000. Site was fertilized with 40-0-0 using 30% UAN solution plus 0.6 oz Harmony Extra® April 14, 2001. Harvest occurred on June 19, 2001.
Blackstone - Planted October 12, 2000. Preplant fertilizer was 300 lb 10-20-20 + 1 ton lime October 5, 2000. Site was fertilized with 50 lb N using liquid nitrogen + 0.5 oz Harmony Extra® + 0.125% X-77® February 9, 2001. Liquid nitrogen was applied at 75 lb March 12, 2001. Harvest occurred on June 12, 2001.
Painter - Planted October 19, 2000. Preplant fertilizer was 500 lbs 10-10-10. Forty lbs N using 20-0-0-4 and 0.5 oz Harmony Extra® were applied February 2, 2001. Forty lb N using 30% cut 50/50 with water were applied February 21, 2001. Harvest occurred on June 9, 2001.
Warsaw - Planted October 16, 2000. Preplant fertilizer was 30-80-80 applied October 12, 2000. Fertilization at 25 lbs using 25-0-0-3 was applied December 7, 2000 with 0.6 oz Harmony Extra®. Fertilization at 35 lbs using 25-0-0-3 was applied February 12, 2001. Fertilization at 45 lbs using 24-0-0-3 was applied March 27, 2001. Three oz Warrior T® was applied May 4, 2001. Harvest occurred June 12, 2001.
Orange - Planted October 10, 2000. Preplant fertilization was 500 lbs 5-10-10 October 3, 2000. Sixty lbs N were applied March 15, 2001. Harvest occurred on June 14, 2001.

WHEAT VARIETIES

When considering wheat variety performance, it is necessary to take seed treatment used on the varieties into consideration. Entries in this test have different seed treatments that may greatly impact performance. Seed treatments are indicated by an acronym in parentheses following the name. For example, USG3209(RT) indicates that this entry was treated with raxil and thiram. "A" is Apron®, "B" is Baytan®, "C" is Captan®, "D" is Dividend®, "R" is raxil, "T" is thiram, and "V" is Vitavax®. Virginia Tech experimental lines and some of the public varieties such as Massey were treated with raxil and thiram.

Virginia's well-drained soils are highly productive for wheat even with the weather variations we experience. Note that the best varieties of wheat yielded above 90 bu/a at two locations and averaged over 80 bu/a statewide. The major current problem in Virginia-style wheat production continues to be low prices, especially for soft red winter wheat in the Mid-Atlantic region.

Virginia Tech's small grain variety testing program evaluates varieties statewide from Painter on the Eastern Shore to Blacksburg in southwestern Virginia. The no-till test planted into corn stubble was repeated near Warsaw, Virginia and is planned to be a regular part of the program. In 1999 we expanded the tests at Blacksburg, Warsaw and Painter to evaluate genetic potential and varietal responses to a common seed treatment of Baytan®, Captan®, and Gaucho® and application of Tilt® fungicide compared to seed treatments as generally marketed and no foliar fungicide.

The extreme variation in weather conditions of the past three seasons demonstates the importance of evaluating a variety over locations and years. Weather variations make it extremely important to evaluate varieties over years and locations. It is also important to evaluate performance of varieties over locations within regions of the state. Varieties that do well on the Eastern Shore and upper Coastal Plain may not do well at Blacksburg and vice versa. Diseases such as powdery mildew are often more severe in eastern Virginia due to climate and the concentration of wheat in the rotations. Leaf rust is often a greater potential yield- and test weight-reducing factor in the eastern region than in other areas of the state. The other factor that should be considered is changes in disease susceptibility of varieties over years. For example, Roane wheat was released for its high yield potential and excellent disease resistance characteristics. Roane and Pocahontas had excellent resistance to powdery mildew until last year when a new race of powdery mildew emerged in the Warsaw area that was able to attack them. Use each new year's results to re-evaluate the best varieties and management practices (e.g. seed and foliar fungicides) for individual farms.

