VIRGINIA

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Department of Crop and Soil Environmental Sciences, Blacksburg, VA 24061, USA.

EASTERN VIRGINIA AGRICULTURAL RESEARCH AND EXTENSION CENTER
Warsaw, VA 22572, USA.

C.A. Griffey, W.E. Thomason, J.E. Seago, N.R. Carpenter, W.S. Brooks, S. Malla, E. Wright, L. Liu, and E. Hokanson (Virginia Tech, Blacksburg, VA), and R.M. Pitman, M.E. Vaughn, D. Dunaway, C. Barrack, M. Beahm, and R. Markham (Eastern Virginia Agricultural Research and Extension Center, Warsaw, VA).

2014 Wheat Production in the Commonwealth of Virginia.

Growing conditions. Temperatures in October 2013 were below the long-term average and, combined with rain showers, wheat planted acres were 10% behind the 5-yr average by the third week of October. Overall, temperatures in November were colder than normal as well and although topsoil moisture was mostly reported to be adequate, autumn growth was slowed. In mid-November, 78% of the intended wheat crop was seeded. Most of the state received adequate rainfall in December, but also experienced wide swings in temperatures. Many areas of the state received significant snow in January and nighttime lows below 0°F. February conditions were much the same, and small grain was rated as 68% in good or excellent condition with 24% fair. Continued wet and cool to cold weather hampered small grain progress, and the portion of the crop rated as good or excellent was reduced to 61%. Crop conditions for wheat improved in April. Major storm events delivered significant rainfall to many areas of Virginia in early May. By 12 May, 66% of the wheat crop was headed, compared with 74% on the same date in 2013. Temperatures that were in the high 80's and 90's resulted in a rapid increase in wheat heading to 84% by 19 May. Warm weather in mid-June hastened crop maturity, and 40% of the anticipated wheat crop was harvested by 22 June.

Production. According to the United States Department of Agriculture's National Agriculture Statistical Service (http://quickstats.nass.usda.gov), in the autumn of 2013, Virginia farmers planted 290,000 acres (117,450 ha) of wheat. The following spring, 260,000 acres (105,300 ha) were harvested. The average yield was 68 bu/acre (4,560 kg/ha), which was a 10% increase over the previous year. Overall, 17,680,000 bushels (481,603 metric ton) of wheat were produced in 2014.

Disease incidence and severity. Entries in Virginia's 2014 state wheat cultivar trials were rated (0 = no infection to 9 = severe infection) for disease severity at four diverse locations. The 116 entries in the 2014 trial had mean powdery mildew ratings that varied from 0 to 6 (mean of 1.6) in Virginia's southern Piedmont region (Nottoway County), 0 to 3 (mean of 0.8) in the southwestern region (Montgomery County), and from 0 to 2 (mean of 0.2) on the Eastern Shore (Accomack County). *Barley/Cereal Yellow Dwarf Virus* infection was moderate at the Eastern Shore site with ratings ranging from 0 to 4.5 (mean of 1.0). Leaf blotch also was prevalent in trials on the Eastern Shore with ratings ranging from 1 to 4 (mean of 1.5). Leaf rust was prevalent in several regions and was moderately severe at the southwestern test site with entry ratings ranging from 0 to 7 (mean of 2.5). Race surveys conducted by Dr. James Kolmer at the USDA–ARS Cereal Disease Lab on 21 isolates from three regions in Virginia identified seven races of leaf rust; only race MBTNB was common at two locations (Richmond and Montgomery Counties). Race TNRJJ also was identified from samples sent from Blacksburg, VA, in Montgomery County. Five additional races (TBJSB, TCJSB, TBRKG, TCRKG, and TCTNB) were identified on the Eastern Shore at Painter, VA. Stripe rust was prevalent and moderately severe in a headrow nursery of State Wheat Test entries at Blacksburg, VA, where race PSTv-100 (virulence for genes *Yr2, Yr3a, Yr4a, Yr6, Yr7, Yr8, Yr9, Yr19, Yr20, Yr21, Yr22, Yr23, YrCle, YrSte, YrYam, YrPr1, YrPr2,* and *YrHVII*) was artificially applied to susceptible borders in an adjoining stripe rust nursery. Stripe rust infection type scores (0 = resistant to 9 = susceptible) ranged from 0 to 9 (mean of 2.3) and rust severities ranged from 1 to 85% (mean of 19%). Naturally occurring stripe rust was noted on a few headrow plots in eastern Virginia at Warsaw (Richmond County). Samples sent to Dr. Xianming Chen at USDA–ARS in Pullman, WA, identified race PSTv-52 (virulence for *Yr6*, *7*, *8*, *9*, *17*, *27*, *43*, *44*, and *YrExp2*).