Note that the future for wheat varieties adapted to Virginia is very positive. Dr. Carl Griffey, Virginia Tech's small grains breeder, has new lines shown in the table starting with "VA" that are in the top yielding group with good disease resistance. He is also ready for the speciality markets as shown by good performance of white seeded lines such as VA97W-375WS and high gluten lines such as VA96-54-326.

Varieties in the top yielding group for at least two years statewide include USG 3209, Pioneer Brand 26R24, Sisson, Century II, Southern States 550, and Southern States 520.

New , top-yielding releases include Sisson, SS 550, and SS 520. Sisson, a Virginia Tech release, is early, has good test weight, excellent resistance to powdery mildew and average standability. Seed of Sisson should be available for planting this fall. SS 550 is medium maturity, shorter than average with good standability, and has excellent resistance to powdery mildew. SS 520 is early, taller than average with good standability and moderate resistance to powdery mildew and leaf rust. Test weight of SS 520 is average.

USG 3209 is moderately early maturity, shorter than average with good standability, has good test weight, and excellent resistance to powdery mildew. USG 3209 has proven to be a leader over years in Virginia and other regions of the country. Pioneer Brand 25R24 is medium maturity, taller than average with good standability, and has good test weight. Pioneer Brand 26R24 showed good resistance to powdery mildew when tested with Baytan seed treatment. Century II is medium maturity, average height with good standability and good test weight. Century II had above average powdery mildew infection when treated with Dividend®. Note that all of the top yielding varieties have good but not excellent standability. If they are fertilized for top yields on highly productive soils you should expect some lodging.

Other varieties that continue to be competitive when looking at two year averages and produce especially well in some areas of the state include FFR 518, AGS 2000, Pioneer Brand 26R38, Pioneer Brand 26R61, Pioneer Brand 2580, Pioneer Brand 2684, Pocahontas, Roane, Featherstone 520, Pioneer Brand 26R46, Jackson, FFR 522, and FFR 535. Varieties in this group should be evaluated by looking at the performance by region of the state. For example, FFR 518 did well in the Coastal Plain but was only average in the Piedmont and Blue Ridge whereas AGS 2000 did well in the Piedmont and Blue Ridge but not in the Coastal Plain. Roane was near the top at Blacksburg but less than average in the Coastal Plain. Refer to Table 8 for individual characteristics of these varieties.

Varieties producing less than average yields over two years in our tests include Pioneer Brand 2643, Coker 9835, Coker 9704,

FFR 566, Coker 9025, FFR 555W, Coker 9663, and Massey. There are special situations where these varieties are still an excellent choice and where management may change varietal performance. For example, Pioneer Brand 2643 has worked well for some producers because it responds well to higher seeding rates and intensive management. It also has the best standability of varieties/lines tested. Coker 9663 is ultra susceptible to powdery mildew which reduces it's yield in eastern Virginia even with an application of fungicide. Coker 9663 performed well at Blacksburg where powdery mildew is not as severe.

SUMMARY OF WHEAT MANAGEMENT PRACTICES FOR THE 2001 HARVEST SEASON

Blacksburg - Planted October 5, 2000. Preplant fertilizer was 25-100-120 applied October 2, 2000. Harmony Extra® was applied at 0.6 oz on April 14, 2001 with 75-0-0 using 30% UAN solution. Harvest occurred on July 2, 2001.
Warsaw - Planted October 17, 2000. Preplant fertilizer was 30-80-100 applied October 12, 2000. 25 lbs N using 25-0-0-3 was applied December 6, 2000 with 0.6 oz Harmony Extra®. 38 lbs N using 25-0-0-3 was applied February 24, 2001. 64 lbs N using 24-0-0-3 was applied March 27, 2001. Three oz of Warrior T® were applied May 4, 2001. Harvest occurred June 26, 2001.
Blackstone - Planted October 12, 2000. Preplant fertilizer was 300 lb 10-20-20 + 1 ton lime October 5, 2000. Site was fertilized with 50 lb N using liquid nitrogen + 0.5 oz Harmony Extra® + 0.125% X-77® February 9, 2001. Liquid nitrogen was applied at 75 lb March 12, 2001. Harvest occurred June 21, 2001.
Painter - Planted October 19, 2000. Preplant fertilizer was 500 lbs/A 5-10-10. Forty lbs N using 20-0-0-4 and 0.5 oz Harmony Extra® were applied February 2, 2001. Forty lbs N using 30% cut 50/50 with water were applied February 21, 2001. Forty lbs N using 30% cut 50/50 with water were applied March 20, 2001. Harvest occurred on June 20, 2001.
Holland - Planted November 1, 2000. Preplant fertilizer was 600 lbs 5-15-20 October 25, 2000. On January 29, 2001 40 units of N was applied using 24-0-0-3. On March 14, 201, 80 units N was applied using 30%. Harvest occurred June 12-13, 2001.
Orange - Planted October 10, 2000. Preplant fertilizer was 500 lbs 5-10-10 applied October 10, 2000. Sixty lbs N were applied arch 15, 2001. Harvest occurred on June 26, 2001.
Shenandoah - Planted October 11, 2000. Forty lbs N were applied February 8, 2001. Sixty lbs N were applied with 0.5 pt 2,4-D March 31, 2000. Harvest occurred July 3, 2001.
Warsaw No-Till - Planted October 31, 2000. Preplant fertilizer was 30-60-100 with 10 lbs S + 1 quart Gamazone Extra® applied October 24, 2000. 25 lbs N using 25-0-0-3 plus 0.6 oz Harmony Extra® was applied December 13, 2000. 38 lbs N using 24-0-0-3 was applied February 24, 2001. 64 lbs N using 24-0-0-3 was applied March 27, 2001. Three oz Warrior T® was applied May 3, 2001. Wheat was harvested June 24, 2001.

WHEAT PLANTED NO-TILL INTO CORN STUBBLE

Wheat was planted no-till into corn stubble on a field adjacent to the Eastern Virginia AREC near Warsaw, Virginia. Cooperator Charles Sanford harvested his corn and shredded the stalks. Preplant fertilization of 30-60-100 with 10 lbs sulfur and 1 quart Gramaxone Extra®/acre was performed October 24, 2000. Seventy-one varieties/lines of wheat were planted into the corn stubble with a Hege plot drill at 30 seeds/row foot on October 31, 2000. Additional fertilizer and herbicide was applied as follows: 25 lbs (25-0-0-3) + 0.6 oz Harmony Extra®/acre on December 13, 2000; 38 lbs (24-0-0-3)/acre on February 24, 2001; 64 lbs (24-0-0-3) on March 27, 2001; 3 oz Warrior T®/acre on May 3, 2001. Powdery mildew ratings were made on June 5, 2001.

First, it must be noted that the yields of no till wheat into corn stubble have been good each of the past three years with only limited scab. The no till yields have been similar to conventional wheat yields on the station. Hopefully the lack of severe scab is typical of what can be expected for producers in future years. Scab probability is generally higher when wheat is planted no-till or reduced-till into corn stubble of environmental conditions are favorable for infection. Virginia Tech is continuing to develop scab resistant lines to reduce future potential scab infections.

Generally the best wheat varieties for conventional tillage are also the best for no-till but not always. Sisson is definitely a star in the no-till test and has been over years. Similar excellent yields have been obtained with USG 3209 and SS 520 each year. Featherstone 520 is an average variety planted conventional tillage but it has performed near the top when planted no-till. Other varieties performing well under no-till are SS 550, FFR 535, Coker 9025, Pioneer Brand 26R38, FFR 518 and Pioneer Brand 26R24.

It also is important to determine which varieties do not do well when planted no-till. Varieties that have not performed well when planted no-till are Roane, Pocahontas, FFR 566, Pioneer Brand 26R46, and Coker 9835.