State cultivar tests. Wheat trials were planted in 7-inch rows at Blackstone, Orange, Holland, Painter, and Shenandoah Valley. They were planted in 6-inch rows at Blacksburg. They were planted in 7.5-inch rows at the Warsaw no-till location. All no-till locations (Holland and Warsaw) and Shenandoah Valley were planted at 48 seeds/ft^2. All other locations were planted at 44 seeds/ft^2.

Selecting the best wheat cultivar is challenging but becomes easier with adequate information on performance over multiple environments. Tests conducted in recent years across Virginia have provided the opportunity to evaluate day length sensitivity, spring freeze damage, glume blotch, Fusarium head blight, and general plant health. Many newer wheat cultivars and lines performed well in all test environments.

The released cultivars that yielded significantly higher than the statewide mean in 2014 were Pioneer Brand 26R10, SS 8360, USG 3404, AgriMaxx 434, Shirley, Pioneer Brand 25R40, USG 3523, Pioneer Brand 26R20, USG 3251, AgriMAXX 413, AgriMAXX 427, Pioneer Brand 26R41, and SS 8412. Pioneer Brand 26R20 and SS 8412 also had test weights that were significantly higher than the overall test mean. The average yield of all lines tested in 2013–14 was 74 bu/acre (4972 kg/ha).

Pioneer Brand 26R10 had the highest two-year average yield at 84.7 bu/acre (5,691 kg/ha). The cultivars USG 3404, Pioneer Brand 26R41, Pioneer 25R40, USG 3251, AgriMaxx 434, USG 3523, Shirley, USG 3612, AgriMaxx 413, and SS 8340 all had grain yields significantly above the two-year (2013 and 2014) test mean of 76 bu/acre (5,106 kg/ha). Among these top yielding cultivars, SS 8340 also had an average test weight of 59.0 lbs/bu (759 kg/m^3) that was significantly higher than the two-year mean of 57.8 lbs/bu (744 kg/m^3) over all entries.

Producers who grow large acreages of wheat should plant two or more cultivars having significantly different maturity dates in order to ensure harvest of high-quality grain having high test weights and no sprouting. In Virginia, it is typical for sporadic or consistent rain showers to interrupt harvest. These wetting and drying cycles and subsequent harvest delays significantly reduce grain test weight and quality. Growers can circumvent this problem by planting cultivars that differ significantly in maturity. Early maturing cultivars often can be harvested first and prior to significant rain showers, and later maturing cultivars harvested subsequently will suffer less damage and losses in test weight and quality due to exposure to such a rain event.

Virginia Wheat Yield Contest results. The 2014 contest was conducted statewide, and the results are in Table 1. Congratulations to our winners!

Table 1. 2014 Virginia Wheat Yield Contest results.

Place	Grower	Farm	County	Yield (bu/acre)	Cultivar
1st	L. Andrews	W.L. Andrews Farm	Essex	112.3	AgriMAXX 438
2nd	Paul Davis	Davis Produce	New Kent	109.7	USG 3251
3rd	Ronnie Russell	Corbin Hall Farm	Middlesex	107.7	Pioneer 26R10
4th	Katie Crossman Myer	Laurel Spring Farm	Westmoreland	93.9	Pioneer 26R20

Newly released cultivars. The soft red winter wheat cultivar **102015123**, derived from the cross 'Pioneer Brand 25R47 (PI 631473) / GA951079-2E31 (PI 644020)', was released by the Virginia Agriculture Experiment Station in 2014. This cultivar is a widely adapted, moderately early heading, wheat cultivar that has high grain yield potential, good milling and baking quality, and has performed well in soft red wheat production areas of the deep south and mid-Atlantic regions. With the possible exceptions of *Wheat Spindle Streak Mosaic Virus* and Hessian fly, cultivar 102015123 expresses moderate to high levels of resistance to diseases prevalent in the soft red wheat region, which include leaf, stripe, and stem rusts; powdery mildew; Fusarium head blight; *Septoria tritici* leaf blotch; *Stagonospora nodorum* glume and leaf blotch; *Barley and Cereal Yellow Dwarf Viruses*; and *Wheat Soil Borne Mosaic Virus*.