EVALUATION OF FUNGICIDE/VARIETY INTERACTIONS

The response of wheat varieties to foliar fungicides at heading varies based on the level of disease present. One of the primary factors affecting disease levels is genetic resistance to diseases such as powdery mildew, leaf rust, tan spot, septoria, barley yellow dwarf, etc. These trials were initiated in 1999 to evaluate the genetic yield potential of current wheat varieties when foliar diseases are uncontrolled compared to fungicide treatment at heading. In 1999 and 2000 (data not presented), yield changes over locations related to Tilt®, Gaucho® and Baytan® application ranged from no difference to over 15 bu/acre depending on variety and location. The response to fungicide also varied among years at individual locations. The response to fungicide application at Blacksburg has generally been less than Warsaw because powdery mildew is usually much less at Blacksburg. The response to fungicide over varieties at heading in Blacksburg was 4 bu/acre in 1999, 16 bu/acre in 2000 and 5 bu/acre in 2001. The large response in 2000 likely was attributable to control of barley yellow dwarf virus in treated versus non-treated plots. In contrast the response to fungicide at Warsaw was 11, 9, and 9 bu/acre for 1999, 2000 and 2001 respectively.

The 2001 results at Painter and Warsaw show varieties such as Sisson that have good resistance to powdery mildew and leaf rust increased in yield only 6 bu/acre when Baytan® +Gaucho® seed treatment and Tilt at heading were applied compared to raxil/thiram seed treatment plus no fungicide at heading. In contrast, AGS 2000 increased in yield by over 20 bu/acre with the additional fungicide treatments at Painter and Warsaw. These results show that effective genetic resistance is an important step toward economical and environmentally sensitive wheat production. However, when needed, fungicide seed treatments and timely foliar fungicide application can make money even at today's wheat prices.

Varieties that are known to be susceptible to powdery mildew such as FFR555W, Coker 9663, Roane and Pocahontas will likely benefit from Baytan® seed treatment when grown in eastern Virginia. Fungicide application at heading should be determined by scouting the field for powdery mildew, leaf rust and septoria to determine the level of disease pressure.

MILLING AND BAKING QUALITY

Milling and baking quality of wheat lines grown in the 1999-2000 Virginia State Wheat Test were assessed by the USDA-ARS Soft Wheat Quality Laboratory (SWQL) in Wooster, Ohio (Table 11). Quality evaluations were conducted using 500 gram seed samples from wheat lines grown at the Shenandoah Valley (Shenandoah County, VA) test site. The data presented here are for a single location and, therefore, are not a definitive measure of a given wheat line's milling and baking quality. Because quality can vary from location to location and from year to year, data over years and locations is needed to accurately define quality of a give wheat line.

Milling and baking quality of wheat lines were compared to that of the local check cultivar Madison, which was selected as the standard. Madison currently is ranked 119 for milling quality out of 242 cultivars milled by the SWQL using a Quadrumat Jr. mill. Based on this ranking, Madison is average for milling quality and above average for baking quality.

For the data presented in Table 11, Madison had a flour yield that was1.0% lower and a cookie diameter that was 0.42 cm smaller than expected for this cultivar. Therefore it was rather lenient as a quality standard; wheat lines scoring lower than "A" for milling quality and lower than "B" for baking quality may have questionable quality.

Milling quality scores ranged from a high of 109.6 to a low of 94.1 and surprisingly most lines exceeded Madison in milling score. Flour yields ranged from a high of 74.3% to a low of 68.1% compared to 70.0% for Madison. Baking quality scores ranged from a high of 104.5 to a low of 58.3 compared with a score of 100 for Madison. Cookie diameter ranged from a high of 18.2 cm to a low of 16.7 cm compare to 17.6 cm for Madison.

Flour protein concentration varied from 9.28 to 11.81%. Protein quality, specifically gluten strength, based on mixograph number varied from a high of 186 to a low of 58. A mixograph number above 130 indicates that a wheat line has strong gluten strength. Thirteen wheat lines had mixograph numbers above 130 and eight of these lines had scores exceeding 150. Four wheat lines with mixograph scores above 150 also had protein concentrations exceeding 10.75%.