Publications.

Balderson T, Chappell G, Drake C, Lawrence M, Moore D, Romelczyk S, and Thomason W. 2014. Virginia On-Farm Small Grain Test Plots. VCE Publication ANR-113NP.

Bamber K, Evanylo G, and Thomason W. 2014. Nitrogen cycling from fall applications of biosolids to winter small grains. Symposium on Management Practices Impact on Soil Nitrogen Conservation. Agron Abstr, ASA, Madison, WI.

Green AJ, Berger G, Griffey CA, Pitman R, Thomason W, and Balota M. 2014. Genetic resistance to and effect of leaf rust and powdery mildew on yield and its components in 50 soft red winter wheat cultivars. Crop Protect 64:177-186 [http://www.sciencedirect.com/science/article/pii/S0261219414002087].

Pavuluri K, Chim BK, Griffey CA, Reiter MS, Balota M, and Thomason WE. 2014. Canopy spectral reflectance can predict grain nitrogen use efficiency in soft red winter wheat. Precision Agric [DOI: 10.1007/s11119-014-9385-2].

Thomason W, Gulick S, and Hokanson E. 2014. Small Grain Forage Variety Testing, 2014. VCE Publication CSES-91NP.

WASHINGTON

WASHINGTON STATE UNIVERSITY
Department of Crop and Soil Sciences, School of Molecular Bioscience & Center for Reproductive Biology, Pullman, WA 99164-6420, USA.

Celiac-safe wheat genotypes: *A dietary solution to the gluten-induced disorders.*

S. Rustgi, D. von Wettstein, N. Ankrah, R.A.T. Brew-Appiah, N. Wen, S.M. Mitchell, R. Gemini, and P. Reisenauer.

Wheat and derived products are elicitors of a number of frequent diet-induced health issues, including gluten intolerance, sensitivity, and allergy, collectively known as the 'gluten syndrome'. These disorders cumulatively affect more than 7.5% of the U.S. population (Rustgi 2013; Rosella et al. 2013). In particular, gluten intolerance or celiac disease alone affects more than 71 million individuals around the globe (i.e., ~1% of the world population), which makes it one of the most devastating disorders of the gastrointestinal tract (Bai et al. 2012). The seed storage proteins of wheat, in particular prolamins (i.e., gliadins and glutenins), are known to trigger this autoimmune condition. So far, 190 celiac-causing epitopes were identified from wheat prolamins, where origin of the 180 epitopes were tracked back to α/β-, γ-, and ω-gliadins and the remaining 10 to low- and high-molecular-weight glutenin subunits. Interestingly, out of these 10 epitopes from glutenins, the high molecular weight glutenins (HMWgs) contribute to only two epitopes, which have shown to elicit immune responses in relatively fewer cases (Comino et al. 2013). The HMW glutenins also are vital for the baking properties of common wheat. Furthermore, the low molecular weight glutenins (LMWgs) and gliadins have imbalanced amino acid profiles, with 15% proline and 35% glutamine, and a reduced content of the essential amino acids lysine, threonine, methionine, and histidine (Koehler and Wieser 2013). Parallel research also has demonstrated that gliadins and LMWgs are inessential for baking, because the flours derived from wheat deletion lines and transformants lacking one or more families of the gluten proteins baked into a normal bread loaf with characteristic organoleptic properties (van den Broeck et al. 2011; Gil-Humanes et al. 2014). Similarly, *in vitro* experiments with washed-out wheat flour residues mixed with recombinant HMWgs HMWDx5 and HMWDy10 baked into normal-looking bread loaves, which further supported the observations made with the wheat transformants and deletion lines (Wen et al. 2012 and references cited therein). Moreover, reduced-gluten, transgenic wheat lines exhibited improved nutritional properties, because their lysine content was significantly higher than that of normal flour due to the compensatory increase in the amount of lysine-rich proteins (Gil-Humanes et al. 2014).

Epigenetic elimination of immunogenic prolamins. Because HMWgs largely contribute to the baking properties of wheat, and are primarily non-immunogenic, we undertook a strategy to specifically eliminate LMWgs and gliadins from grains by endosperm-specific silencing of wheat *DEMETER* (*DME*) homoeologues. DME enzymes regulate transcriptional activation of the prolamin genes (except HMW glutenin genes) during endosperm development by demethylation of their promoters (Osorio et al. 2012; Wen et al. 2012). Under the auspices of NIH (National Institutes of Health) and